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## CO<sub>2</sub> Emission and Financial Development Nexus in Nigeria: Fresh Insights from Asymmetry Cointegration

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### Abstract

In recent times, studies on the nexus between carbon emissions and financial development have become plentiful. Very few of them consider the nonlinearity or asymmetry of the relationship between financial development indices and CO<sub>2</sub> emissions. The objective of this study is to explore asymmetric cointegration within the framework of the non-linear autoregressive distributed lag model on the emissions-financial development nexus using Nigeria's data from 1981 to 2020. Our findings revealed the existence of an asymmetric long-run relationship between CO<sub>2</sub> emissions and financial development measured by credit to the private sector, financial deepening, and market capitalization. Positive shocks to Credit to private sectors have a negative and significant impact on the emission at 1% level, while negative shock is not statistically significant in explaining emission in Nigeria. Positive shocks of market capitalization insignificantly reduce emissions and vice versa. Moreover, asymmetric shocks of financial deepening have negative and significant effects on emissions in Nigeria. The study therefore recommends that domestic credits to the private sector should be geared towards enhancing renewable energy, as more investments are required especially in solar and wind energy. In addition, environmental laws be strengthened and pollution taxes be introduced to mitigate the increasing level of CO<sub>2</sub> released through the consumption spree for energy-demanding and CO<sub>2</sub>-emitting goods aided by the increasing level of Nigeria's financial development.

**Keywords:** Asymmetry, CO<sub>2</sub> Emission, Financial Development, Market Capitalization, NARDL.

**JEL Classification:** C22, G00, Q5.

### 1. Introduction

CO<sub>2</sub> emission arising from the unprecedented level of growth and industrialization is widely recognized as a major culprit for raising the global temperature (Acheampong, 2019; Guo, 2021). Consequences arising from emissions include

but are not limited to; reduction in water bodies, toxic gas emissions, natural resource depletion, polluted air, and increased sunlight intensity (Adedoyin, Ozturk, et al., 2020; Adedoyin, Abubaka, et al., 2020). As the environment remains the only source of natural capital, conserving it remains a center core of global players (Agabo et al., 2021), hence, policy formulation strategy for mitigating global warming necessitates the curbing of CO<sub>2</sub> emissions (Acheampong, 2019).

In the literature, several factors have been adjudged to be the reason for increased emissions such as; population expansion, economic growth, FDI, and trade (Sehrawat et al., 2011). Famous among these factors is financial system development (henceforth: FD). It is observed that, in Nigeria, as the trend of CO<sub>2</sub> emission is increasing by almost 0.2 percent annually, financial services have been steadily improving contemporaneously (Iheanacho, 2016; Yahaya et al., 2021). This development prompts the question of whether the improvement in Nigeria's financial system is the possible cause of the increasing level of CO<sub>2</sub>.

Recently, much emphasis has been focused on the nexus between CO<sub>2</sub> and financial system development because it is believed that, FD increases carbon emission (Zhang, 2011) via the transmission mechanism of increased energy consumption. In other words, improved financial system development is capable of increasing the energy demand in a country whose production will consequently erode environmental cleanliness. Imamoglu (2019) opined that a country's financial system development might affect negatively its environmental quality arising from higher levels of energy consumption. Yahaya et al. (2021) agree with this position as they find financial services to be detrimental to environmental quality through increasing access to consumption of high-emission technologies and appliances.

FD increases CO<sub>2</sub> emission through many indirect channels of increased demand for energy-consuming technologies arising from both households and businesses. This effect is seen in three folds; the household, firm, and country-wide level. To the households, sound financial intermediation increases availability and access to credit which in turn increases the chances of the households to purchase energy-consuming goods such as; automobiles, washing machines, refrigerators, houses, etc. These goods according to Zhang (2011) and Guo (2021) by their nature of being high-energy-demanding products, their consumption naturally deteriorates environmental quality following the already fact that energy consumption increases CO<sub>2</sub> emission. On the second fold are the firms whose demand for machinery, and labor and fixed capital is satisfied from the money and capital markets. With improved FD, chances are that firms will increase their

production through borrowings and other means of financing from both the capital and money market, hence increasing environmental consequences through increased CO<sub>2</sub> emission.

At the macroeconomic level, the effect of FD on environmental quality when analyzed within the discourse of the transmission mechanisms of the Pollution-haven hypothesis proves to be a driver of FDI that in turn deteriorates the environmental quality of a country. The hypothesis shows how dirty industries shift to less environmentally stringent countries to enjoy high production while worrying less about environmental costs (Gill et al., 2018). In other words, FD increases the flow of FDI which in turn heightens environmental degradation.

On the flip side, is the argument of scholars that FD has positive effects on environmental quality as it lowers the level of emission (Tamazian et al., 2009; Tamazian and Bhaskara Rao, 2010; Shahbaz et al., 2013; Shahbaz et al., 2018). Amongst the arguments advanced for this, is that FD may facilitate the inflow of R&D in eco-friendly projects and lessen the cost of environmental-friendly projects (Tamazian and Bhaskara Rao, 2010). Similarly, Thangaiyarkarasi and Vanitha (2021) see the negative effect of FD on carbon emission in at least two aspects as thus; firstly, a well-developed financial system finances firms' quest for enhanced and cost-effective production technology which are devoid of environmental degradation. Secondly, improvement in FD is capable of supporting, funding, or financing various government's R&D on green and renewable energy projects. This will improve the energy infrastructure of the country as well as reduce CO<sub>2</sub> emissions.

From the foregoing, while it is clear that there exists a bulk of incontrovertible empirical works supporting the positive nexus between energy consumption and CO<sub>2</sub> emission, the same conclusion cannot be drawn for the FD-emission nexus because of the conflicting results reported herein. One plausible reason for this inconclusiveness in the results may be attributable to the model estimation techniques employed. Looking at the literature, one could see the dominant use of linear models which assume symmetrical relationships amongst variables which according to Shin et al. (2014) have the disadvantage of: poor determination of the cointegrating parameters; related insufficient information for inference and forecast; and their inability to capture some vital features of the underlying dynamics of a system (Tong, 2015).

The question to ask therefore is what if the relationship between CO<sub>2</sub> emission, energy demand, and FD is asymmetrical. Answering this question is the preoccupation of this work; hence, we employed the asymmetric cointegration modeling technique within a Nonlinear ARDL framework using Nigerian data.

## **2. Literature Review**

### **2.1 Theoretical Underpinning**

The theoretical foundations of this work will rely on the famous Environment Kuznet Curve (EKC) derived from the work of (Kuznets, 1995) on growth and inequality which is now adopted to show the nexus between the environment and the economy. The empirics arising from the EKC-backed theory point towards the fact that environmental quality deteriorates at the early stages of economic development, peaks at a turning point, and improves with a further improvement in growth thereby exhibiting an inverted U-shaped curve (Dinda, 2004; Liu et al., 2019; Ben Jebli et al., 2022).

Defined differently, the EKC shows how environmental quality changes as the fortunes of a country change (Dinda, 2004). Therefore, among the key variables in quantifying the fortunes of a country is its level of FD. An increase in FD accompanies growth, in the same way growth necessitates improved financial services. FD is therefore seen in this study as being akin to growth and is adopted as such to substitute growth in the EKC framework since it is also a variable that reveals or signifies a country's level of fortune.

Empirical findings showed increasing levels of FD deteriorating the environment via the transmission mechanism of increased demand on polluting goods and services (Zhang, 2011; Imamoglu, 2019; Yahaya et al., 2021; Guo, 2021) while some argued that it improves the environmental quality through powering domestic greening technologies (Tamazian et al., 2009; Tamazian and Bhaskara Rao, 2010; Shahbaz et al., 2013; Shahbaz et al., 2018). A cursory look at these two conflicting results, one will observe that FD harms the environment of less developed economies like Nigeria at the same time improves that of developed economies such as French (Xionga et al., 2016; Hafeez et al., 2018; Shahbaz et al., 2018). This dichotomy can be likened to the inverted U-shaped curve of the EKC hypothesis which shows both negative and positive effects of rising fortunes on the environment of a country at the initial and developed stages respectively.

Analogously, FD as a variable that is connected and seldom denotes the income level of the economy, if used, as a surrogate to growth within the context of the EKC has shown how the FD can be harmful to their environment in the

initial stage of development of an economy say the less developed ones, but will turn out to mitigate environmental degradation when the economies become developed.

## **2.2 Empirical Review**

Going through the plethora of literature, it is observed that, scholars on this subject matter have reported varying and conflicting results. For instance, Sadorsky (2010) in a panel study of 22 emerging economies, found a positive relationship between financial development and energy consumption but contrastingly, Abbasi and Riaz (2016) found that financial variables played a role in emission mitigation. It is equally observed that the reason for this difference in result sometimes arises from countries or regions being studied as seen in Xionga et al. (2016) in which, financial development was found to have reduced carbon emissions in the developed regions and increased it in the less developed regions. This conforms with the work of Hafeez et al. (2018) and Shahbaz et al. (2018) on the French economy where they argued that financial development lowers carbon emissions, thereby improving the French environmental quality.

However, the work of Imamoglu (2019) takes an exception to the developed and less developed nations dichotomy as his work conducted globally among a panel of 176 countries, found a long-run equilibrium relationship between carbon dioxide emissions and financial sector development in both the developed and developing countries.

Cetin and Ecevit (2017) also studied the impact of financial development on carbon emissions in the Turkish economy for the period 1960-2011, considering structural breaks; their study reveals a causal link between financial developments to carbon emissions. Similarly, Jiang and Ma (2019) found from a global perspective, that financial development could significantly increase carbon emissions. However, Acheampong (2019) found that none of the financial development indicators exert a significant nonlinear effect on carbon emissions, which is in tandem with Ahmed (2020) who also found a negative influence of financial effect on CO<sub>2</sub> emissions in Egypt.

In Nigeria, the works of Adewuyi and Awodumi, (2020), Yahaya et al. (2021), and Okere et al. (2021) established empirical evidence of a positive relationship between financial development and CO<sub>2</sub>. Interestingly, Ozdeser et al. (2021) whose study used ARDL and was also conducted in Nigeria data supports

the positive nexus between FD and CO2 emission through rising fossil fuel consumption. In a separate but similar study, Guo (2021) reported the same result from China following his robust Maki cointegration and frequency domain causality test.

From the literature reviewed, it is evident that there is a considerable divergence in the results obtained on the relationship between FD and environmental quality across different regions studied. In Nigeria however, there seem to be similarities in the conclusion of a positive relationship between FD and CO2 emission from the literature we have reviewed so far.

Another critical observation is that while there is a plethora of literature in this area, studies on Nigeria are scanty. Methodologically, almost all works reviewed modeled the FD-emission nexus symmetrically without exploring asymmetric regression. This has serious implications for the results obtained, the conclusion and the policy recommendations generated therefrom. Therefore, in reaction to the above, this work set out to study the asymmetric relationship between FD, energy demand, and emission in Nigeria within a NARDL framework.

### 3. Dataset and Econometrics Models

#### 3.1 Dataset and Sources

Table 1 explains the data used for this study. The data is a yearly series spanning from 1981 to 2020. The choice of the period is largely explained by data availability. Before estimations, all variables are transformed into natural logarithms.

**Table 1.** Data Variable Measurement

S/N.	Variable	Code	Definition	Source
1	Carbon dioxide emission	$lCO_{2,t}$	This is the total carbon emission measured in thousand metric tons.	WDI
2	Domestic credit to the private sector	$lcp_t$	The domestic credit to the private sector by banks as a percentage of GDP.	WDI

3	Market capitalization	$lmc_t$	The annual market capitalization on the Nigerian stock exchange market in billions of naira.	CBN
4	Financial deepening	$lfp_t$	The ratio of broad money supply (m3) to nominal GDP percentage.	CBN
5	GDP	$lgd_t$	Economic growth	CBN

**Source:** World Development Indicators (2022) & Central Bank of Nigeria (2022).

**Note:** WDI is an acronym for World Development Indicators, while CBN stands for Central Bank of Nigeria.

### 3.1 Econometrics Models

In line with the objective of this study, we specify a model with CO2 as a dependent variable and domestic credit to the private sector, market capitalization, financial deepening, and GDP as regressors thus;

$$CO2_t = f(lcp_t, lmc_t, lfp_t, lgd_t) \quad (1)$$

The Econometrics approach utilized in this study involves three different phases; firstly, the stationarity status of variables is examined using the traditional ADF, PP, and KPSS tests as well as the nonlinear Fourier-based unit root test of Guris (2018). The traditional test is for order of integration to ensure that none of the variables is I(2) while the latter will test the nonlinear stationarity of the variables. Secondly, we looked into the asymmetric long and short-run effect of the regressors on CO2 using the NARDL approach. In addition, an auxiliary regression for the Principal Components of FD (LCP, LMC, LFP) is conducted to see the effects, if any of the aggregated FD indices on CO2. Lastly, we conducted some important diagnostics tests for the model.

#### 3.1.1 Non-Linear Autoregressive Distributed Lag Model

Recent developments have shown that macroeconomic variables exhibit nonlinear characteristics, as such; modeling co-integration can be done within the context of decomposed explanatory variables known as asymmetric co-integration. It is used for testing whether the positive shocks of the independent variables have the same effect as their negative shocks on the dependent variables. Although there are several methods of modeling asymmetric relationships, see Schorderet, 2003; Escribano et al., 2006; however, Shin et al. (2014) observed the dominant use of the two-step Engle-Granger technique of asymmetric co-integration. One noticeable defect of the two-step Engle-Granger technique of asymmetric cointegration is that it is not only a short-run modeling technique, but is equally

less efficient than the single-step ECM estimation of Shin et al. (2014) which jointly models both the short and long-run-asymmetries-called NARDL.

Since NARDL is an extension of the Shin et al. (2001) framework, the prerequisite condition for application of ARDL to time series holds in NARDL. The major one is that the stationary status of variables shouldn't include I(2) variables. It is on this note that we conducted a unit root test on the variables using the traditional unit root tests of Augmented Dicky Fuller (ADF), Phillips- Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) after which we followed shin, Yu, and Greenwood-Nimmo (2014) to write (Equation 1) thus:

$$\begin{aligned}
 \Delta LCO2_t = & \beta_0 + \sum_{i=0}^m \beta_1 \Delta LCO2_{t-i} + \sum_{i=0}^m \beta_2 \Delta lcp_{t-i}^+ + \sum_{i=0}^m \beta_3 \Delta lcp_{t-i}^- \\
 & + \sum_{i=0}^m \beta_4 \Delta lmc_{t-i}^+ + \sum_{i=0}^m \beta_5 \Delta lmc_{t-i}^- + \sum_{i=0}^m \beta_6 \Delta lfp_{t-i}^+ \\
 & + \sum_{i=0}^m \beta_7 \Delta lfp_{t-i}^- + \sum_{i=0}^m \beta_8 \Delta lgd_{t-i}^+ + \sum_{i=0}^m \beta_9 \Delta lgd_{t-i}^- + \gamma_1 CO2_{t-1} \\
 & + \gamma_2 lcp_{t-1}^+ + \gamma_3 \Delta lcp_{t-1}^- + \gamma_4 lmc_{t-1}^+ + \gamma_5 lmc_{t-1}^- + \gamma_6 lfp_{t-1}^+ \\
 & + \gamma_7 lfp_{t-1}^- + \gamma_8 lgd_{t-1}^+ + \gamma_9 lgd_{t-1}^- + \psi_t DU_t + \epsilon_t
 \end{aligned} \tag{2}$$

where  $\Delta$  is the difference operator indicating the first difference of variable,  $i$  is the lagged values,  $\beta_1$  to  $\beta_9$  and  $\gamma_1$  to  $\gamma_9$  are the short run and long run coefficients respectively,  $\psi_t$  is the coefficient of break date dummy  $\epsilon_t$  is the disturbance term. The error correction equation of NARDL formulated above can be expressed as;

$$\begin{aligned}
 \Delta LCO2_t = & \beta_0 + \sum_{i=0}^m \beta_1 \Delta LCO2_{t-i} + \sum_{i=0}^m \beta_2 \Delta lcp_{t-i}^+ + \sum_{i=0}^m \beta_3 \Delta lcp_{t-i}^- + \\
 & \sum_{i=0}^m \beta_4 \Delta lmc_{t-i}^+ + \sum_{i=0}^m \beta_5 \Delta lmc_{t-i}^- + \sum_{i=0}^m \beta_6 \Delta lfp_{t-i}^+ + \sum_{i=0}^m \beta_7 \Delta lfp_{t-i}^- + \\
 & \sum_{i=0}^m \beta_8 \Delta lgd_{t-i}^+ + \sum_{i=0}^m \beta_9 \Delta lgd_{t-i}^- + \vartheta_t ect_{t-1} + \epsilon_t
 \end{aligned} \tag{3}$$

## 4. Result Interpretation and Discussion

### 4.1 Descriptive Statistics and Correlation Matrix

Table 2 presents at a glance the salient characteristics of the 40 observations of the annual time series data we used in the study as well as pair-wise correlations between the variables. The results show that a positive and significant correlation exists between the dependent variable LCO2 and the four independent variables of LCP, LFI, LFP, and LGD. All results of the pairwise correlation range from 0.65 to 0.95.

**Table 2.** Descriptive Statistics and Pair-wise Correlations

	<b>LCO2</b>	<b>LCP</b>	<b>LMC</b>	<b>LFP</b>	<b>LGD</b>
Mean	11.3508	2.1554	6.2136	2.6680	10.3882
Std. Dev.	0.2371	0.3523	3.1508	0.3321	0.52524
Min.	10.6558	1.5989	1.6094	2.1358	9.6934
Max.	11.8101	2.9757	10.5607	3.2146	11.1857
JB	0.9393	1.7447	3.9087	3.8964	4.1977
Probability	0.6252	0.4179	0.1416	0.1425	0.1225
Observations	40	40	40	40	40
LCO2	1.0000				
LCP	0.6509	1.0000			
LMC	0.8427	0.8403	1.0000		
LFP	0.7186	0.7186	0.7872	1.0000	
LGD	0.8496	0.8289	0.9581	0.8884	1.0000

**Source:** Research finding.

#### 4.2 Unit Root Test

In carrying out the NARDL asymmetric cointegration technique, variables can be I(0) or I(1) but cannot be integrated into the second order I(2). Hence, a unit root is conducted following the traditional methods of ADF, PP and KPSS, and results obtained therefrom, affirm that, all variables are I(1) except for a few exceptions reported from KPSS which identifies the stationarity of LCO2 and LFP at level. Notwithstanding, the non-existence of any I(2) variables validates the adoption of the NARDL and the mixed levels of integration further encourages the deployment of the NARDL estimation technique.

**Table 3.** Stationarity Test Results

<b>Variables</b>	<b>ADF</b>		<b>PP</b>		<b>KPSS</b>	
	<b>level</b>	<b>1st diff.</b>	<b>level</b>	<b>1st diff.</b>	<b>level</b>	<b>1st diff.</b>
LCO2	-1.6157	-9.7153**	-1.1779	-15.276**	0.7301*	
LCP	-1.7343	-5.8011**	-1.5853	-9.9767**	0.6649	0.5000*
LMC	-0.4914	-4.7595**	-0.5002	-4.7797**	0.7555	0.1422**
LFP	-0.9609	-5.7717**	-0.8372	-6.1641**	0.6424*	
LGD	-1.0411	-3.7830**	0.4510	-3.7830**	0.7348	0.292293**

**Source:** Research finding.

**Note:** \*\*&\* shows 5% and 1% level of significance.

However, testing for order of integration as far as nonlinear models are concerned cannot suffice because Güriş (2018) mentioned that, the traditional unit root tests tend to be nonstationary when dealing with nonlinear variables. To avert this problem, the new flexible Fourier form nonlinear unit root test proposed by Güriş (2018) in which the nonlinear adjustment is modeled using an exponential smooth threshold autoregressive (ESTAR) model is deployed to test whether the variables are nonlinear stationary or not.

**Table 4.** Guris (2018) Nonlinear Unit Root Test

Variables	Lags	Test statistics	Decision	Critical values	
				1%	5%
LCO2	3	16.22887**	Stationary	20.32	14.72
LCP	3	7.293370	Nonlinear unit root	12.32	14.72
LFP	3	12.88887*	Stationary	10%	12.32
LMC	3	18.65670**	Stationary		
LGD	3	18.42112**	Stationary		

**Source:** Research finding.

**Note:** the signs of \*\*\*, \*\*, and \* refer to the rejection of the unit root hypothesis at 1%, 5%, and 10% levels respectively. Lag method (AIC), Maximum lags(3).

From the Guris (2018) nonlinear unit root test, evidence shows that except credit to the private sector that depicts unit root, all other variables are stationary with nonlinearity with breaks at unknown dates at a 5% level of significance.

#### 4.3 Short and Long-run NARDL Results

Consequent upon the validation of the suitability of NARDL by the unit test results seen in Tables 3 and 4, we carried out the short-run and long-run NARDL estimation with the view of exploring the impact of credit on private sector, financial deepening, market capitalization as well as growth on the level of CO2 emission in Nigeria.

**Table 5.** Short and Long-run NARDL Results

NARDL Short-Run Result; Dependent Variable: LCO2							
Regressors	Lags						
	0	1					
$\Delta$ LCP <sup>+</sup>	0.206396 (0.3398)	0.435727 (0.0966)***					
$\Delta$ LFP <sup>+</sup>	0.777132 (0.0260)**	-1.247151 (0.0018)*					
$\Delta$ LFP <sup>-</sup>	-0.501581 (0.2439)	-0.629001 (0.0418)**					
$\Delta$ LGD <sup>+</sup>	0.341742 (0.7203)	-2.245438 (0.0048)*					
NARDL Long-Run Result							
LCP <sup>+</sup>	LCP <sup>-</sup>	LMC <sup>+</sup>	LMC <sup>-</sup>	LFP <sup>+</sup>	LFP <sup>-</sup>	LGD <sup>+</sup>	LGD <sup>-</sup>
-0.1486 (0.0010)*	-0.2138 (0.7696)	-0.3177 (0.3055)	2.0970 (0.0757)***	-0.8193 (0.0004)*	-0.3856 (0.0673)***	7.4869 (0.1124)	9.6556 (0.0967)***
Diagnostics							
Bound test	ECM <sub>t-1</sub>	Adj. R <sup>2</sup>	Hetero. Test	LM Test			
4.155510	-0.863618 (0.0000)*	0.739170	(0.1280)	(0.1277)			
LCP <sub>LR</sub>	LMC <sub>LR</sub>	LFP <sub>LR</sub>	LGD <sub>LR</sub>				
25.18963 (0.0000)	14.77864 (0.0006)	17.56625 (0.0002)	5.79223 (0.0161)				

**Source:** Research finding.

**Note:** ( ) = Probability values, LR=Long-run Wald test. \*, \*\*, \*\*\* mean significance at 1%, 5%, and 10%, respectively.

Table 5 reports the results obtained from the estimation of Equation (2). In the short run, the result shows that while the positive shock of LCP in the current period is positive but statistically insignificant, a 1% increase in LCP from last year will induce emission by 0.40% in the current period of the short run. In other words, credit to the private sector granted in the current period may have a positive influence on the level of emission but will only be significant after a year. This is plausible in the sense that as credit is extended to households and firms, which enables them to procure CO<sub>2</sub>-emitting products such as automobiles and machinery, there is a lag period in the process of purchase, shipping, and installation before subsequently put into usage, which will increase CO<sub>2</sub> emission. Similarly, a positive shock in financial deepening in Nigeria in the current year will exacerbate LCO<sub>2</sub> emission by 0.77 whereas that of the previous year will reduce emission at a much higher rate of 1.24 in the short run. Interestingly, shock from LFP<sup>-</sup> in the previous year is seen to be a contributing factor to LCO<sub>2</sub> emission in the current period. Lastly, the lag of positive growth will reduce emissions.

From the long-run result, a shock in LCP<sup>+</sup> will reduce emission by 0.21. Although this is not expected a priori, the result may be pointing to the possibility that the increased credit access by households and firms is channeled towards procurement of environmentally friendly products or those powered by renewable energies. This result conforms with the result of (Tamazian et al., 2009; Tamazian and Bhaskara Rao, 2010; Shahbaz et al., 2018) conducted in BRICS, Transitional economies, and France in respective order.

While a positive shock in market capitalization is not seen to have a positive effect on emission as expected a priori, a negative shock reduces emission by 2.09. This is because a negative shock in market capitalization means a shrink in the firm's value which directly harms its productive capacity. A decrease in production will certainly reduce CO<sub>2</sub> emission - this is expected a priori. The positive and negative shocks of financial deepening (LFP) are 0.81 and 0.38 reduction and increase in CO<sub>2</sub> respectively. An increase in financial deepening (here defined as a ratio of money supply concerning the GDP) means more money in circulation, hence more effective demand from agents amongst which are environmentally-degrading products. Lastly, a negative shock in GDP causes a decline in CO<sub>2</sub> emission by 9.65, because a decline in GDP anthropogenic consequences of production.

On the whole, the long-run Wald test of the regressors affirms the nonlinear asymmetries in our model. Also, our dynamic multipliers graphs (Figures 3 to 5) show that the dependent variable responds more to negative shocks than positive shocks of the regressors except LFP.

In general, financial development is seen to be a contributing factor to the reduction of CO<sub>2</sub> emissions in Nigeria. This finding is not a stand-alone as Hafeez et al. (2018), and Shahbaz et al. (2018) reported it for 52 countries and the French economy in respective order. Notwithstanding, the finding is bizarre in the context of the Nigerian economy because it is at par with the reports of Adewuyi and Awodumi (2020), Yahaya et al. (2021), and Okere et al. (2021) all conducted in Nigeria. The reason for this may not be far from the difference in the methodology employed. While in the aforementioned works estimation was conducted based on the assumption of a symmetrical relationship, in our case we assumed that the positive and negative effects of the regressors on CO<sub>2</sub> are rather asymmetric. The dynamic multipliers graphs derived therefrom support this position as they reveal how CO<sub>2</sub> responds more to negative shocks than positive shocks.

The post-estimation results reveal that: the bound test affirms the cointegration of variables which means there is evidence of long-run relationship among the variables; The adjusted R<sup>2</sup> of 0.73 supports model fitness; the ECM is negative, less than unity and statistically significant and could revert any disequilibrium shock experienced at a speed of 86%; the probability values of (0.1280) and (0.1277) for Heteroskedasticity test and Breusch-Godfrey serial correlation (LM Test) show that the errors in the residuals of the model are homoscedastic and the model is also devoid of serial correlation. The CUSUM and CUSUM squares test reveal that the parameters of the model are stable.

Additionally, it is acknowledged in the literature that several studies do conduct a Principal Component Analysis (PCA) for the three financial development variables of LCP, LFP, and LMC to see the aggregated effect of financial development on CO<sub>2</sub> emission. Therefore, a PCA for the three financial development variables of LFI, LFP, and LMC is carried out and the variable derived therefrom is called FD. Below is the table for the PCA.

**Table 5.** PCA Result

Variable	Eigen Value	Proportion	Cumulative Proportion
LCP	2.643761	0.8813	0.8813
LFP	0.212850	0.0710	0.9522
LMC	0.143389	0.0478	1.0000

**Source:** Research finding.

From Table 5 above, the Eigenvalues and proportions of 2.64 and 0.88 for LCP show the variables' dominance in the LCP. However, notwithstanding, the two other variables of LFP and LMC form the 12% other component of the PCA variable generated. Following this, Table 6 below shows the NARDL result of the PC of FD.

**Table 6.** NARDL Results of Aggregated FD and LCO2

NARDL Long-Run Result				
Dependent Variable: LCO2				
FD <sup>+</sup>	FD <sup>-</sup>	LGD		
-0.0339	-0.1611	-0.3267		
(0.3939)	(0.0007)*	(0.3785)		
Diagnostics				
Bound test	ECM <sub>t-1</sub>	Adj. R <sup>2</sup>	Heteroskedasticity test	LM Test
5.9422	-0.9179	0.5757	(0.8095)	(0.5445)
	(0.0000)*			

**Source:** Research finding.

**Note:** ( ) = Probability values, \* means significance at 1%. LED=energy demand.

A positive shock from FD is not statistically significant, but a negative one will induce LCO2 emission by 0.16. Evidence from the result shows that LGD has no long-run asymmetric effect on LCO2. This is understandable in the sense that LED is the transmission mechanism through which the impact of FD is passed on LCO2, as access to credit spurred by FD increases demand for carbon-emitting products such as automobiles and machinery for households and firms respectively.

## **5. Conclusion and Policy Recommendation**

Several studies have been conducted on the impact of financial development and the quantum of CO<sub>2</sub> emission in several countries across different regions of the globe. However, except a very few, all works assumed symmetric and linearity in the relationship among variables. In this work, we explored the possibility of a nonlinear relationship with the assumption of asymmetric cointegration within the NARDL for Nigeria from 1981 to 2020. Findings reveal that financial development is a contributing factor to the reduction of CO<sub>2</sub> emissions in Nigeria during the period under study. This finding agrees with Hafeez et al. (2018) and Shahbaz et al. (2018) conducted on the French economy, but is at variance with those works on the Nigerian economy by Adewuyi and Awodumi, (2020), Yahaya et al. (2021), and Okere et al. (2021). The reason for this may not be far from the difference in the methodology employed. While we employed the nonlinear asymmetric cointegration technique of NARDL, they employed a linear and assumed symmetrical relationship. Our results about the existence of the asymmetric relationship between CO<sub>2</sub> and financial development measured by credit to the private sector, financial deepening, and market capitalization. CO<sub>2</sub> emission is found to be more responsive to negative shocks of credit to private and market capitalization than it is to positive shocks. Contrariwise is the case for financial deepening.

This revelation of CO<sub>2</sub> is more responsive to negativity than positive shocks to FD variables, and linear models do not account for it, therefore, it means that symmetrical models have ignored this very important part of the discussion in the CO<sub>2</sub>-FD nexus, the inclusion of which herein appears to be a value addition.

Based on the findings emanating from this study, we believe that the following suggestion will cushion the asymmetric effect of financial development on carbon emissions in Nigeria. First, domestic credits to the private sector should be geared towards enhancing renewable energy, as more investments are required especially in solar and wind energy. Second, a well-developed financial system is a panacea for green energy finance, policy directions that make credit available at zero or low interest rates should be pursued for the renewable energy market to reduce the use of unclean energy.

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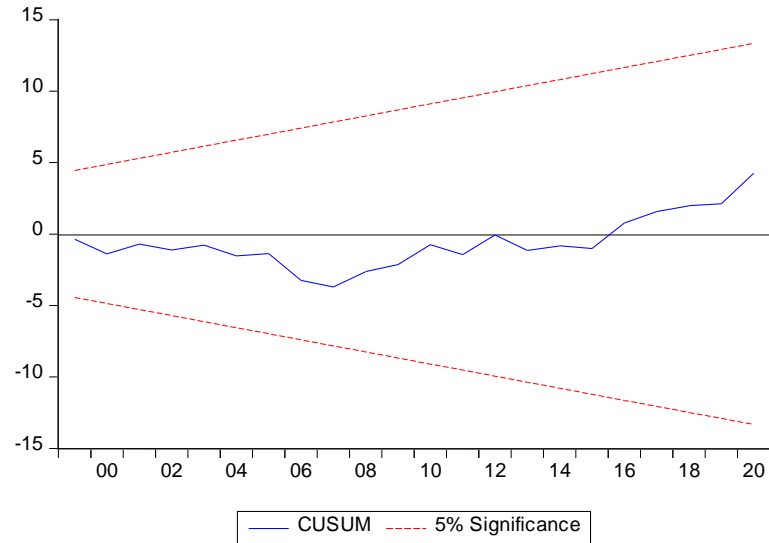
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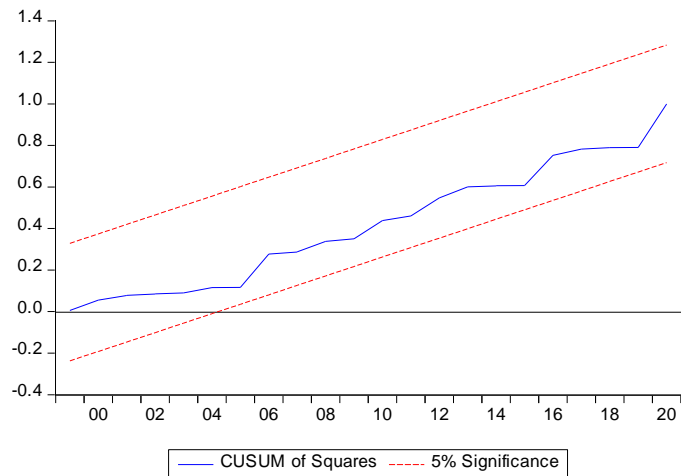
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## Appendix



**Figure 1.** CUSUM Test for CO2-FD Nexus in Nigeria

Source: Research finding.



**Figure 2.** CUSUM of Squares Test for CO2-FD Nexus in Nigeria

Source: Research finding.

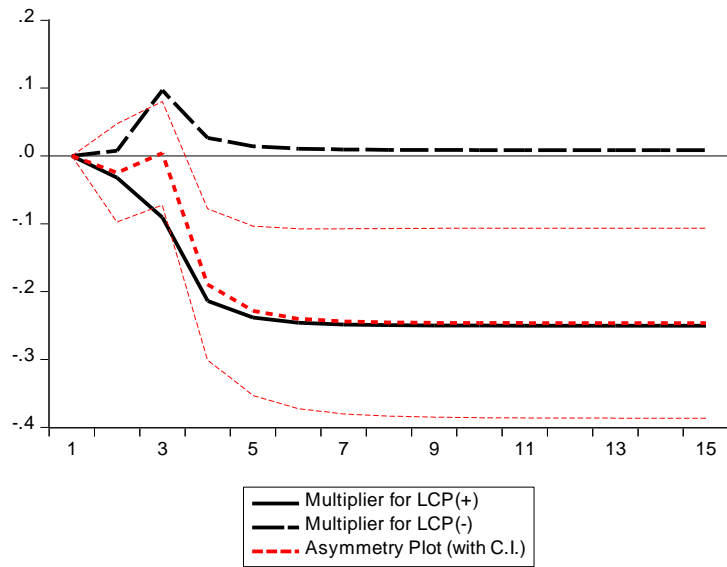


Figure 3. Dynamic Multiplier for LCP

Source: Research finding.

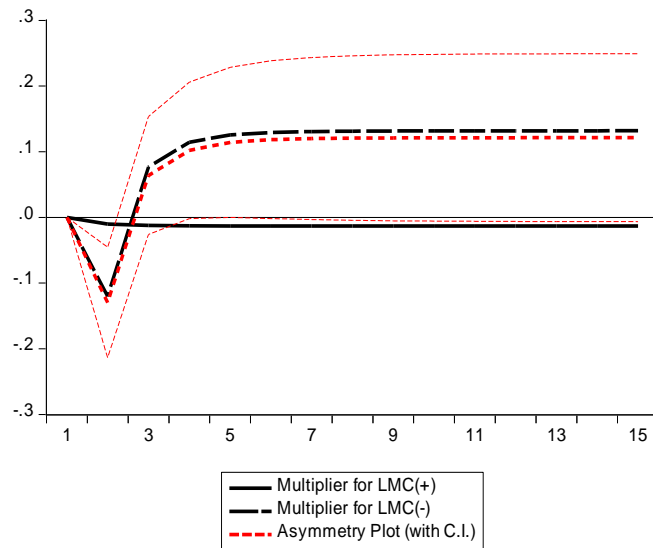
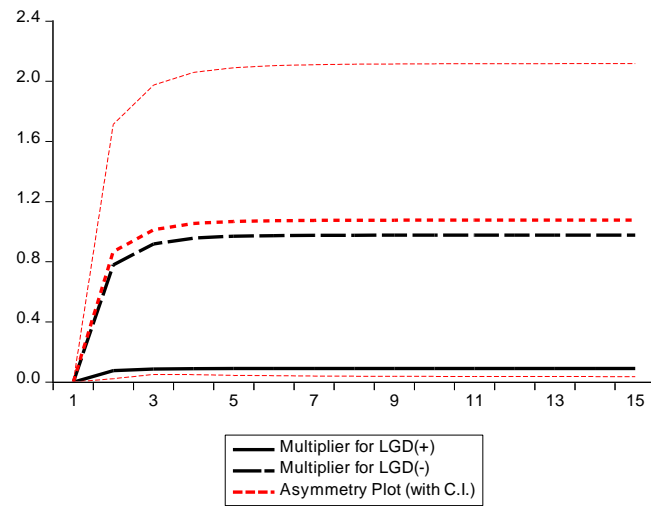


Figure 4. Dynamic Multiplier for LMC

Source: Research finding.



**Figure 5.** Dynamic Multiplier for LGD

Source: Research finding.



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## The Effect of Emigration on Foreign Trade: The Case of Afghanistan (2001-2019)

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### Abstract

Immigration is one of the factors affecting macroeconomic variables, including foreign trade. Considering the large number of Afghan migrants throughout the world, this study sought to investigate the effect of Afghan migrants on the imports and exports of this country during 2001-2019, using the semiparametric augmented gravity model for the empirical purpose of the study. The results of the semiparametric estimation of the fixed effects model have indicated that the role of emigration on the volume of exports and imports of Afghanistan has a non-parametric effect. That is, on some levels of emigration, the increase in the number of immigrants abroad has increased trade and confirms the existence of a complementary relationship between labor migration and trade, contrary to the theory of Heckscher-Ohlin, but at other levels, the accumulation of immigrants has caused a decrease in the volume of Afghanistan's imports and exports. This result is consistent with Heckscher-Ohlin's theory. Of course, it can be due to the integration of immigrants in the host society and the disconnection with the destination countries, the difference in skills level and information of immigrants.

**Keywords:** Foreign Trade, Migration, Gravity Model, Semiparametric Model, Trade Policy.

**JEL Classification:** C14, C23, F10, F13, F22.

### 1. Introduction

Migration is a hot debate in the world economy and influences both the guest and host countries politically, socially, and economically. It is defined as the movement of an individual or a group across the political boundaries of a geographical unit to

another for permanent or temporary residency in a location other than the mother country and as a factor altering the status of the migrants (Kothari, 2002). Many theories such as neoclassical theory, human capital theory, new economic theory, world system theory and dual labor market theory, network theory, migration system theory, and transnational migration seek to explain the reasons for migration.

According to the report of the United Nations (2021), the world's migrant population equaled 271 million individuals in 2019, amounting to 3.5% of the world's population. Migration flows out of some specific bonds between the origin and destination countries, such as foreign trade and foreign direct investment (Castles and Miller, 2009). Migration has implications for both origin and destination countries. One of the important effects of migration on economic issues is its effect on the volume of trade between the origin and destination countries (Gould, 1994; Girma and Yu, 2002; Lewer and Berg, 2009; Chao and Yu, 2002; De Arcangelis et al. 2022). Migrants influence the volume of foreign trade between the origin and destination countries by reducing transaction costs (Gould, 1994), altering the labor force supply and labor force demand (Entzinger et al., 2004), changing labor force productivity (Ottaviano et al., 2018), providing information about host and origin countries (Murat and Pistiresi, 2009; Dunlevy, 2004), changing in consumer preferences (Gould, 1994; Tai, 2009; White, 2007), sending remittances (McKenzie and Sasin, 2007; Tung, 2018; Portes et al., 1989; Poot and Strutt, 2010; Hubler, 2016) and finally changing in foreign direct investment (Light and Rosenstein, 1998; Saxenian, 2002; Lucas, 1990; Van den Berg and Lewer, 2009; Aubry et al., 2012).

Afghanistan is one of the biggest migrant-sending countries in the world and was the world's tenth migrant-sending country in 2020 according to a report by the United Nations<sup>1</sup>. However, migrants comprised 13% of this country's population in 2019, at which the migration statistics increased by 5.4% compared to the former period.

Concerning the large number of Afghan migrants in different countries of the world and the numerous ways they impact the trade volume, this paper evaluated the effect of migration on the foreign trade of Afghanistan with Afghan-receiving countries and its trading partners. Identifying the relationship between immigration and trade can help to determine the appropriate trade policies to exploit the capacity created by Afghan immigrants for the development of trade

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<sup>1</sup>. <https://worldmigrationreport.iom.int/wmr-2020-interactive/>

between Afghanistan and immigrant-receiving countries. A bulk of studies tackling the effect of migration on foreign trade are linked to migrant-receiving countries and have employed parametric methods, while there are few surveys on migrant-sending countries using the semiparametric method. Thus, among the innovations of this study, we can refer to its methodology and research location, which is a migrant-sending country. The study employed the semiparametric gravity model to investigate the effect of Afghan immigrants on the country's trade flows with its main trading partners during the 2001-2019 period. The following sections will include a discussion of theoretical foundations, a review of the literature, a specification of the research model, an analysis of empirical results, and a conclusion of the study.

## **2. Relationship between Migration and Foreign Trade**

Although migration is not equally defined in international terms, it can be recognized as individuals' or groups' relocation from a place they reside to another in the country or other countries by crossing international boundaries for temporary or permanent residency<sup>1</sup>. Depending on their levels of development, countries can experience both immigration and emigration. In the migration literature, a prevalent classification of migration divides migration into two forms of forced and voluntary migration. Individuals moving from one country to another as asylum seekers, refugees, and domestic displaced persons are considered forced migrants. However, others moving for various purposes, e.g., supplying the labor force, are heeded as voluntary migrants. The first group has no choice but to migrate due to facing struggles in their countries, while the second group migrates looking for their benefits (Hugo, 2008; Koppenberg, 2012; Zetter, 2015).

To perceive the reasons for migration, Kurekova (2011) classifies migration theories into domains of migration determiners and migration perpetuation according to the studies of prominent scholars, such as Massey et al. (1993) and Arango (2000). Based on this classification, the theories of neoclassical, human capital, new economics, world system, and dual labor market fall into the determinant factors of migration. In addition, Massey et al. (1993) explained that the geographical difference between labor force supply and demand, the difference in labor force return rate, risk management, and household decisions, the relationships between the capitalist society and neighboring countries, and the perpetual demand of the industrial society for migrant labor forces constituted

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<sup>1</sup>. <https://www.iom.int/who-is-a-migrant>

migration factors in the neoclassical, human capital, new economics, world system, and dual labor market theories, respectively.

The migration-trade relationship is debatable in two respects. The traditional perspective claims that the international transfer of goods and production factors can be replaced (Massey, 1993; Mundel, 1957). That is why one can suppose that trade liberalization can restrain migration (Lodefalk and Hatzigeorgiou, 2021) and vice versa when it comes to policymaking. This logic gave rise to the North American Free Trade Agreement (NAFTA) between America, Canada, and Mexico (Uchitelle, 2007).

However, the basic assumption of the neoclassical theory advocates concerning the migration-trade replacement cannot persist when some underlying model assumptions, such as the presence of unequal technologies, exist throughout the world. For this reason, we can assert that, unlike the conventional theories of migration and trade, new theories confirm a complementary relationship between them. These applied theories and models were initially developed and presented by Clerides et al. (1998), Bernard et al. (2003), and Melitz (2003). They generally explain that the concurrent growth of migration and trade refers to a direct relationship between these two economic behaviors (Van den Berg and Lewer, 2009). There is a bulk of evidence revealing that migration positively impacts the surge of trade between the origin and destination countries of migrants. Accordingly, Mundel (1957) employed Heckscher-Ohlin's standard trade model to show that the mobility of both production and trade factors complement each other (Markusen, 1983; Schiff, 2006).

Regarding the relationships between migration and trade, we can generally state that migration influences the trade flow through different channels, as we discuss in the following.

**Information path:** Migrants can provide the origin country with information related to the job opportunities and official and commercial environments of the host country (Murat and Pistiresi, 2009). Migrants are more privileged in knowledge acquisition due to their familiarity with the economies of different countries and societies. Thus, trading becomes possible due to the product or cost differences between the host and origin countries (Dunlevy, 2004). In other words, a common barrier to trade is having no or incomplete knowledge of trade opportunities. However, migrants have the advantage of being able to connect themselves to trade systems and find customers or suppliers in the host country (Gould, 1994). Gould (1994) argues that less information about the host country before the migration enhances the commercial effect of migration. The

informational impact implies that those migrants should increase exports and imports (Wagner et al., 2002).

**Consumer preferences path:** Some researchers believe that migrants prefer to consume the products of their own country (Gould, 1994) and call it the effect of the preference. Nonetheless, not all migrants enjoy these preferences, while only some demand the domestic products of the origin country. Tai (2009) expects that migrants' orientations toward demanding the products of their own country, as White (2007) named the *transplanted home bias*, transfer to the other individuals in the host country and raise the total importation (*preferences effect*). In addition, it is implicitly assumed that preferences may transfer from the host to the origin country and enhance the exportation of the host country to migrants' origin countries. On the whole, we can conclude that the effect of the preference can increase bilateral imports between the origin and destination countries of migrants.

**The Effect of Transaction Cost:** There are mechanisms through which migrants can reduce bilateral transaction costs of trade if they possess adequate knowledge of the origin country. The first is the person-specific mechanism in which the bilateral transaction costs of trade decline due to the commercial relationships or personal contacts of migrants. Regardless of which country migrants come from, migration always decreases bilateral transaction costs of trade in this mechanism. In the second non-specific mechanism, bilateral trade costs decrease due to the extra knowledge of migrants about foreign markets and different social institutions. According to this mechanism, whether migration reduces the bilateral transaction costs of trade or not relies on which countries migrants come from. If they are from countries with identical social and political institutions to the host country, they will be less effective in decreasing bilateral transaction costs of trade (Girma and Yu, 2002). Put differently, it is assumed that migration impacts trade with those origin countries that lack formal procedures for contract conclusion and are usually developing countries. Gould (1994) believes that inadequate information in the host country before migration makes the commercial effect of migration bolder.

In addition, another common assumption is that migrants reduce the fixed trade costs so that new trades are stimulated. It is expected that migrants decrease the fixed costs at the outset of trading a new product internationally, along with the variable costs of its trade (Hiller, 2013; Lodefalk and Hatzigeorgiou, 2019).

**Remittances:** Remittances are among trade-impacting migration channels. McKenzie and Sasin (2007) confirm that the effect of migration on trade cannot be separated from the impact of remittances and vice versa. Tung (2018) revealed that

input remittances negatively impacted the trade balance of the Asian and Oceania countries. Besides, it was illuminated that the per capita growth of the annual Gross Domestic Product (GDP) negatively impacted the trade balance, indicating that the income flourishing might give rise to the escalation of the exportation value, besides imbalances in countries' international trades. Furthermore, individuals migrating from developing countries often send remittances to their families and thus indirectly impact trade, investment, and technology diffusion (Portes et al., 1989; Poot and Strutt, 2010; Hubler, 2016).

**Foreign direct investment (FDI):** FDI is one of the channels through which migration can influence trade. However, the relationship between migration and FDI flows is complicated. Light & Rosenstein (1998) and Saxenian (2002) assert that entrepreneur migrant communities provoke numerous flows of international investments, while Lucas (1990) argues that capital always transfers to countries with large numbers of workers. Studies on migration and foreign direct investment often assume that this relationship is positive regardless of the investment incentive (Van den Berg and Lewer, 2009). Thus, migrants promote investment in the origin country and reduce information friction using their foreign relationships and knowledge. Migrants' transfer of international information concerning job opportunities in the origin country creates trade opportunities for exporters and investors. Since exporters build relationships with investors, this information leads to trade enhancement via investments in the origin country that increase products by accessing cheap production resources. In the meantime, the migration of skilled labor forces is associated with exportation and direct foreign investment more strongly than the total migration (Aubry et al., 2012).

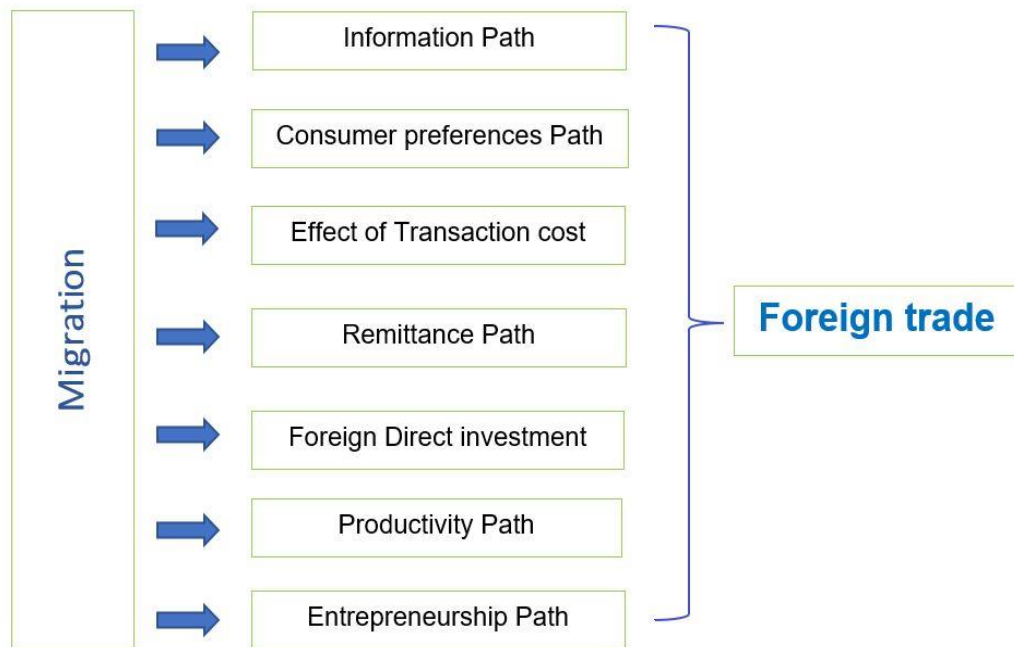
**Productivity:** Given the employment of migrants with varying capacities in different sectors, it is possible to change productivity and enhance competition in migrant-receiving industries. Migrants may replace intermediate importation inputs whose production used to be outsourced by the companies. However, these inputs can be produced by emigrants inside the country. Hence, we can assert that emigrants influence productivity and exportation costs. Concerning the effect of emigrants on the exportation practices of companies, we can explain that emigrants may increase the flow of exportation to their origin countries in two ways: They may help with customizing and targeting services to the customers of their own countries, such that domestic companies can successfully penetrate the new market. On the other hand, emigrants assist with the expansion of the present market for companies by improving the already-presented services. Therefore,

they raise sales and the earning of income from that market, known as the intensive margins of trade (Ottaviano et al., 2018).

Migrants increase skill diversity across companies and thus positively impact their productivity (Kerr and Lincoln, 2010; Ortega and Peri, 2014; Peri et al., 2015; Ghosh et al., 2014). Just as outsourcing reduces the prime costs of companies, the employment of migrants in production processes can also decrease their costs (Grossman and Rossi-Hansberg, 2008).

**Entrepreneurship:** Today, entrepreneurship accompanies several concepts such as global competition, innovation, productivity, employment, economic development, and welfare. This relationship can also be established by migrant entrepreneurship. Some factors such as the development of information and communication tools, transportation facilitation, the world shrinking, people moving beyond national borders, and the desire to live in prosperity in different attitudes lead to immigrant entrepreneurship with integration. Migrant entrepreneurship was first studied in America and then in Europe, especially after World War II (Light, 1973). Since entrepreneurship stimulates the backward and forward linkages of the economy and offers new jobs to the market, entrepreneurs help promote the exportation trade of a country, which is a foremost economic development. They produce goods and services on large scales to attain enormous sums of foreign exchange resources through exports and prepare the necessary sources for the supply of imports (Dhaliwal, 2016).

Figure 1 summarizes what we already discussed the channels of migration that affect foreign trade.



**Figure 1.** Effects of Migration Channels on Trade

**Source:** Research finding.

### 3. Literature Review

Hatzigeorgiou and Lodefalk (2021) investigated the literature on the relationship between migration and internationalization and examined the contribution of migrants to international trade, as well as transboundary and direct foreign investments. They conclude that although evidence shows migration facilitates trade and internationalization, the respective literature also reflects the existing gaps and fundamental inconsistencies.

Pellegrina and Sotelo (2021) investigated the relationships between migration, privatization, and trade in Brazil from 1950 to 2010. The results of their study showed that farmers migrated to regions with high employment rates, where they started working and earned more income than other migrants. Thus, the recession of migration costs noticeably enhances Brazil's contribution as a pioneer goods exporter.

Ma and Tang (2020) examined the migration-trade relationship inside China, considering 279 cities dominated by this country. The findings revealed that despite its negative impact on density and nominal wage, the flow of migrant workers elevated welfare in destination cities between the years 2000 and 2005

and provided neighboring cities with higher welfare achievements through inter-city trades.

Mihi- Ramirez et al. (2019) investigated the international mobility of capital and labor force in a paper entitled ‘The Interaction of Emigration and Immigration with Foreign Direct Investment, International Trade, and remittances’. Focusing on two periods, i.e., before (1998-2007) and after (2008-2016) the great depression, their study employed a Mixed Linear Model (MMA) to analyze the statistics of 112 countries having close migratory, commercial, and capital-transfer relationships with Spain. The results display that the numerousness of emigrants in Spain increased foreign direct investment, outward and inward remittances, and the country’s exportation to and importation from emigrants’ origin countries, while emigration from Spain was reversely correlated with foreign direct investment and outward remittances.

Steingress (2018) examined the effect of immigrants on US foreign trade using the exogenous effect of the resettlement of political refugees in different US states between 2008 and 2013 and found that immigrants by changing preferences and reducing transaction costs increase imports from their country of origin of migrants and increases exports to these countries.

In a paper titled ‘Determinants of Iran’s Emigration Flows: An Application of Dynamic Panel Data Approach, Renani et al. (2014) examined the reasons for the emigration of Iranians. This research applied confirmatory analysis to develop the quality-of-life index and explore its effect, besides economic and political indices, on the flow of emigration. The results revealed that institutional quality and political and institutional factors affected emigration from Iran. In addition, the presence of Iranian emigrants in the destination country is one of the reasons for the surge of emigration in those countries. However, the variable of distance has a negative effect on emigration from Iran.

Tayebi et al. (2012) investigated the effect of migration and brain drain on the economic growth of origin countries. Using panel data, this study probed 79 origin countries as senders of specialized emigrants and 6 destination countries during the 1991-2004 period. The investigation illuminated that brain drain slowed down the economic growth of these countries by reducing the accumulation of human capital in the countries of origin.

In general, the literature has confirmed the significant effect of migration on trade. In most of these studies, the effect of immigrants on the trade of host countries is considered a parametric relationship between foreign trade and migration, in which an econometric regression model has been specified and

estimated to show such a relationship. However, by reviewing the research done, it is clear that immigration can act as a substitute based on the model of Heckscher-Ohlin and cause an increase or decrease in trade against the direction of migration, or it can complement trade and with the increase in immigration, international trade will increase. So it is possible to explore a non-parametric relationship between migration and trade. In this research, an attempt has been made to fill this literature gap by examining the effect of emigration on the foreign trade of the immigrant-sending country using a semiparametric method.

#### 4. The Model

Globalization and the mobility of production factors lead to many changes in the macroeconomic variables of countries. Heckscher-Ohlin's theory assumes that production factors exist inside the country and cannot transfer to other countries. However, the migration and globalization issues have resulted in numerous studies probing the effect of migration on the countries' volumes of foreign trade and the development of international trade theories. Migrants impact and—in other words—facilitate the flow of trade through information channels, consumer preferences, transaction costs, remittances, foreign investment, productivity, and entrepreneurship. One of these channels is the effect of migrants on the transaction cost and trade facilitation. In this respect, Gould (1994) employed Bergstrand's microeconomics model (1985), considering the gravity equation, and explained the effect of migration on trade parametrically while nonlinearly as below:

$$\log EX_{US,i} = \alpha_1 (M_{i,US} / (\alpha_2 + M_{i,US})) + \varepsilon_{ex} \quad (1)$$

$$\log IM_{i,US} = \beta_1 (M_{i,US} / (\beta_2 + M_{i,US})) + \varepsilon_{im} \quad (2)$$

In these equations, migrant stock (M) is considered a substitute for the transaction cost, and their effects on (EX/IM) trade are investigated. However, the decline of the transaction cost in trade is a channel by which migrants influence trade, and migrants differently impact the trade flow regarding the information levels they transfer to reduce transaction costs and the particular characteristics of trade partners. In addition, it is significant to use the migrant stock instead of migrant flow since migration impacts the transaction cost by not only the current migration flow but also the population of the past migrants. When entering their countries of origin, migrants bear new information that has probably not been shared by old and new migrants. For this reason, the migratory effect on trade, resulting from alterations in migrant accumulation, is probably bolder in countries that have already a large number of migrants than in countries with a small migrant population (Mundra, 2005). Mundel (1957) and Massey (1993) confirmed the

presence of a substitutive relationship between migration and trade based on Heckscher-Ohlin's model, while Markusen (1983) and Schiff (2006) approved the complementary relationship between migration and trade. It is noteworthy that these contradictory perspectives confirm the different effects of migration on trade flows. Mundra (2005) investigated the nonlinear relationship between migration and trade. On the other hand, a misspecification of a functional form of an empirical model for migration may lead to estimation bias. Thus, it can be appropriate to use non-parametric models, as one solution to this problem, that does not have functional form constraints. Such models are employed when no distinct relationship is already determined between the dependent and independent variables. Therefore, if the relationship of the independent variables with the dependent variable is specified and determined in a model, and if the relationship of an explanatory variable with the independent variable is unspecified, semiparametric regression is applied (REF?). As defined previously, Equations 1 and 2 explain the nonlinear relationship between migration and trade flows, while this relationship lacks a specific functional form due to the varying impacts of migrants on trade. Therefore, to investigate the effect of migration on Afghanistan's foreign trade, we have employed a semiparametric regression, wherein the variables of the gravity model are parametrical, and migrant accumulation is considered a nonparametric variable. Mundra's (2005) model was used for specifying the semiparametric gravity model of trade as below:

$$\ln Y_{ijt} = \alpha_i + \forall \ln Y_{ijt-1} + \beta_1 \ln GDP_{PER}_{it} + \beta_2 \ln GDP_{PER}_{jt} + \beta_3 \ln POP_{it} + \beta_4 \ln POP_{jt} + \beta_5 \ln DIST_{ijt} + \beta_6 \ln OE_{XR}_{ijt} + \beta_7 ECO + \beta_8 COMBORDER + m(Z_{it}) + U_{ijt} \quad (3)$$

where  $\ln Y_{ijt}$  is the logarithm of the trade flow from country  $i$  to country  $j$ , estimated in two separate equations (export and import), and  $\ln Y_{ijt-1}$  is the logarithm of the trade lag and includes lagging exportation and importation, leading to the method of the panel model and adjusting the trade-related costs. Such adjusting costs may arise in trade transactions owing to Ladder contracts, which impede the immediate reaction of trade partners to technology shocks and trade costs (Baltagi et al., 2014). Emikonel (2022) shows that partial adjustment is made to the trade about its long-run equilibrium value.  $\ln GDP_{PER}_{it}$  is the logarithm of GDP per capita of Afghanistan,  $\ln GDP_{PER}_{jt}$  is the logarithm of GDP per capita of the destination country (selected trade partners),  $\ln POP_i$  is the logarithm of Afghanistan population,  $\ln POP_j$  is the logarithm depicting the population of the destination country (selected trade partners),  $\ln DIST_{ijt}$  is the logarithm of the

distance between the capital of country  $i$  with country  $j$  (the distance of Kabul with trade partners),  $LnOEXR_{ijt}$  is the logarithm of the official exchange rate between countries  $i$  and  $j$ , ECO is the dummy variable of membership in ECO (Economic Cooperation Organization), COMBODER is the dummy variable of sharing a border with Afghanistan, and  $m(Z_{it})$  is the nonparametric variable of migration. It is worth noting that  $i$  and  $j$  represent Afghanistan and its trade partners in this equation, respectively.

For model estimation, we have used data from Afghanistan's 27 trading partners that simultaneously have had bilateral trade relations with the country, as well as Afghani emigrants residing in these countries in the 2001-2019 period. The data related to the bilateral trade, GDP per capita, population, exchange rate, the distance between Kabul and the capitals of partner countries, and migration were extracted from the COMTRADE<sup>1</sup> database, World Bank<sup>2</sup>, the distance between countries site<sup>3</sup>, population database of the United Nations<sup>4</sup>.

The gravity model is widely used in international trade to explain bilateral trade flows and has been very successful in empirical analysis. The gravity equation is based on the fact that the volume of trade between two countries is directly related to the gross national product (GNP) or gross domestic product (GDP) of the two countries and inversely related to the geographical distance between them. Tinbergen (1962) and Poyhonen (1963) are the pioneering studies of the gravity model. Anderson (1979) and Deardorff (1998) consider that the gravity equation can explain international trade (Leitao and Tripathi, 2013). Tinbergen's theoretical foundation of this model was improved by Anderson (1979), Bergstrand (1989), Brocker (1989), Deardorff (1998) and Linnemann (1966), and Rasoulinezhad and Kang (2016).

The gravity model has been used in many studies in a parametric way, but few studies have been done in a non-parametric way. Due to the non-parametric nature of the migration variable, a semiparametric gravity model has been used to estimate the data. Robinson's method is used for estimating the semiparametric model. According to this method, the partial linear semiparametric model is defined as below:

$$Y = x'\beta + m(z) + u \quad (4)$$

where  $u = y - E[y|x,z]$  and refers to the following relation:

1. [www.comtrade.un.org](http://www.comtrade.un.org)

2. <https://data.worldbank.org/indicator>

3. <https://www.distance-between-countries.com>

4. <https://www.un.org/en/development/desa/population/migration/data>

$$E[y|z] = E[x|z]'\beta + m(z) \quad (5)$$

Since  $E[u|x,z]=0$  implies  $E[u|z]=0$ , we obtain the below equation by subtracting the above equations from each other:

$$Y - E[y|z] = (x - E[x|z])'\beta + u \quad (6)$$

The conditional moments of the equation above are unknown but can be replaced with nonparametric regressions. Thus, Robinson introduced the Ordinary Least Squares (OLS) regression estimation:

$$y_i - \hat{m}_{yi} = (x_i - \hat{m}_{xi})'\beta + v \quad (7)$$

where  $\hat{m}_{yi}$  and  $\hat{m}_{xi}$  are predictions from nonparametric regression of, respectively,  $y_i$  and  $x_i$  over  $z_i$ . Given independence over  $i$ , the OLS estimator of  $\beta$  in the above equation is  $\sqrt{N}$  consistent and asymptotically normal with:

$$\sqrt{N}(\hat{\beta}_{pl} - \beta) \xrightarrow{d} N[0, \sigma^2(\text{plim} \frac{1}{N} \sum_{i=1}^N (x_i - E[x_i|z_i])(x_i - E[x_i|z_i])' )^{-1}] \quad (8)$$

We assume that  $u_i$  reflects iid[0,  $\sigma^2$ ]. For the estimation of  $V[\hat{\beta}_{pl}]$ ,  $(x_i - E[x_i|z_i])$  is replaced with  $(x_i - \hat{m}_{xi})$ . Since the  $m(z) = E[y|z] - E[x|z]'\beta$  equation is established, it can be constantly estimated by the  $\hat{m}(z) = \hat{m}_{yi} - \hat{m}_{xi}'\hat{\beta}$  expression. Various nonparametric estimators of  $\hat{m}_{yi}$  and  $\hat{m}_{xi}$  can be applied. Concerning Robinson's model, this study employed the kernel smoothing function. The estimator of the kernel density was introduced by Rosenblatt (1956) in the form of the below equation, wherein the  $k(\cdot)$  weight function is called the kernel function.

$$\hat{f}(x_0) = \frac{1}{Nh} \sum_{i=1}^N \frac{(x_i - x_0)}{h} \quad (9)$$

where  $h$  is the smoothing parameter called the bandwidth, and  $2h$  is the window width. Density is estimated by the  $\hat{f}(x_0)$  evaluation in a range wider than the values used for histogram drawing, i.e.,  $x_0$ . Evaluation is usually made in samples of  $x_1, x_2, \dots, x_n$ , leading to the attainment of a density estimation smoother than that of the histogram. Although there are various kernel functions such as the Triangle kernel, Fourth-order Gaussian kernel, Gaussian Kernel, Epanechnikov Kernel, Uniform Kernel, and Tricoboc Kernel, the present study employed the Epanechnikov Kernel for its purpose.

## 5. Empirical Results

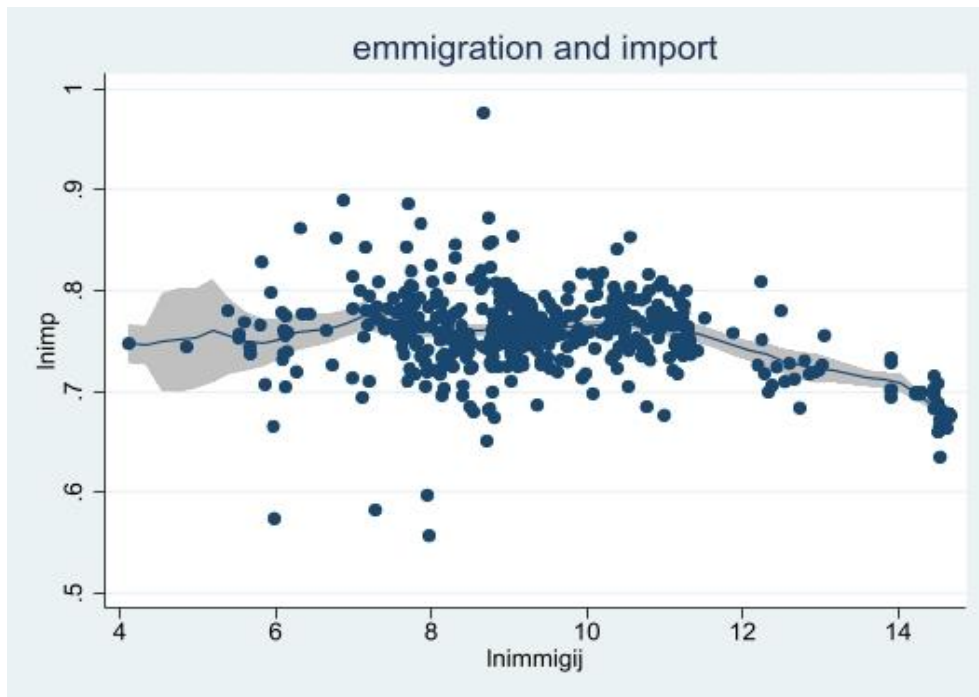
In this section we investigate empirically the effect of Afghan migrants on the exports and imports volumes of this country with its trading partners. To this purpose, two semiparametric augmented gravity equations specified in the previous section were estimated by the Stata. Robinson's (1988) estimator and the

Epanechnikov Kernel were used for estimation and smoothing, respectively. Tables 1 and 2 report the estimated values of the imports and exports gravity models, respectively. Figures 1 and 2 indicate the nonparametric relationships between imports, exports, and Afghan emigrants, respectively.

**Table 1.** Parametric Estimation for Afghan Imports Gravity Model

Parametric Estimation for Gravity Model			
Variable	Coefficient	t-Statistic	P> t
lnimp1	0.735	25.14	0.000
lnpopi	-0.066	-2.41	0.016
lnpopj	0.018	6.19	0.000
lndisij	-0.017	-3.72	0.000
lnoexrij	0.006	3.00	0.003
comborder	0.066	2.91	0.004
eco	0.02	1.96	0.050
lngdpperi	0.016	0.82	0.411
lngdpperj	0.036	5.49	0.000

**Source:** Research finding.



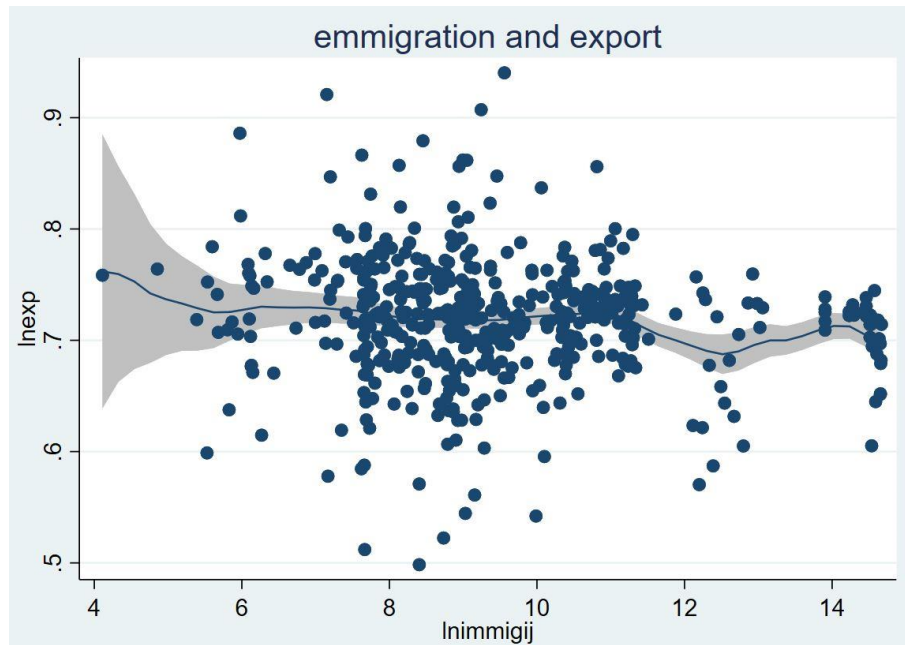
**Figure1.** Nonparametric Relationship between Afghan Imports and Emigration

**Source:** Research finding.

**Table 2.** Parametric Estimation for Afghan Exports Gravity Model

Parametric Estimation for Gravity Model			
Variable	Coefficient	t-Statistic	P> t
lnexp1	0.698	21.77	0.000
lnpopi	-.053	-1.35	0.179
lnpopj	0.018	4.66	0.000
lndisij	-.025	-3.92	0.000
lnoexrij	0.002	0.90	0.368
comborder	0.000	0.03	0.979
eco	0.019	1.27	0.204
lngdpperi	0.049	1.73	0.084
lngdpperj	0.028	3.13	0.002

**Source:** Research finding.

**Figure 2.** Nonparametric Relationship between Afghan Exports and Emigration

**Source:** Research finding.

Considering the results of the parametric estimations in Tables 1 and 2, most findings are in line with the theoretical foundations and the results of studies conducted by Baltagi et al. (2014) and Emikonel (2022). The population of Afghanistan has a negative and significant effect on its volume of importation from other countries. According to the latest report of the World Bank in 2020, almost

74% of Afghanistan's population resides in rural regions. Concerning the low level of development, the dominance of the rural economy, and the spread of poverty in Afghanistan, we can argue that population growth in this country reduces import flows of the country with its selected trading partners, which the finding is consistent with the findings of the Mundra's (2003) study. The populations of the trading partners of Afghanistan also have a positive and significant effect on its imports from and exports to these countries. Since a country's population reflects the market potential and economics of scale, we can assert that the increasing size of the market of Afghanistan's trade partners encourages exports to and imports from these countries. Based on the theoretical foundations, the geographical distance between the two countries variable, representing trade transportation costs, negatively and significantly impacts the exportation and importation volumes of Afghanistan. This result corresponds with the findings of a study carried out by Abafita and Tadesse (2021). The exchange rate variable has a positive and significant effect on the volume of imports, implying that the imports of Afghanistan also increase when its exchange rate goes up. The reason for this contradiction perhaps lies in the way the exchange rate is determined in this country. The exchange rate in Afghanistan is controlled in a managed way by the Central Bank and the use of foreign aid comprises almost 50% of the budget and 12% of the GDP of Afghanistan annually and makes the country's monetary value stronger than the economic realities; another reason for the extensive trade deficit of this country during the examined period. The contiguity (joint boundary) variable has also a positive and significant impact on imports, implicating that it reduces trade costs while increasing import flows. ECO membership is directly and significantly related to exports and increases the country's imports from the selected partners. International trade unions and economic organizations are developed to facilitate inter-country trading. Therefore, results suggest that the enrolment of Afghanistan in ECO raises the importation of this country from the member countries. The per capita income variable of Afghanistan only influences its exports positively and significantly, implying that the exports of this country go up with the rise of its per capita income. The variable associated with the per capita income of the trading partners is positively and significantly related to the values of exports and imports. Additionally, imports from and exports to these countries increment with an increase in the per capita income of these countries. This relationship means that the rise of per capita income augments economies and raises trade values.

Concerning the nonparametric part of the model, the semiparametric regression of the fixed effects of the imports and exports equations was implemented by Robinson's estimator and the Epanechnikov Kernel smoother, and the results were presented in Figures 1 and 2, reflecting the effect of Afghan emigration on the exports and imports of this country, respectively. The findings indicate that Afghan migrants leave different impacts on import and export values, such that at some migratory levels, the upsurge in the number of Afghan emigrants leads to trade enhancement and affirms the presence of a complementary relationship between migration and trade in contrast with Heckscher-Ohlin's theory. By introducing the products of the origin country to the host society and vice versa, Afghan emigrants reduce trade costs and elevate Afghanistan's exportation to and importation from these countries due to their familiarity with the markets of the origin and destination countries. This outcome is congruent with the findings of the studies by Markusen et al. (1995), Martin (2001), and Mitchel and Pain (2003). However, the increased number of emigrants decreases the values of imports and exports of Afghanistan at other levels of migrant accumulation. Among the reasons for this reduction, we can refer to the integration of migrants with the host society, their disconnection from their origin country, and the differences in their skill and information levels. In this case, according to Heckscher-Ohlin's theory, a substitutive relationship between migration and trade is established, and many emigrants reduce Afghanistan's trade volume. This result is consistent with the results of Bruder (2004). Furthermore, Hijzen and Wright (2010) illuminated that the migration-trade relationship could be either substitutive or complementary to the skill level of migrants.

## **6. Conclusion and Suggestions**

The present study investigates the relationship between migration and foreign trade in Afghanistan from 2001 to 2019. For this purpose, data estimation was conducted using a semiparametric gravity model. The literature tackling the relationship between migration and foreign trade vividly reflects a substitutive or complementary relationship between these two variables. Several studies have investigated and confirmed the relationship between migration and trade in migrant-receiving countries. Thus, replicating such studies for migrant-sending countries such as Afghanistan, with numerous emigrants from different countries worldwide, can help employ their potential to reinforce foreign trade. However, since few studies have attended this area in the semiparametric debate despite its applied merits, the present research could confirm the presence of a semiparametric

relationship between migration and foreign trade. The effect of Afghan immigrants has an impact on the trade volume of this country with the countries receiving immigrants in both export and import sectors according to the obtained results.

The values of trade with some partners of Afghanistan increased at the confidence level of 95% when the number of Afghan emigrants was large in these countries, affirming a complementary relationship between migration and trade. The existence of a complementary relationship confirms this fact that with the increase of immigrants, better and more information is provided to the markets for both host and guest countries, which reduces the transaction costs, and as a result, the volume of trade increases in the same direction as the number of immigrants.

However, other parts of Figures 1 and 2, demonstrated that the volume of trade with some other partners of Afghanistan decreased, confirming Heckscher-Ohlin's result and the presence of a substitutive relationship between trade and migration. This outcome could be due to the successful integration of the emigrants in the host country and the fading ties between migrants and their country of origin. Since Afghanistan is faced with an abundance of labor and according to the theorem of Heckscher-Ohlin, the confirmation of the substitution relationship between Afghan immigrants and the trade volume of the countries receiving these immigrants means that these countries are similar in the production of labor-intensive goods and with the increase in immigration, the trade of these goods has decreased, so it is recommended to be careful in the commercial policy towards these countries, to adopt the appropriate comparative advantage and plan for its products due to the presence of immigrants in these countries. In general, it can be concluded that when formulating trade policy, the effect of immigrants on trade should be taken into consideration and that this potential is used to strengthen trade between Afghanistan and the immigrant-receiving countries.

Investigating the effect of immigrants on trade with more detail in final goods, intermediaries, and raw materials and also, the separation of immigrants based on skills can provide more accurate and practical results. Unfortunately, this information was not available for Afghanistan at the time of the investigation, but it can be one of the research options for researchers in large immigrant-receiving countries such as Iran and Pakistan. Finally, a policy toward opening the economy would be helpful to reduce Afghan emigrants, who seek employment abroad.

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## Remittances, Financial Development, and Poverty Reduction in Sub-Saharan Africa

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### Abstract

This study specifically investigates the direct effect of financial development and remittances as well as the interaction effect of remittances and financial development (FD) on poverty reduction in various income groups in sub-Saharan Africa. The study employed the Panel ARDL model on data from 31 sub-Saharan countries during the period 1990-2020. The study found that in the long run, both remittances and FD contribute to poverty reduction in sub-Saharan Africa, middle-income, and low-income groups within the region. The study also found that the interaction of remittances and FD does not contribute to the poverty alleviation process. In the short run, both remittances and FD fail to enhance poverty reduction in the region and among the income groups. Likewise, the interaction between remittances and FD does not contribute to poverty reduction in the region and within the income groups. The study found that the levels of income play no role in the relationship between remittances, financial development, and poverty reduction but it has little effect in the short-run. There is a need to make financial institutions more efficient in promoting the inflow of remittances through the formal channel by easing and reducing the cost of the transaction of remittances.

**Keywords:** Remittances, Financial Development, Poverty Reduction, Sub-Saharan Africa.

**JEL Classification:** B26, F24, I32, N17.

### 1. Introduction

This study examines the moderating role of financial development in the nexus between remittances and poverty reduction in sub-Saharan African countries. A study such as this is motivated by the 2030 Sustainable Goals of the United Nations to reduce extreme hunger and poverty, and by issues in research circles. Recent reports from the World Bank (2020) indicate that sub-Saharan African countries

have become home to hunger and extreme poverty, despite global progress in reducing poverty. For instance, three out of the five poorest countries now live in Africa (Christiaensen and Hill, 2019; Bicaba et al., 2017; Dada and Fanowopo, 2020), while close to 40% of the entire population in SSA wallows in abject poverty (World Bank, 2020). According to the Oxford Poverty and Human Development Initiative (2018) and Tewolde and Weldeyohannes (2018), 58% of the SSA population is considered to be multidimensionally poor. A similar trend has been observed in terms of remittances in the region, with over \$42 billion received in 2020 as remittances from migrants. In the region, Nigeria, Zambia, Mozambique, and Ghana receive a significant share of remittances. Despite this, the countries with the highest percentage of remittance inflows are also among the most impoverished. While remittances have increased in the region, poverty levels have continued to rise, posing a threat to the achievement of Sustainable Development Goals (SDGs) (Akinlo and Dada, 2021); therefore, understanding the role of remittances in poverty reduction in SSA is critical.

Additionally, both theoretical and empirical research have remained inconclusive regarding remittances' impact on growth and welfare. In addition to spurring economic growth, remittances also reduce poverty by increasing capital formation, providing additional income for consumption, and smoothing consumption patterns, particularly during periods of shock that have a multiplier effect on both aggregate demand and output (Yang and Martinez, 2006; Acosta et al., 2008; Azizi, 2018; Konte, 2018; Dada and Akinlo, 2022); and reducing poverty levels (Inoue, 2018; Inoue and Hamori, 2016; Azizi, 2021). Additionally, remittances have been identified as one of the stable sources of foreign currency that could be used both to correct the balance of payments difficulties and for development projects (Ratha et al., 2011; Huay and Bani, 2018). Although international remittances contribute to economic growth and human welfare, they also pose several developmental challenges. The inflow of remittances may cause the exchange rate of the receiving country to appreciate in real terms, as well as increasing inflation, which can worsen output levels and employment conditions. It is pertinent to note that these factors adversely affect the poor. This channel is known as the "Dutch disease effect" (Acosta et al., 2009; Catrinescu et al., 2009; Mughal, 2013; Majeed, 2014). As a result of migration, growth and poverty can become worsened if skilled workers leave the country (both highly skilled and semi-skilled) resulting in brain drains (Adams, 2003; Docquier et al., 2007; Chauvet et al., 2013). The result may be that remittances are used for immediate consumption instead of productive activities (Vacaflores, 2018; Abduvaliev and

Bustillo, 2019). Furthermore, remittances could make beneficiary households lazy, dampening long-run growth (Mehedintu et al., 2019). This channel is known as the labor market participation channel.

Having a strong financial sector can reduce the negative impact of remittances on welfare through inflation, exchange rate appreciation, and labor market participation channels. To solve these problems, effective communication and effective cooperation between remittances and financial development (hereafter, FD) is essential. The FD could serve as a conduit to offset the negative effects of remittances, particularly poverty (Giuliano and Ruiz-Arranz, 2009; Majeed, 2014; Akobeng, 2016). In addition to protecting poor households from exogenous shocks, a well-developed financial sector can also assist them in directing their surplus funds to profitable investments. The financial sector may be able to pool remittances into large deposits, which can then be used to fund productive activities and projects with a high return (Levine, 2005; Donou-Adonsou and Sylwester, 2016). Furthermore, it facilitates transactions by serving as an intermediary between sender and receiver and allows the poor to benefit from financial services and opportunities, especially through specialized financial institutions (Nyamongo and Misati, 2011; Aggarwal et al., 2011; Kaidi et al., 2019; Sharimakin and Dada, 2020; Olaniyi et al., 2022). Furthermore, financial development could serve as a tool to reduce the high cost of sending remittances to the home country (World Bank, 2021)<sup>1</sup>. For instance, it is estimated that in 2019, an average of 8.9% was used to send money to sub-Saharan Africa, a value higher than the global average of 6.8% as well as the Sustainable Development Goal 10 target of 3%. Several empirical studies have examined FD's role in the remittance-growth nexus (Aggarwal et al., 2011; Demir-güç-Kunt et al., 2011; Bangake and Eggoh, 2020, and Olayungbo and Quadri, 2019), but not much attention has been paid to the role FD plays in the relationship between remittances and poverty.

The argument is that economies with a strong financial sector are more likely to have banking regulations and services that make it simple and affordable for people to send money home, which would increase the impact of remittances on eradicating poverty. When the financial sector can foster an atmosphere that encourages the flow of remittances and also pools remittance funds for investment, there will be a rise in remittance inflow with a potential poverty reduction. In contrast, financial institutions in economies with weaker financial sectors would not be able to promote easy remittances inflow or reduce the cost of remittances

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<sup>1</sup>. Remittance costs are calculated as the fee migrant would pay as a percentage of a \$200 transfer

transfer, which can decrease the impact of remittances on poverty reduction. We build on other studies to argue that the FD is a necessary condition for the magnitude of the impact of remittances on poverty reduction since a strong financial sector can raise household investment levels through easy remittance transfers. Thus, we explore how the effect of remittances varies, if at all when interacting with FD in sub-Saharan Africa. Also, previous studies have not considered whether the level of economic development influences the relationship between remittances, FD, and poverty reduction. There is evidence that countries with high Gross National Income (GNI) may be able to deal with poverty more effectively than low-income countries since they have more resources available to develop infrastructure and social welfare packages to assist the poor and the jobless. A country's economic development can have a significant impact on the quality and efficiency of poverty reduction programs and infrastructure development. As a result, countries that do not have adequate resources may not be able to effectively combat poverty. Therefore, the study expands the sample to include sub-samples based on income level (middle-income and low-income countries), providing a more detailed picture of the dynamics and differences among the various income groups in SSA. Moreover, the sub-samples of the sample provide a homogeneous panel that enables policymakers to formulate and design appropriate policies related to remittances, FD, and poverty levels in the region.

This study contributes to the literature in three different ways. First, the study contributes to the literature on remittances and welfare by shedding light on the moderating role of financial development in the relationship between remittances and poverty in sub-Saharan African (SSA) countries. Second, the study focuses on developing countries, SSA. SSA offers an interesting study area being the region with the highest poverty level in the world (Christiaensen and Hill, 2019; World Bank, 2020) and one of the highest remittance-receiving countries in the world (Olayungbo and Quadri, 2019), with weak financial development (Allen et al., 2014; Olaniyi and Oladeji, 2021). Third, the study uses panel data of 31 countries located in SSA (14 middle-income countries and 17 low-income countries), and Pooled Mean Group and Dynamic Fixed Effect estimation techniques were utilized as the estimation techniques to address endogeneity in remittances-welfare literature, and the estimates provide both long-term and short-term data, which are important for policy formulation.

Apart from the introduction, the remaining part of this paper is sectionalized. Section 2 focuses on a brief literature review. Section 3 presents the methodology

and Data. The results and discussion are presented in section 4. Section 5 deals with implications and conclusions.

## **2. Literature Review**

This section provides empirical evidence of the link between remittances, FD, and poverty. This review is done along three strands in the literature; FD-poverty nexus, remittances-poverty nexus, and lastly, remittances-FD-poverty nexus.

### **2.1 FD- Poverty Nexus**

Applying cross-sectional data from 48 developing nations, Imai et al. (2012) conclude that FD especially micro-finance reduces poverty. Kaidi and Mensi (2019) examine the relationship between FD, income inequality, and poverty reduction by accounting for the role of political institutions. Using a panel of 93 democratic countries and 31 autocratic countries, the results from the study suggest that in autocratic countries, FD and democratic institutions reduce inequality and poverty, while the reverse holds for democratic countries.

Sehrawat and Giri (2016) submit that FD reduces poverty in South Asia and Southeast Asia by reducing transaction costs in the economy and motivating the poor to accumulate savings. In the same vein, Sehrawat and Giri (2017) also conclude that FD and economic growth abate poverty levels while income inequality and inflation rates worsen poverty in India using ARDL. However, Fowowe and Abidoye (2013) found that FD failed to reduce poverty and inequality in African countries. Kaidi and Mensi (2017) also submit that FD proxy by banking and stock market indicators fail to reduce poverty level in a sample of 138 countries between 1980 and 2014. Kaidi et al. (2019) concluded that FD does not contribute to poverty reduction, using a sample of 132 countries between 1980 and 2014.

Cepparulo et al. (2016) investigated the role of institutions in the relationship between FD and poverty in developing countries from 1984 to 2012. The interactive term of FD and institutional quality has a reducing effect on poverty as institutions rise. Along the same line, Rashid and Intartaglia (2017) also assess the role of institutions and economic growth in the link between FD and poverty in developing countries. Applying GMM, the study concludes that FD plays a significant role in reducing absolute poverty, while the indirect effect of FD through institutions shows that FD has a greater reducing effect on poverty when the institution is strong. In addition, Perez-Moreno (2011) submits that FD has a different effect on poverty reduction in developing countries.

## **2.2 Remittances-Poverty Nexus**

Gupta, Pattillo, and Wagh (2009) explore the role of remittances on poverty and FD in SSA using different estimation techniques. Findings from the study reveal that remittances have a poverty-reducing effect and aid the development of the financial sector in the region. Similarly, Imai et al. (2014) investigate the impact of remittances on growth and poverty in 24 Asia and Pacific countries. The authors conclude that remittances spur growth and reduce the poverty level in the study area. The direct effect of remittances on poverty is also found in the study. However, Jongwanich (2007) found that remittances have a marginal impact on growth and poverty in Asia and the Pacific countries using GMM with account for endogeneity. In addition, Serino et al. (2011) conclude that remittances have a different uneven impact on the poverty quantile of 66 developing countries between 1981 and 2005. Azam et al. (2016) examined the effect of remittances across various income groups in 39 countries between 1990 and 2014. Applying FMOLS, the result suggests that remittances worsen poverty alleviation in upper-middle-income countries.

Anyanwu and Erhijakpor (2010) also submit that remittances lessen poverty in 33 African nations between 1990 and 2005. Furthermore, using macro data, Akobeng (2016) examines the effectiveness of remittances in reducing poverty and inequality in SSA. Controlling for time-invariant country-specific effect and endogeneity, the outcome of the study suggests remittances lessen poverty, but the size depends on the proxy used to measure poverty. Also, remittances reduce income inequality in SSA. Similarly, Azizi (2021) examine the effect of workers' remittances on poverty and inequality in 103 developing countries between 1990 and 2014. Applying instrumental variable regression that addresses the endogeneity issue, the result shows that remittances reduce poverty using different proxies and inequality.

Meanwhile, Huay and Bani (2018) used human capital to mediate the relationship between remittances and poverty in 54 developing countries using GMM. The results from the study suggest that education helps channel the positive effect of remittances to poverty reduction, thus remittances reduce poverty through education. Vacaflores (2018) examines the effectiveness of remittances in reducing poverty and inequality in 18 Latin America between 2000 and 2013. The conclusion from the study reveals that remittances lessen poverty and inequality; while remittances are more felt in countries receiving smaller amounts than countries with a large volume of remittances inflow. Masron and Subramaniam (2018) also corroborate the result of Vacaflores (2018) by examining the effect on

44 developing countries between 2006 and 2014. Further, Masron and Subramaniam (2021) assess the implication of remittances on poverty in 44 developing countries between 2006 and 2014. The outcome of the study suggests that the poverty level tends to be lower in countries with a higher flow of remittances. Hatemi-J and Salah Uddin (2013) focus on the direction of causality between remittances and poverty reduction in Bangladesh from 1976 to 2010. The author's finding suggests a two-way relationship between remittances and poverty reduction.

Using micro-level data on poverty, Adam (2006) submits that remittances lessen poverty among recipient households in Ghana. Similar results are obtained by Azam and Gubert (2006) for Mali and Senegal and Dejene (2005) for Ethiopia. In another study, Adams and Page (2005) investigate the impact of migration and remittances on poverty and inequality in 71 developing nations. Applying methods that control for endogeneity, the finding from the study suggests that both international migration and remittances significantly reduce the level, depth, and severity of poverty in the developing world. Furthermore, Abduvaliev and Bustillo (2019) examine the effect of remittances on economic growth and poverty in 10 former post-Soviet republics. Submission from the study reveals that remittances boost economic growth and reduce the poverty level.

### **2.3 Remittances-FD-Poverty Nexus**

Focusing on the interactive effect of remittances and FD on the poverty level of 120 developing countries, Inoue (2018) submits that FD and remittances help in combating poverty in developing countries. Furthermore, the author concludes that remittances substitute for FD in reducing poverty. Kousar et al. (2019) investigate the role of FD and remittances on poverty and income inequality in Pakistan using ARDL-bound testing. Findings from the study show that remittances increase both poverty and income inequality both in the short run and long. In another related study, Majeed (2014) examine the moderating effect of FD in the link between remittances and poverty for 65 developing countries between 1970 and 2008. The empirical findings show that the effect of remittances on poverty depends on the level of FD. Countries with strong FD benefit maximally from the poverty reduction effect of remittances and vice-versa.

From the above strands in the literature, it is evident that only a few studies have examined the impact of remittances on poverty in SSA with little study in the region examining the role played by the financial sector in channeling the positive effect of remittances to the well-being except Akobeng, (2016). However, this

study is different from Akobeng (2016) as the study considers different income groups in SSA. This study, therefore, contributes to the body of knowledge in this regard. The following hypotheses are tested in this study.

*Hypothesis 1: Remittances and FD have a positive effect on poverty reduction*

*Hypothesis 2: FD moderates the effect of remittances on poverty reduction in SSA*

*Hypothesis 3: The effect of remittances, FD, and their interactions on poverty varies across income groups in SSA*

### **3. Methodology and Data**

#### **3.1 Sample and Data**

The variables and the period for this analysis were selected based on economic theory and data availability. For instance, the data on the Human Development Index from the United Nations Development Program (UNDP) starts from 1990 and data are not available or scanty for some of the sub-Saharan African countries. Based on this, annual data for 31 sub-Saharan African nations from 1990 to 2020 were utilized as the sample. This implies that those countries that lack data and whose data are scanty are excluded from the study.

Poverty reduction is the dependent variable, which is measured by life expectancy (POVL) and the Human Development Index (POVH). The other variables included in the study are remittances and financial development. Two control variables are included in the study. They are trade openness and government expenditure. Data on remittances, financial development, government expenditure, life expectancy, and trade openness are obtained from the World Development Indicator while data on the human development index is obtained from the United Nations Development Program database.

#### **3.2 Measures of Variables**

The first measure of poverty reduction is life expectancy. Life expectancy (POVL) is the average number of years a newborn is projected to live if mortality patterns at the moment of birth remain constant in the future is called life expectancy. Life expectancy was employed by Magombeyi and Odhiambo (2018a; 2018b) to measure poverty. The second measure of poverty reduction is the human development index (POVH). The human development index is created by the human development index to show a more comprehensive and long-term approach

to poverty reduction that considers factors such as life expectancy, education, and standard of living. The Human Development Index was employed as a proxy for poverty reduction by Gohou and Soumare (2012) and Utama (2015). Financial Development (FD) is proxied by domestic credit to the private sector (% GDP). Domestic credit to the private sector indicates the totality of credit made available to the private sector by banks and other financial institutions. Personal remittance (REM) as a percentage of GDP – This includes personal transfers and the compensation of employees. Trade openness (OPEN) – Trade openness is measured by the sum of imports and exports as a percentage of GDP. Government expenditure (GOVE) as a percentage of GDP is the final government consumption expenditure. All the variables except the human development index are obtained from the World Bank Development Indicator. The Human Development Index is obtained from the United Nations Development Program Indicator (UNDP). We present the summary form of definitions of variables, data sources, and a priori expectations in Appendix (Table A1) while summary statistics of the data are presented in Appendix (Table A2). The list of countries is provided in Appendix (Table A3).

### **3.1 Models and Data Analysis Procedure**

We use the panel ARDL model in this study because of its benefits. For example, Pesaran and Shin (1999) established that panel ARDL is appropriate for variables with different integration orders, irrespective of whether they are  $I(0)$ ,  $I(1)$ , or combining the two. Another benefit of the ARDL model is the ability to estimate the short-run as well as the long-run impacts from a data set with a wide cross-section and time dimensions at the same time. Another advantage of the ARDL model that made it necessary to use it in our study is that it is appropriate for studies with limited sample sizes, such as the one we have. This full sample includes 31 countries and a 31-year time series. However, the middle-income countries consist of 14 countries while the low-income countries consist of 17 countries and both have 31-year time series which are small for typical panel studies but can be accommodated by ARDL models.

The key feature of the pooled mean group (PMG) is that it allows short-run coefficients and intercepts, as well as the speed of adjustment to long-run equilibrium values and error variances, to vary by country, but long-run slope coefficients remain the same across the countries. Pesaran and Smith (1995) proposed the second technique mean group (MG), which involves estimating independent regressions for each nation and calculating the coefficients as

unweighted means of the estimated coefficients. There are no restrictions as a result of this. In the long and short run, it allows all coefficients to change and be heterogeneous. Finally, the dynamic fixed effects (DFE) estimator is similar to the PMG estimator in that it constrains the slope coefficient and error variances to be identical across all nations in the long run. The speed of adjustment coefficient and the short-run coefficient are also restricted in the DFE model to be equal. However, the model features country-specific intercepts. The panel ARDL form of Pesaran and Smith (1999) is presented as:

$$\begin{aligned} \Delta POVR_{it} = & A + \varphi_1 POVR_{it-1} + \omega_i \sum_{i=1}^n \Delta REM_{it-1} + \sigma_i \sum_{i=0}^n \Delta FD_{it-1} + \\ & \theta_i \sum_{i=0}^n \Delta GOVE_{it-1} + \pi_i \sum_{i=0}^n \Delta OPEN_{it-1} + \tau_i \sum_{i=0}^n \Delta REM * FD_{it-1} + \\ & \beta_1 POVR_{it-1} + \beta_2 REM_{it-1} + \beta_3 FD_{it-1} + \beta_4 GOVE_{it-1} + \beta_5 OPEN_{it-1} + \\ & \beta_6 REM * FD_{it-1} + \eta_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

where POVR is poverty reduction, REM is the remittances, FD stands for financial development, GOVE represents government expenditure, OPEN signifies trade openness and REM\*FD is the interaction of remittances and FD.  $\varphi$  is the coefficient of the lagged dependent variable,  $\varphi_1$ ,  $\omega_i$ ,  $\sigma_i$ ,  $\theta_i$ ,  $\pi_i$ , and  $\tau_i$  are the short-run coefficients,  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$ ,  $\beta_4$ ,  $\beta_5$  and  $\beta_6$  are the long-run coefficients.  $\eta_i$  and  $\varepsilon_{it}$  are the unobserved country-specific effect and error term respectively. Hypothesis2 is tested by estimating the coefficient  $\tau_i$  for the short run and  $\beta_6$  in the long run. If  $\tau_i$  or  $\beta_6 > 0$ , the results would mean that FD and remittances are complementary. If  $\tau_i$  or  $\beta_6 < 0$ , it would mean that FD and remittances are substitutes. If  $\tau_i$  or  $\beta_6 = 0$ , it would mean that the impact of remittances on poverty reduction is independent of FD.

Three different estimators can be used to estimate Equation (1). The first estimator is the mean MG model which was developed by Pesaran and Smith (1995). The second estimator is the PMG estimator which was proposed by Pesaran et al. (1999). The third estimator is the DFE. However, we will make use of PMG and DFE estimators in this study. Hausman, on the other hand, will be used to choose the best results. The Hausman test is commonly used to investigate if the differences between these estimators are significant. The null hypothesis is that there is no significant difference between PMG and DFE estimations. The PMG estimator is preferred if the null hypothesis is not rejected since it is efficient. We exclude the MG because of its necessary condition for consistency and validity which requires a sufficiently large time-series dimension of the data. According to

Samargandi et al. (2019), the cross-country dimension should also be large (at least 20–30) countries, a condition our low-income and middle-income countries cannot satisfy. Also, as stated by Favara (2003), for small  $N$ , the MG estimator is sensitive to outliers and small model permutations.

In the ARDL model, it is expected that the lag structure of the ARDL needs to be determined by some consistent information criterion. Therefore, in this study, we select the lag structure using the Schwartz Bayesian criterion. For the full sample, middle-income countries and low-income countries, we imposed lag structure (1, 1, 1, 1, 1, 1), (1, 1, 0, 1, 0, 1), and (1, 1, 1, 0, 1, 1) respectively for poverty reduction, FD, remittances, government expenditure, trade openness and the interaction term. Finally, aside from analyzing the full sample, we consider middle-income countries and low-income countries to investigate if income levels influence the relationship between remittances, FD, and poverty reduction. All 48 countries in Sub-Saharan Africa were divided into four groups by the World Bank. Low-income countries are in the first group, lower-middle-income countries are in the second group, upper-middle-income countries are in the third group, and high-income countries are in the fourth group. According to the classification, the region's low-income group includes 27 countries. We have 14 countries in the lower-middle-income group, and 6 countries in the upper-middle-income group. The high-income group is made up of just 1 country. The lower-middle-income and upper-middle-income groups are combined to form middle-income countries. We exclude upper-income countries because only one country belongs to this income group in sub-Saharan Africa.

## 4. Results and Discussion

### 4.1 Unit Root

It is necessary to perform the unit root test to determine the order of integration and avoid spurious results. We perform a unit root test by employing panel unit root tests such as Levin et al. (2002), Im et al. (2003), ADF-Fisher, and PP-Fisher Chi-square statistics. Levin et al. (2002)  $t$ -statistic assumes a homogeneous or common unit root process according to Maddala and Wu (1999) and Choi (2003). However, Im et al. (2003)  $W$ -statistic, ADF-Fisher, and PP-Fisher Chi-square statistics assume a heterogeneous or individual unit root process. From Table 1, where we present the results of the unit root test, it is obvious that some variables are stationary at a level while some are stationary at first difference. For instance, government expenditure is stationary at a level while other variables are stationary at first difference. The unit root results show that the panel ARDL model is

appropriate for this study as it is suitable for the combination of I(0) and I(1) variables.

**Table 1.** The Result of the Unit Root Test

	Method	At level		At first difference	
		Intercept	Trend	Intercept	Trend
POVL	Levin et al.	3.356	4.905	-22.989***	-16.528***
	Im et al.	6.886	-1.049	-21.524***	-16.778***
	ADF-Fisher	40.043	90.829	499.248***	612.063***
	PP-Fisher	45.839	71.095	71.514***	294.550***
POVH	Levin et al.	1.269	-0.998	-4.909***	-3.682***
	Im et al.	8.341	2.921	-9.887***	-8.704***
	ADF-Fisher	14.705	39.199	218.496***	195.664***
	PP-Fisher	33.149	51.508	657.594***	652.289***
FD	Levin et al.	0.274	-12.150***	-16.546***	-12.697***
	Im et al.	0.902	-5.013***	-14.196***	-11.460***
	ADF-Fisher	68.440	340.606***	295.362***	269.982***
	PP-Fisher	56.716	343.400***	482.383***	526.431***
REM	Levin et al.	-3.584***	3.9E+15	-11.049***	-9.498***
	Im et al.	-1.864**	-0.680	-14.415***	-12.638***
	ADF-Fisher	87.187***	74.621**	320.372***	266.864***
	PP-Fisher	114.171***	95.711***	594.107***	1563.17***
GOV	Levin et al.	-3.295***	-2.642***	-14.155***	-11.112***
	Im et al.	-3.588***	-3.018***	-16.759***	-13.371***
	ADF-Fisher	103.354***	94.189***	367.370***	274.570***
	PP-Fisher	111.459***	92.671***	648.639***	764.504***
OPEN	Levin et al.	1.171	2.955	-6.028***	-3.896***
	Im et al.	-0.121	1.689	-13.088***	-10.820***
	ADF-Fisher	60.797	58.561	302.907***	244.052***
	PP-Fisher	93.960***	101.666***	572.150***	1309.68***

**Source:** Research finding.

**Note:** \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% levels of significance.

#### 4.2 Cointegration Test

To investigate whether a long-run relationship exists or not among the variables, we perform a cointegration test using the panel cointegration test proposed by Pedroni (1999; 2004). Based on the evidence from the literature, Pedroni cointegration is the most popular panel cointegration test and consists of seven tests. The results of the cointegration test are presented in Table 2. From Table 2, four out of the seven tests rejected the null hypothesis of no cointegration while the remaining three tests accepted it. Since the number of tests that rejected the null hypothesis of no cointegration is greater than those that accepted it, we

concluded that there is cointegration among the variables. Also, the panel ADF and group ADF which are regarded as the most reliable statistics according to Pedroni (2004) and Asongu et al. (2016) are among the significant tests.

**Table 2.** Panel Cointegration Result

Test	Statistics	Prob.	Weighted Statistics	Prob.
<b>Within Dimension</b>				
<i>Panel-v</i>	-1.955	0.975	-4.162	1.000
<i>Panel-rho</i>	2.382	0.991	2.842	0.998
<i>Panel-pp</i>	-6.647***	0.000	-6.083	0.000
<i>Panel-Adf</i>	-4.547***	0.000	-4.044	0.000
<b>Between-Dimension</b>				
<i>Group-rho</i>	3.706	0.999		
<i>Group-pp</i>	-9.142***	0.000		
<i>Group-Adf</i>	-3.711***	0.000		

**Source:** Research finding.

**Note:** \*\*\* indicates 1% levels of significance.

### 4.3 The effect of remittances, FD, and their interaction on Poverty Reduction

Table 3 shows the results of the full sample, which included 31 countries in sub-Saharan Africa. The findings of the PMG and DFE estimators are presented in the Table. The Hausman test is also presented for selecting the most efficient and consistent estimator. In the long run, the PMG model shows that FD has a positive and significant effect on poverty reduction, while the DFE model shows the same result. This shows that, in the long run, FD helps to reduce poverty. This finding is similar to those found by Dhrifi (2020) and Dada and Akinlo (2021) in their research. In both the PMG and DFE models, remittances assist to alleviate poverty. The coefficient of remittances is significant at 1% and 5% in the PMG and DFE models respectively. Studies like Vargas-Silva et al. (2009), Imai et al. (2014), Azam et al. (2016) and Inoue and Hamori (2016) found that remittances contribute to poverty reduction. This implies that our long-run full sample result supports hypothesis 1, that remittances promote poverty reduction. In the PMG model, the coefficient of the interaction term is significantly negative, but in the DFE model, it is insignificant. Based on this finding, it shows that as the interaction of FD and remittances is increasing, poverty reduction is reducing. This shows that FD and remittances act as substitutes in poverty reduction. This long-run result rejects Hypothesis 2, that FD negatively moderates the effect of remittances on poverty

reduction in sub-Saharan Africa. Government expenditure significantly enhances poverty reduction in the PMG model while its effect is not significant in the DFE model. This finding supports Mehmood and Sadiq (2010) who found that government expenditure reduces poverty. Likewise, trade openness is central to poverty reduction as indicated in the PMG model. The sign of the coefficient of trade openness is positive and significant at 1%. This indicates that as trade openness is increasing, poverty reduction is also increasing. This finding is consistent with Acheampong et al. (2021) who found that trade openness reduces poverty in sub-Saharan Africa. As we said earlier, we will test the efficiency of the PMG estimator over the DFE estimator through the Hausman test. The probability of the Hausman test is insignificant indicating that the null hypothesis of the homogeneity restriction on the regressors, in the long-run, is accepted. As a result, the PMG estimator appears to be more efficient than the DFE estimator.

In the short-run, the coefficient of FD is insignificant in the PMG model but negative and significant at 5% in the DFE model. This shows that FD fails to contribute to poverty reduction in short-run. Remittances produce no effect on poverty reduction in the short-run as its coefficient is not significant in both PMG and DFE models. Unlike in the long-run, government expenditure does not contribute to poverty reduction as its coefficient is negative and significant in the DFE model and insignificant in the PMG model. The coefficient of trade openness is not significant in the PMG and DFE models, meaning that it has no effect on poverty reduction in the short-run. The interaction terms also produce no effect on poverty reduction as its coefficient is not significant in both PMG and DFE models. This shows that our short-run result of interaction term supports Hypothesis 4, that the effect of remittance on poverty reduction is independent of FD in sub-Saharan Africa.

**Table 3.** The Full Sample Results

Variable	Pooled Mean Group (PMG)		Dynamic fixed effects (DFE)	
	Coef	Std. Error	Coef	Std. Error
<b>Long-run coefficient</b>				
FD	0.078**	0.354	1.029***	0.167
Remittances	38.486***	10.231	1.871**	0.635
Government expenditure	6.302***	1.727	-0.394	0.255
Trade Openness	1.169***	0.346	-0.063	0.042
FD. Remittances	-1.045***	0.287	-0.034	0.027
<b>Short-run Coefficient</b>				
$\Delta$ FD	0.008	0.002	-0.223**	0.036
$\Delta$ Remittances	0.058	0.175	0.032	0.080
$\Delta$ Government expenditure	0.006	0.010	-0.087**	0.028
$\Delta$ Trade Openness	-0.001	0.003	-0.004	0.005
$\Delta$ FD. Remittances	-0.544	0.401	-0.003	0.003
ECM(-1)	-0.0001	0.002	-0.087***	0.013
Constant	0.463	0.526	4.158***	0.761
Country	31		31	
Observation	774		774	
Hausman test			2.46	
<i>p</i> -value			0.782	

**Source:** Research finding.

**Note:** \*\* and \*\*\* imply significance at 5% and 1%, respectively. The long-run results are presented in the first panel, while the short-run results and adjustment speed (ECM(-1)) are presented in the second panel. The Hausman test shows that the PMG estimate is more consistent and efficient than the DFE estimation. The lag structure is ARDL (1, 1, 1, 1, 1, 1) and the order of variables is Poverty reduction, FD, remittances, government expenditure, trade openness, and the interaction term. The full sample, annual data 1990–2020.

To determine if the level of income plays a role in the relationship between remittances, FD, and poverty reduction, the models are re-estimated for middle-income countries and low-income countries according to classification by the World Bank. The results for the middle-income countries are presented in Table 4. In the long run, both the PMG and DFE indicate that FD enhances poverty reduction. Likewise, from the PMG and DFE results, remittances contribute to poverty reduction. This indicates that Hypothesis 1 is supported in middle-income countries, that remittances contribute to poverty reduction in the long run. The interaction term has a negative sign in the PMG model while it has a positive sign in the DFE model. However, since the Hausman test indicates that the PMG estimator is more efficient compared to DFE, our conclusion will be based on the

PMG model. This implies that Hypothesis 2, that FD moderates the effect of remittances on poverty reduction is rejected in middle-income countries in the long run. The negative coefficient of government expenditure in both PMG and DFE models shows that as government expenditure increases, poverty rates in middle-income countries. Acheampong et al. (2021) found a similar result in sub-Saharan Africa. This might be due to insufficient capital to provide the infrastructures like good roads, electricity, health care facilities, and water supply which can reduce poverty. Most of the sub-Saharan African countries depend on foreign aid, grants, and assistance to meet their capital expenditure which can significantly increase employment levels and output thereby reducing poverty. It can also be due to the pattern of spending of government. If government spending tends towards recurrent expenditure without paying attention to the high percentage of unemployed people by supporting them through social welfare packages, the effect of the government expenditure on poverty reduction might not be felt.

On the short-run results, FD has no effect on poverty reduction from both PMG and DFE estimations in middle-income countries. The coefficient of the remittances is negative and significant at 1% in the PMG model while in the DFE model, it is insignificant. Hypothesis 1 that remittances have a positive effect on poverty is rejected in middle-income in the short-run is rejected. The interaction term (REM\*FD) does not affect poverty reduction in the PMG model. However, in the DFE model, the interaction of remittances and FD reduces poverty reduction. The coefficient of government expenditure is insignificant in PMG and DFE models. This indicates that government expenditure does not affect poverty reduction in middle-income countries. From the PMG model, the coefficient of trade openness is insignificant but it is negative and significant in the DFE model.

**Table 4.** Results of Middle-Income Countries

Variable	Pooled Mean Group (PMG)		Dynamic fixed effects (DFE)	
	Coef	Std. Error	Coef	Std. Error
<b>Long-run results</b>				
FD	0.371***	0.021	0.119***	0.022
Remittances	0.875***	0.051	0.229**	0.112
Government expenditure	-0.045***	0.021	-0.259***	0.062
Trade Openness	0.009*	0.004	0.010	0.012
FD.Remittances	-0.017***	0.022	0.015***	0.005
<b>Short-run Results</b>				
$\Delta$ FD	-0.002	0.002	0.001	0.001
$\Delta$ Remittances	-0.035***	0.012	-0.005	0.005
$\Delta$ Government expenditure	0.006	0.005	0.003	0.003

$\Delta$ Trade Openness	0.002	0.001	-0.001**	0.001
$\Delta$ FD.Remittances	-0.003	0.002	-0.003*	0.0001
ECM(-1)	-0.027***	0.004	-0.032***	0.001
Constant	1.281***	0.232	1.775***	0.095
Country	14		14	
Observation	353		353	
Hausman test			0.12	
<i>p</i> -value			0.999	

**Source:** Research finding.

**Note:** \*, \*\*, and \*\*\* imply significance at 10%, 5%, and 1%, respectively. The long-run results are presented in the first panel, while the short-run results and adjustment speed (ECM(-1)) are presented in the second panel. The Hausman test shows that the PMG estimate is more consistent and efficient than the DFE estimation. The lag structure is ARDL (1, 1, 0, 1, 0, 1) and the order of variables is Poverty reduction, FD, remittances, government expenditure, trade openness, and the interaction term. The middle-income countries, annual data 1990–2020.

In both the PMG and DFE models, the results for low-income countries in Table 5 show that FD has a positive and significant effect on poverty reduction. This means that, in the long run, financial progress helps to reduce poverty. Remittances also help to alleviate poverty, as its coefficient is positive and significant in both the PMG and DFE models. Hypothesis 1 appears to be supported in low-income nations in the long run, based on this study. This suggests that individual FD and remittances are critical for poverty reduction. In PMG and DFE models, the coefficient of the interaction term is significant and negative. This indicates that the interaction between remittances and FD does not lead to long-term poverty reduction. This implies our hypothesis 2, that FD moderates the effect of remittances on poverty reduction is rejected. Like in middle-income countries, government expenditure fails to reduce poverty reduction. Trade openness has a positive sign and is significant, meaning that it reduces poverty. Other research, such as those by Christiaensen et al. (2003), Sakr (2012), and Kis-Katos and Sparrow (2015), have found that trade openness reduces poverty in the long run. The Hausman test, like the other results in the previous tables, shows that the PMG estimator is more efficient than DFE. In both PMG and DFE estimations, none of the variables is significant in the short run.

Table 5. Results of Low-income Countries

Variable	Pooled Mean Group (PMG)		Dynamic fixed effects (DFE)	
	Coef	Std. Error	Coef	Std. Error
<b>Long-run Results</b>				
FD	0.622***	0.044	0.438***	0.083
Remittances	0.986***	0.209	1.486***	0.281
Government expenditure	-0.076**	0.035	-0.391***	0.098
Trade Openness	0.050***	0.011	0.129***	0.024
FD. Remittances	-0.024***	0.008	-0.038***	0.013
<b>Short-run Results</b>				
$\Delta$ FD	-0.001	0.009	0.008	0.005
$\Delta$ Remittances	0.005	0.043	0.008	0.013
$\Delta$ Government expenditure	-0.002	0.007	0.002	0.004
$\Delta$ Trade Openness	-0.001	0.001	0.002	0.001
$\Delta$ FD. Remittances	-0.054	0.063	-0.001	0.001
ECM(-1)	-0.010*	0.006	-0.031***	0.002
Constant	0.494*	0.271	1.479***	0.086
Country	17		17	
Observation	409		409	
Hausman test			0.14	
<i>p</i> -value			0.999	

**Source:** Research finding.

**Note:** \*, \*\*, and \*\*\* imply significance at 10%, 5%, and 1%, respectively. The long-run results are presented in the first panel, while the short-run results and adjustment speed ECM(-1) are presented in the second panel. The Hausman test shows that the PMG estimate is more consistent and efficient than the DFE estimation. The lag structure is ARDL (1, 1, 1, 0, 1, 1) and the order of variables is Poverty reduction, FD, remittances, government expenditure, trade openness, and the interaction term. The low-income countries, annual data 1990–2020.

The study found that in the long run, FD contributes to poverty reduction in the full sample and among the income groups. This is possible because FD makes it possible for lower-income households to obtain loans and set up smaller businesses that boost their income (Appiah-Otoo and Song, 2021; Jalilian and Kirkpatrick, 2002; Naceur and Zhang, 2016). This finding suggests that the financial sector is a major tool for poverty reduction in the long run. According to Zahonogo (2017), FD can help the poor in the diversification of their sources of income through self-employment, hence reducing poverty. Because the financial sector makes financial resources available to the poor, they can alleviate financial constraints and engage in productive activities. According to Stiglitz (1998) and Jalilian and Kirkpatrick (2002), FD can contribute to poverty reduction directly by providing the opportunity for the poor to have access to finance and achieve

sustainable development. Indirectly, FD can stimulate poverty reduction through economic growth, and the benefits from the growth are channeled to the poor (De Gregorio, 1996). The inability of FD to enhance poverty reduction in the short run might be due to the small size and underdevelopment of the financial sector in the region, which does not make the sector effective enough to reduce poverty in the short run.

Remittances are a determinant of poverty reduction based on the results of the full sample and income groups in the long run. This finding supports previous studies like Musakwa and Odhiambo (2019), Anyanwu and Erhijakpor (2010), and Gupta et al. (2009), which showed that remittances contribute to poverty reduction in SSA. Remittances serve as an additional source of income for those families who receive them. In addition to providing resources for the poor, it improves living standards through a variety of indirect multiplier effects as well as macroeconomic implications. The short-run effects of remittances are mixed. Remittances have an insignificant effect on poverty reduction in the full sample and low-income countries but have a significant negative effect in middle-income nations.

The interaction of FD and remittances fails to reduce poverty in the full sample and among the income groups in the long run. This finding is consistent with Inoue (2018) who also found a similar result. However, it contradicts Majeed (2014) who found that FD enhances the effect of remittances on poverty reduction. This suggests that FD and remittances are substitutes for reducing poverty rates. In other words, it implies that FD and remittances fail to complement each other to reduce poverty and the expansion of FD will reduce the impact of remittances on poverty reduction and vice versa. This shows that our finding does not support hypothesis 2 that FD enhances the impact of remittances on poverty reduction. On the magnitude of the coefficients of FD and remittances, there is evidence that the effect of remittances on poverty reduction is greater than FD. This finding reveals that a disconnection exists between the inflow of remittances and the financial markets in sub-Saharan Africa indicating that the level of FD and remittances inflow through the informal financial markets is low. It could also indicate that the number of remittance recipients in sub-Saharan Africa who have access to financial services is still minimal in comparison to the bulk of remittances flowing. The uneven distribution of financial institutions in the economy might limit access to financial institutions for some people, notably those living in villages.

In the long run, government expenditure does not enhance poverty reduction in the middle and low-income groups while in the short run, it does not affect poverty reduction. This finding contradicts studies like Kwon and Kim (2014) and Mosley et al. (2004) who found that government expenditure reduces poverty. However, this finding is in line with Anderson et al. (2018) and Acheampong et al. (2021). This might be due to insufficient capital on the part of the government to implement policies and provide infrastructures such as electricity, health facilities, potable water supply, and good roads which can easily link villages to towns for easy transportation of farm products. Most of the governments in sub-Saharan Africa depend on foreign aid and loans to execute capital projects which can have a major effect on poverty reduction. Acheampong et al. (2021) and Ibrahim and Alagidede (2018) stated that government spending in most SSA countries is associated with higher income inequality and poor economic growth which worsen poverty. However, the long-run result of the full sample indicates that government expenditure contributes to poverty reduction. Government expenditure can reduce poverty directly and indirectly according to Dahmardeh and Tabar (2013). Government expenditure can enhance poverty reduction directly through benefits like job creation, subsidies, and social welfare programs received by the poor from the government. Government expenditure can indirectly reduce poverty when government expenditure in infrastructures, agriculture, health, and education boost economic activities and output.

Trade openness contributes to poverty reduction in the long run, which implies that trade openness is very important for poverty reduction. According to Onakoya et al. (2019), trade openness can attract additional domestic and foreign investment which increases the rate of capital accumulation and thereby reduces poverty rates. Jhingan (2005) stated that one of the ways of tackling poverty is for countries to open their economies to international trade so that more capital can be injected. The failure of trade openness to contribute to poverty reduction in the short run may be ascribed to the incapacity of the region to take full advantage of trade liberalization by diversifying production and exports.

On whether the income level influences the effect of remittances, FD, and their interactions on poverty reduction, we found that income levels do not influence the effect of FD on poverty reduction both in the long-run and short-run irrespective of poverty indicators used. The income levels influence the effect of remittances on poverty reduction in the short run. This is because remittances failed to reduce poverty rates in the middle-income group but had no effect in the low-income group when poverty reduction is measured by life expectancy. The

levels of income do not influence the effect of the interaction term in the long-run and short-run.

#### **4.4 Robust Check**

We provide robust checks by using the Human Development Index to proxy poverty reduction. The result is presented in Table 6. However, we present the results of the PMG for the full sample, middle-income countries and low-income countries only. The result of the DFE is not presented for two reasons. First, the Hausman test indicates that PMG is better than DFE. Second, the variables in the DFE estimation are insignificant. However, the result of the DFE is available on demand.

Starting with the long-run results, FD reduces poverty in the full sample, middle-income group, and low-income group. This indicates that the effect of FD on poverty reduction remains the same even when we use the human development index to measure the poverty reduction indicator. Remittances help to alleviate poverty in the full sample, as well as in middle- and low-income nations. Like in previous Tables, remittances and FD are substituted in reducing poverty as the interaction of remittances and FD fails to stimulate poverty reduction in the full sample, middle-income group, and low-income countries. This indicates that our finding rejects hypothesis 2 that FD moderates the effect of remittances on poverty reduction. Government expenditure reduces poverty when the poverty reduction is proxied by the Human Development Index in the full sample and among the income groups. Trade openness enhances poverty reduction in the full sample and among the income groups. In the short run, the coefficient of FD is insignificant across the models, indicating no effect of financial development on poverty reduction. Remittances have no effect on poverty reduction in the full sample and middle-income group while its effect is significant and negative in the low-income group. The interaction term produces no effect on poverty reduction as its coefficient is insignificant in any of the models. The coefficient of government expenditure is insignificant in the full sample and middle-income group, but its effect is negative and significant in the low-income group.

The results in Table 6 also indicate that the levels of income play no role in the effect of financial development on poverty reduction in both the short and long run. The levels of income do not affect the effect of remittances on poverty reduction in the long run but it influences the relationship between remittances and poverty reduction in the short-run. Finally, the effect of the interaction term is not affected by levels of income in the short-run and long-run.

**Table 6.** Results of Panel ARDL (Dependent variable: Human Development Index)

Variable	Pooled Mean Group (PMG)		Pooled Mean Group (PMG)		Pooled Mean Group (PMG)	
	Full Sample		Middle-Income Countries		Low-Income Countries	
	Coef	Std. Error	Coef	Std. Error	Coef	Std. Error
<b>Long-run Results</b>						
FD	0.002**	0.001	0.007*	0.004	0.011***	0.001
Remittances	0.044***	0.014	0.299**	0.127	0.021***	0.004
Government expenditure	0.032***	0.005	0.038***	0.014	0.011***	0.002
Trade Openness	0.003***	0.001	0.006*	0.003	0.001***	0.004
FD. Remittances	-0.003***	0.001	-0.010**	0.005	-0.002***	0.002
<b>Short-run Results</b>						
$\Delta$ FD	0.001	0.002	0.001	0.002	0.002	0.003
$\Delta$ Remittances	-0.003	0.007	0.006	0.173	-0.003**	0.001
$\Delta$ Government expenditure	-0.002	0.003	0.001	0.004	-0.004*	0.002
$\Delta$ Trade Openness	9.070	0.001	-0.001	0.006	-9.050	0.001
$\Delta$ FD. Remittances	0.020	0.021	-0.001	0.001	-0.001	0.001
ECM(-1)	-0.007	0.009	-0.031	0.001	-0.037	0.036
Constant	0.004	0.003	0.001	0.009	0.011**	0.007
Country	31		14		17	
Observation	718		340		375	
Hausman test	0.00		0.00		0.28	
<i>p</i> -value	1.000		1.000		0.998	

**Source:** Research finding.

**Note:** \*, \*\*, and \*\*\* implies significance at 10%, 5%, and 1% respectively. The long-run results are presented in the first panel, while the short-run results and adjustment speed (ECM(-1)) are presented in the second panel. The Hausman test shows that PMG estimate is more consistent and efficient than DFE estimation.

The lag structure for full sample is ARDL (1, 1, 1, 0, 1, 1), middle-income countries (1,0,1,0,0,0) and low-income countries (1, 0, 0, 0, 0, 0) and the order of variables is Poverty reduction, FD, remittances, government expenditure, trade openness and the interaction term. The low-income countries, annual data 1990–2020.

## **5. Implications of Findings and Conclusion**

### **5.1 Implications of Findings**

In the long run, FD helps to reduce poverty in sub-Saharan Africa and among the income groups, according to this study. This finding implies that FD is crucial to poverty reduction in the region in the long-run. Therefore, there is a need to increase the deepening of the financial sector for better performance. Also, more effort and effective policies are required to transform the financial sector as the sector is still underdeveloped compared to other regions across the world. This will enable the sector to be more effective in channelling funds to the poor for investment and thereby reducing the level of poverty more. Policies that will allow financial institutions to make more funds available for the poor to finance small-scale businesses or increase the access of the poor to funds can as well further reduce the poverty level. The increase in the deepening of the financial sector could be a means through which FD will enhance poverty reduction in the short-run. The inability of FD to enhance poverty reduction in the short-run might be due to the lack of deepening and underdeveloped state of the financial sector in the region.

The study also found that remittances enhance poverty reduction in sub-Saharan Africa and among the income groups in the long-run. As a result, we can conclude that remittances provide a stable source of finance for sub-Saharan African countries by raising the earnings of families whose members relocate to other countries to work, hence reducing poverty. The government might need to introduce and implement policies that can facilitate the easy inflow of remittances for more poverty reduction. When people have more finance, they are more likely to save and invest, which can lead to an improvement in their level of living. The government can initiate a partnership between international banking services and remittance transfer operators to establish official channels for easy and lower costs of transferring remittances. A decrease in the cost of sending remittances could enhance households' disposable income, resulting in additional poverty reduction. Additionally, there is a need to establish entrepreneur and career development centers whereby non-migrant families can be trained in business skills. This will likely stimulate non-migrant families to use their remittances for the establishment of small businesses that will further lower poverty.

In addition, the study found that the coefficient of the interaction term is negative. This indicates that remittances and FD fail to complement each other in the poverty reduction process indicating that the effect of remittances on poverty reduction may be weak as the financial sector is expanding, and vice-versa. However, based on the fact that FD and remittances enhance poverty reduction

individually, this finding has an important policy implication in the sub-Saharan African region. First, since the sub-Saharan African region is one of the largest recipients of remittances but with a low level of FD, there might be a need for the region to promote the inflow of remittances through the formal channel by easing and reducing the cost of the transaction of remittances to alleviate poverty. Second, if the region's financial sector is well-developed but remittance inflow is low, there may be a need to boost financial depth by increasing access to and use of formal financial services.

Similarly, our result suggests that trade openness is important for alleviating poverty in SSA since it can enhance capital inflow and foreign investment. Therefore, policymakers in SSA must promote sound trade policies that will attract more funds and foreign investment that will increase employment opportunities and hence reduce poverty.

Though our findings show that the effect of government expenditure on poverty reduction depends on the proxy of poverty used, this study recommends that government expenditure should be pro-poor in the region. That is government expenditure should aim at reducing poverty in SSA. For instance, government spending on transfers and subsidies needs to be carefully planned to reach the intended population.

## **5.2 Conclusion**

In this study, we examined the moderating role of FD in the relationship between remittances and poverty reduction in sub-Saharan Africa during the period 1990-2020. We estimate models in which the poverty reduction is explained by FD, remittances, and their interaction term in the full sample consisting of 31 countries, the middle-income group consisting of 14 countries and the low-income group consisting of 17 countries. Levin et al. (2002), Im et al. (2003), ADF-Fisher, and PP-Fisher Chi-square statistics unit root tests are employed to check the order of integration of the variables while panel cointegration test proposed by Pedroni (1999, 2004) are used to confirm the existence of long-run relationship. The results of unit root tests revealed that none of the variables is I(2) while the cointegration test confirms the existence of long-run relationship. The relationship among the variables is considered among the income groups to see if the level of income is influencing their relationship. To achieve the objectives of this study, we employ the advanced econometric technique to assess the individual impact of FD, remittances and their interactions on poverty reduction. The error correction-based

autoregressive distributed lag ARDL(p,q) model was used, which includes three separate tests: MG, PMG, and DFE estimators.

Our findings show that FD significantly contributes to poverty reduction in the long-run in the full sample and among the income groups whereas in the short-run FD fails to reduce poverty. Furthermore, our findings show that remittances enhance poverty reduction in the long-run in sub-Saharan Africa and among the income groups but in short-run remittances could not stimulate poverty reduction. The interaction of FD and remittances does not contribute to poverty reduction both in the long-run and short-run suggesting that FD and remittances are playing a complementary role in reducing poverty.

## Appendix

**Table A1.** Definition of Variables, Data Sources and Piori Expectations

Variables	Symbols	Descriptions	Expected Signs	Source
Life Expectancy	POVL	Life expectancy at birth, total (years)		WDI
Human Development Index	POVH	A composite indicator that measures average accomplishment in terms of life expectancy, education, and living standards.		UNDP
Financial Development (FD)	FD	The totality of credit made available to the private sector by banks and other financial institutions	Positive	WDI
Remittances	REM	Personal remittances received (% of GDP)	Positive	WDI
Government Expenditure	GOVE	General government final consumption expenditure (% of GDP)	Positive	WDI
Trade openness	OPEN	Trade openness (the ratio of exports plus imports to GDP)	Positive	WDI

**Source:** Research finding.

**Note:** UNDP is the United Nations Development Program. WDI is the World Development Indicator.

**Table A2.** Summary Statistics of the Variables

Variable	Obs	Mean	Sta.Dev	Min	Max
<b>POVL</b>	930	55.643	7.750	26.17	74.51
<b>POVH</b>	862	0.471	0.121	0.19	0.8
<b>FD</b>	942	18.675	23.890	0.40	160.12
<b>REM</b>	901	4.089	13.134	0.01	167.43
<b>GOV</b>	931	14.356	6.210	0.91	43.48
<b>OPEN</b>	961	65.080	35.773	9.96	225.02

**Source:** Research finding.

**Table A3.** The List of Countries

Full Sample		Middle-income countries	Low-income countries	
Benin	Madagascar	Botswana	Benin	Zimbabwe
Botswana	Mali	Gabon	Burkina Faso	
Burkina Faso	Mauritius	Mauritius	Central afr rep	
Cameroon	Mozambique	South Africa	Chad	
Central afr rep	Niger	Cameroon	Gambia	
Chad	Nigeria	Congo Rep	Guinea	
Congo Rep	Rwanda	Coite d voire	Guinea Bissau	
Coite d voire	Senegal	Estiwani	Madagascar	
Estiwani	Seychelles	Ghana	Mali	
Gabon	Sierra Lone	Kenya	Mozambique	
Gambia	South Africa	Lesotho	Niger	
Ghana	Sudan	Mauritania	Rwanda	
Guinea	Tanzania	Nigeria	Senegal	
Guinea Bissau	Togo	Sudan	Sierra Lone	
Kenya	Zimbabwe		Tanzania	
Lesotho			Togo	

**Source:** Research finding.

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## The Analysis of the Economic Effects of Investment in the Tourism Industry of Razavi Khorasan Province: An Application of the Two-Region Input-Output Model

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### Abstract

This research investigated the direct and indirect effects of an investment in tourism sub-sectors in Razavi Khorasan Province on the value added of other economic sectors of Razavi Khorasan Province and other provinces by the input-output approach. Therefore, the FLQ-RAS method was developed to prepare the two-region input-output table of Razavi Khorasan Province and other national economies based on the input-output table of 2016. We used a non-statistical method to prepare the input-output coefficients and the two-region model. The results indicate that the simultaneous increase of 700 billion riyals in tourism-related sectors in the Razavi Khorasan province directly affects wholesale and retail activities, other ground transportation, and governmental human health activities. Also, in terms of increasing investment in every tourism activity, government human health creates the most significant overall effect compared to other activities, wholesale and retail activities, as well as administrative activities, and support services, have the second and third ranks of influence from the increase in investment. Also, the actions of government human health, Accommodation and Wholesale, and retail, except motor vehicles and motorcycles have experienced the most direct effects from investment.

**Keywords:** Investment in Tourism, Razavi Khorasan Province, Tourism Sector, Two-Region Input-Output Model, Value-Added.

**JEL Classification:** O11, P45, Z32.

### 1. Introduction

Tourism plays an essential role in the economic growth of many countries, and its development leads to the progress and prosperity of the national economy. This industry has taken a share of the world's economic activities, including exports, generating income, creating jobs, and exchanging cultures. The tourism sector has a high potential to stimulate other economic sectors through backward and forward

linkages. Tourism goods and services spending leads to a chain of transactions that increases the need to supply goods and services from other sectors. Tourism Consumption demand also creates more employment and affects the economy (Prasad and Kulshrestha, 2015).

Tourism is a means to transfer income resources from countries or regions of origin to the country or region of destination receptive to tourism. One of the essential economic characteristics of tourism is the consumption of income from tourism areas in the same places. Tourism causes direct revenue and indirect money cycle but also causes the growth of handicrafts and other industrial products. Tourism can become the most crucial source of income in the case of proper and comprehensive planning along with foresight for the areas with tourist attractions.

In this regard, Iran is considered one of the top ten tourist countries in the world in terms of the richness of historical and natural monuments, which can be used for sustainability in the country's oil-dependent economy. However, only 0.06% of the world's tourism income is allocated to this country (Bahmani and Namamian, 2018), which requires proper planning, especially in the field of investment in the development of infrastructure and practical factors in attracting tourism. Also, Razavi Khorasan province is one of the most important provinces in the country in attracting tourists, especially domestic tourists, which has impacted the growth of production and employment. This province is one of the tourism hubs in Iran with significant cultural, religious, natural, handicrafts, Etc. Features. The existence of the holy shrine of Imam Reza (a.s.) in this province has made it one of the essential religious bases of the Shiite world and the first pilgrimage center in Iran, which has tourism capabilities with valuable religious-cultural functions at the national and international level (Bazzazan et al., 2019). This province has a great capacity in the tourism sector, with 1859 registered national monuments, 246 hotels, and 4277 beds (total) for ecotourism and traditional accommodation (Razavi Khorasan Provincial Cultural Heritage Statistical Yearbook, 2019).

According to the Iranian Statistics Center report, the gross domestic product of this province in 2019 was 2489 thousand billion rials, which accounted for 5% of the country's gross domestic product. The investigation of the value added of different economic sectors of the province during the years 2011 to 2018 indicates that the service activity related to the provision of food and accommodation, with an average growth of 18.83, ranks fifth in the increase of value added in the

investigated years in Razavi Khorasan province. So, investing in this industry can create significant direct and indirect effects in the province.

The cross-sectoral analysis is one of the best options for evaluating the contribution of tourism to the development of each economic sector from the point of view of macroeconomics. In recent years, many researchers have studied the importance of tourism on local economies (Daye et al., 2020; Nguyen, 2021; Mamirlulova et al., 2020; Wang et al., 2020). One of the unique approaches is the top-down approach, which includes the input-output (I-O) model and the computable general equilibrium (CGE) model in different areas (Saayman and Rossouw, 2010; Metilainen et al., 2016; Tohmo 2018; Lin et al., 2020). In general, the input-output tables published by the statistics center have made calculations more manageable. Studies in the field of tourism using the input-output approach in Iran are less widespread, but they have a long history. One of the reasons for its lack of expansion is the need for satellite statistics related to tourism. In using the general balance and input-output methods, access to one of the satellite statistics related to the expenditures of foreign tourists by economic sectors is necessary. However, researchers are forced to use other unofficial sources and individual studies or integrate all tourism-related sectors due to the need for more preparation of satellite accounts of tourism in Iran by statistical institutions (Bazzazan et al., 2020). Therefore, in this research, the direct and indirect effects of an investment in tourism sub-sectors in Razavi Khorasan Province on the value added of other economic sectors of Razavi Khorasan Province and other national economies using input-output. For this purpose, first, the FLQ-RAS method was developed to prepare the two-region input-output table of Razavi Khorasan Province and other national economies based on the input-output table of 2016.

## **2. Literature Review**

Investing in the tourism industry means creating capital or products that can be produced or other goods or services in the tourism industry to obtain more profit in the private sector or regional revitalization and economic growth for public purposes (Zaree Mirkabad, 2016). Areas of investment in tourism sectors such as hotels, health, and treatment centers (health tourism), commercial tourism, adventure tours, sports tourism, museums, and parks, training of employees working in the tourism sector, and renovation of airports and roads. The expansion of the tourism sector requires significant investment in its various sub-sectors to achieve the goals of attracting tourists to the countries. In general, investing in the

tourism industry increases the security and development of countries' political relations, and it will have positive effects from the cultural, social, and environmental aspects. It is one of the fast-yielding industries that is considered one of the critical economic resources (Momoni & Homayounifar, 2014).

It is necessary to pay attention to some features of this industry to invest in the tourism industry:

1. Non-economic factors strongly influence the demand side in this industry.
2. Produced goods and services are primarily non-storable.
3. Industrial tourism is seasonal.
4. Umbrella nature of the tourism industry: There needs to be more provision of tourism goods and services to create more demand for other goods and services of this industry.
5. The strong impact of the transportation system on the tourism industry
6. Long-term return on investment
7. An Increasing number of large multinational companies (Moallem, 2018).

Tourism infrastructure is one of the most critical sectors in tourism that requires investment. Building and creating a hotel, restaurant, camping, etc., are among these things that require much investment and therefore require the use of different methods and tools in the field of attracting domestic and foreign capital. Tourism is a suitable platform for investment due to the characteristic of early returns. Unlike other investments, such investments remain in countries because hotels cannot move like consumer goods. The factors that cause the growth and development of tourism include improving income and wealth, traffic, entertainment spaces, globalization, immigration, special events, education, information, communication technology, marketing, and other infrastructure in general—and tourism infrastructure in particular (Matias et al., 2007). In recent years, the economic potential of the tourism industry has increased as one of the fastest-growing industries in many developing countries and other regions. However, the truth is that tourists travel to a country where tourism services and related infrastructure are available. Therefore, improving tourism services helps to attract more tourists.

Therefore, improving tourism infrastructure to increase the destination's attractiveness is the main factor in attracting tourists. In addition, recent studies have shown that tourism infrastructure, directly and indirectly, has a positive effect on the quality of life of residents through the development of sustainable tourism (Mamirkulova et al., 2020). Wang et al. (2020) believe that developing

infrastructure in developing countries has promoted cultural tourism activities and international sports events, which will attract the flow of tourists and increase economic benefits. Prioritizing the development of infrastructure to realize the vision of the tourism business has an impact on improving the experiences of tourists, improving the living standards of residents, increasing job opportunities, and protecting cultural and historical values and natural landscapes (Bi et al., 2020; Kanwal et al., 2020 and Shafiee et al., 2019). Daye et al. (2020) have also identified various benefits of improving tourism infrastructure. The results of this study have shown that tourism workers, the public sector, and other commercial organizations claim that tourism infrastructure improvement projects have beneficial effects on communities. According to Oh (2005), the first reason for developing the tourism industry in most countries is the exploitation of its economic benefits. The tourism industry can significantly impact increasing employment, income related to accommodation and hotels, expansion of various services, and development of infrastructure, which can even ultimately lead to an increase in foreign investment.

### **3. Input-output Model of Tourism**

The tourism input model is a cognitive method for estimating the share of the tourism sector and specific products in the tourism market. Standard data collection techniques are used widely to analyze tourism's contribution to a particular economy, and ad hoc multipliers are abandoned. At the local scale, many data-generating studies have been conducted to analyze the economic effects of tourism in areas such as islands and cities, including the studies of Chang et al. (2016) in South Korea and Ribeiro et al. (2017). In the north of Brazil, Faturay et al. (2017) in 8 regions of Indonesia, Artal-Tur et al. (2019) in the region of Mauritius, Spain, Kronenberg et al. (2018) in Sweden, and Yang et al. (2018) in Chinese provinces. The input-output model is still widely used in academic and non-academic circles due to its relative simplicity in calculating and visible results for tourism management issues.

These facts explain why the resulting input-output analysis, as expressed in the related literature published in recent years, is still a modern approach to studying the economic effects of tourism (Artal Tur et al., 2020). Of course, new studies and perspectives have combined and modified several aspects of the original input-output model to solve some problems related to the original model. Cai et al. (2006) developed a method to calculate tourism's posterior and anterior links and proposed to supplement and analyze tourism's impact with links analysis.

In fact, by using the previous and previous links of different economic sectors along with the input-output tables, various angles of the tourism sector and the effects of other economic sectors and their impact on the tourism sector are investigated. For example, the building sector is one of the sectors that impact hotel management as a previous sector.

Fletcher (1989) recommends input-output analysis to analyze tourism artifacts. In calculating the economic effects of tourism, he claims that the input-derived approach is handy for calculating the economic effects of tourism. He has shown that compared to the cost-benefit analysis, the input-output model is a general equilibrium approach that focuses attention on the interdependencies of the sector based on the input-output table. The structural nature of the input-output table allows researchers to calculate the direct, indirect, and induced economic effects of tourism and provide policymakers with a comprehensive view of the tourism economy. After that, Archer (1995) measured the relative share of tourism in exports, income, employment, and public sector income in Bermuda based on the input-output table of 1985, 1987, and 1995 and showed that compared to other export sectors; tourism has played a significant role in Bermuda's economy. Regarding integrating tourism expenditures in the input-output framework, these tables provide a suitable division nationally and regionally to facilitate tourism studies. Of course, less attention is paid to modeled import leakages in the existing literature. For example, Oosterhaven and Fan (2006) set the consumption coefficients, but they need to mention the tourism demand vector and coefficient matrix. Archer and Fletcher (1996) showed that a large amount of additional input related to imports is needed to obtain an accurate disaggregation of consumption between domestic and imported components.

So far, many studies have tried on the effects of an investment in tourism and economic growth and development, as well as input-output models in tourism. The table below presents a summary of the most important and latest studies in the field of research. The studies reviewed in this section are divided into several categories. In some of these studies, investment opportunities in tourism have been identified in different regions. Some others studied the relationship between investment and tourism.

In some cases, this relationship has been two-way, and in other cases, there has been a one-way relationship from tourism to investment or vice versa. The results of studies related to the effects of an investment in tourism and economic development show that in most of the studies, investment in tourism has had

positive effects on the economic growth and development of countries, creating employment and income in countries. Significantly, investment in tourism infrastructure has had many positive effects on the economy of destination countries and their residents.

Also, some studies have used multi-regional methods to investigate the effects of factors such as tourism expenditures and the growth of the tourism sector on employment and production in some provinces along with other regions.

Despite that, the effect of change in marginal demand and changes on employment in the tourism sector has been examined in previous studies, but we have tried to examine the effects of change in tourism as part of marginal demand. Indeed, all the sectors that are directly and indirectly related to tourism are considered as tourism sectors by the application of coefficients related to the contribution of the sector in tourism, while, the only sectors directly related to tourism have been investigated in previous studies.

Also, most of the internal studies that have been done specifically on tourism examined from the perspective of national tourism, and the tourism capacities of the regions are not taken into consideration. There needs to be more focus on the effects of an investment in this industry on other economic sectors.

**Table1.** Summary of Literature Review

Researchers	Year	Research Title	Country (Region)	Research Method	Results
Lee and Hlee	2021	The Intra-and Inter-Regional Economic Effects of Smart Tourism in Seoul	Seoul	I-o	Inside the city, it creates high-income effects, added value, and a lot of employment and helps to provide tax revenues. Outside the city, it is expected that the smart tourism city will create high production effects.
Anter and Almaghraby	2021	Tourism Value Chain in the Egyptian National Economy	Egypt	I-o	The reverse link of the tourism industry in the region with agriculture, wholesale and retail, mining, transportation and support, and other business support activities.
Artal-Tur et al.	2020	Measuring the economic contribution of tourism to	Spain	I-o	Important differences in the number of economic effects calculated between national and regional approaches

		destinations within an input-output framework			
Artal-Tur et al.	2019	Estimating the impact of cruise tourism through regional input-output tables	Spain	I-o	The general effects of increasing employment, wages, gross production and value-added
Ivandić and Šutalo	2019	An integrated TSA and IO model for the estimation of the overall contribution of tourism	Croatia	I-o	There is a very strong impact of tourism on other economic sectors
Kronenberg et al.	2018	A multi-period perspective on tourism's economic contribution—a regional input-output analysis for Sweden	Sweden	I-o	On the one hand, economic links have been strengthened, especially for the user sectors. On the other hand, sectorial recessions in 2012 and 2014 led to a reduction in indirect effects on the entire economy, although the consumption of tourists continued to increase.
Tohmo	2018	The economic impact of tourism in Central Finland	Finland	I-o	Tourism has a significant impact on production, which includes the direct and indirect effects of consumption by tourists in different sectors.
Ribeiro et al.	2017	Tourism and Regional Development in the Brazilian Northeast	Brazil	I-o	Tourism expenses in Northeast Brazil have caused a 3.9% increase in GDP. Furthermore, the sectorial analysis showed significant spillover effects in Certeza Brazil, especially for manufacturing industries. On the other hand, tourists' expenses have played a role in reducing regional inequalities.
Fauzel et al.	2016	Analyzing the Impact of Tourism Foreign Direct Investment on Economic Growth	Mauritius Island	VECM	Tourism FDI has helped boost economic growth

Banerjee et al.	2015	Reconciliation once and for all economic impact evaluation and social cost-benefit analysis	Haiti	Rcge-Ms	The investment has helped to reduce regional poverty and reduce the poor population by 1.6 percent and the positive effects of this investment will be 182 percent by 2040 in the hotel and restaurant sector and 2 percent in the regional gross product.
Ghorbani et al.	2021	Evaluating the effects of tourism on the development of the urban economy	Ardebil	Factor Analysis	The factors of economic prosperity, economic stability, and economic justice have had the greatest impact on tourism, respectively.
Bazazan et al.	2020	The economic effects of the arrival of domestic tourists in Razavi Khorasan Province	Razavi Khorasan	I-o	The sectors of industry, transportation, warehousing, wholesale, and retail have been most affected by tourism, respectively.
Bazazan and Azad dana	2018	The economic effects of the arrival of domestic tourists in Qom	Qom	I-o	The production of the province increased by 5.16% and the employment of the province increased by 8.08% with the arrival of domestic tourists to Qom province in 2013
Farahani	2017	Evaluating the impact of international tourism on Iran's economy	Iran	SEM	The increase in income from foreign tourism has led to an increase in the production of all economic sectors. The upper deciles of urban households have benefited more from the expansion of foreign tourism than the lower deciles of urban households.

**Source:** Research finding.

#### 4. Method

The essential purpose of preparing regional input-output tables is to analyze the dependence of regional economic sectors can be divided into two general forms. First is the dependence on the existing economic sectors in each region, and second, the dependence between the existing sectors in the region and the sectors

of other regions. The second dependence type includes intra-country and inter-country trade exchanges (Shadab Far, 2017).

In the upcoming study, to investigate the effect of investment in tourism in Razavi Khorasan Province on other economic sectors of Razavi Khorasan Province and other national economies, the input-output model of two regions has been used. The structure of the mentioned model is in the format of the Razavi Khorasan-province region with index (1) and other regions of the national economy with index (2) in a table, and the following signs show the matrices and vectors of the table. First, the structure of the two-region input-output table is in the following table.

Z11: Square matrix of inter-sectoral (intra-regional) trade exchanges in Razavi Khorasan Province

Z12: Matrix of exchanges (trade) between Razavi Khorasan province and other regions of the national economy, the origin of which is Razavi Khorasan province, and the destination is other regions of the national economy.

Z21: Matrix of exchanges (trade) between other regions of the national economy and Razavi Khorasan province, the origin of which is other regions of the national economy, and the destination is Razavi Khorasan province.

Z22: Square matrix of inter-sectoral (intra-regional) intermediary exchanges in other regions of the national economy (provinces)

Y11: Column vector of the final demand of Razavi Khorasan Province, which represents the flow of goods from the parts of Razavi Khorasan Province to the final demanders in the province, which includes private consumption, government consumption, capital formation, and inventory changes.

Y12: Column vector of the flow of goods and services from Razavi Khorasan province to final consumers in other provinces

Y21: Column vector of the flow of goods and services from other provinces to the final consumers in Razavi Khorasan province.

Y22: Column vector of final demand (flow of goods and services) from other national regions (provinces) to final demanders in other provinces.

E1: Column vector of the export flow of goods and services from Razavi Khorasan Province to abroad

E2: Column vector of the flow of exports of goods and services from other regions of the national economy to abroad

M1: Row vector of partial imports of Fars province from the outside world

M2: Line vector of imports of part of other national regions (provinces) from the outside world  $V^1$ : a line vector containing the value added of a part of Razavi Khorasan province

V2: Line vector containing the value added of part of other regions of the national economy.

X1: Column vector containing the partial output of Razavi Khorasan province

X2: Column vector containing the output of other regions of the national economy (provinces) Therefore, the structure and components of the two-region input-output table for Razavi Khorasan province can be considered as follows.

**Table 2.** The Structure of the Two-Region Table of Razavi Khorasan Province and Other Regions of the National Economy

total output	Final demand		intermediate demand		buyers	
	Overseas export	Other regions of the national economy	Razavi Khorasan	Sectors of other regions of the national economy	Sectors of Razavi Khorasan	Sellers
$X^1$	$E^1$	$Y^{12}$	$Y^{11}$	$Z^{12}$	$Z^{11}$	Sectors of Razavi Khorasan
$X^2$	$E^2$	$Y^{22}$	$Y^{21}$	$Z^{22}$	$Z^{21}$	Sectors of other regions of the national economy Intermediary costs
				$V^2$	$V^1$	Value added
				$M^2$	$M^1$	Overseas import
				$X_2^1$	$X_1^1$	total input

**Source:** Research finding.

Two inter-regional exchange matrices are calculated to carry out the studies, one matrix for Razavi Khorasan Province's exchanges with other national economies and the other for the exchanges of other national economies with Razavi Khorasan Province. For this purpose, the diagonal matrix of Razavi's Khorasan imports from other national economies and the diagonal matrix of other provinces' imports from Razavi Khorasan province were used. Therefore, in this way, two matrices of inter-regional exchanges can also be calculated. The final demand

vector of the two regions is calculated as a residual by aligning the table of the two regions.

The general steps for preparing the regional input-output table using the spatial contribution approach are as follows:

1. All statistical bases required for research are grouped into 71 economic sectors to harmonize and unify statistics and information,
2. The figures of both national and regional input-output tables are in terms of billions of Rials.
3. Choosing the right measure of space economy: In this study, the output is considered the space factor.
4. Estimation of imports of different sectors of the regions: due to the lack of statistics related to the number of imports and exports of a sector at the regional level, to calculate the cross-border imports of each sector at the regional level, it is assumed that the degree of dependence of each sector on the outside world is the same at the regional and national level. Therefore, the corresponding ratios at the national level have been used for regional levels, which is equal to the product of the ratio of national import to national output by regional output.
5. At this stage, the national input table for 2016 and the region accounts for 2015, the input table for both regions is estimated, and the statistical validity of the coefficients of both regions has been measured based on the minimum statistical errors.
6. Calculation of imports from other regions: to determine the scope of activities of each sector at the regional level and carefully examine the region's economic structure according to its spatial dimensions, imports from other regions for each sector at the regional level are intermediate costs.
7. One of the significant problems of location share methods is that using this approach makes it impossible to estimate cross-border exports and even exports to other regions. Under these conditions, export is considered as waste in the final demand. Therefore, in the spatial share approach, the final demand is a residual from the difference between the total demand and the intermediate demand.

## **5. Result and Discussion**

The results of the two regions of Razavi Khorasan province and other national economies are shown separately in 71 economic sectors in Table 10. In this section, the economic structure of the regions, including the analysis of production, supplies based on consumption, value-added, and its results by sector for both

regions, have been evaluated, which helps to have a more appropriate view of the conditions of Razavi Khorasan Province and other national economies. Therefore, according to the results shown in the table below, it is possible to obtain a proper analysis of the economic structure of the two regions and understand the importance of economic sectors in terms of production share in each region. According to the results, the service sector of residential (private and rented) and non-residential units, with 11.56% of the total output of Razavi Khorasan province, is the most important among other sectors in the region and also compared to other national economies. The share of this sector in other national economies is 7.5%, and in the national economy is 7.7%. Also, wholesale, retail, except for motor vehicles and motorcycles, and production of food products are in second and third place of production in Razavi Khorasan Province. This is although the sectors of accommodation (residences) and service activities related to food and beverages (restaurants, etc..) account for a total of about 2.5% of the production share of the province, and the sector of activities related to food and Drinking is ranked higher than providing space. Also, the mentioned two sectors have a higher share than the national economies.

Regarding the share of the main activities in the two regions, the results show that agriculture, industry, mining, and services have 12.8, 34.83, and 52.2 percent of the total production of Razavi Khorasan province, respectively. While in other national economies, 9.48, 51.53, and 38.97 percent, and in the national economy, 9.66, 50.67, and 39.66 percent of the total production have been allocated to agriculture, industry, mining, and services, respectively. Therefore, the production structure of other national economies is more similar to the national economy because it forms a larger share of the country's total production. On the other hand, in Razavi Khorasan province, the service sector has taken a large share, which shows the importance of this sector in the province.

**Table 3.** Partial Income in Two Regions and the National Economy in 2015 (Billion Rials)

Economic sectors	country (national)		Other national economies		Khorasan Razavi	
	output	Ratio (%)	output	Ratio (%)	output	Ratio (%)
agriculture	2401218.44	9.664	2235023.054	9.488	166195.386	12.897
industry and Mining	12591736.5	50.677	12142233.37	51.539	449503.151	34.881
Other sectors of industry and mining	10698409.6	43.058	10335168.8	43.868	363240.787	28.187

Residential buildings	497281.4	2.001	474391.97	2.014	22889.428	1.776
Other buildings	1396045.5	5.618	1332672.6	5.657	63372.936	4.918
Services	9854695.94	39.66	9181772.529	38.974	672923.365	52.22
Other service sectors	5102880.23	20.536	4772938.093	20.259	329942.12	25.604
Wholesale, retail, except motor vehicles and motorcycles	2002420.7	8.059	1862433	7.905	139987.61	10.863
Transportation by intercity railway	43736.131	0.176	39707.335	0.169	4028.7957	0.313
Other ground transportation	1177706.3	4.74	1098958.5	4.665	78747.859	6.111
Water and air transportation	135117.2	0.544	123144.25	0.523	11972.952	0.929
Accommodation	36266.989	0.146	24878.181	0.106	11388.808	0.884
Service activities related to food and beverages	270665.62	1.089	249001.76	1.057	21663.861	1.681
Administrative activities and support services	117286.31	0.472	110297.31	0.468	6988.9995	0.542
Activities related to government human health	342937.1	1.38	319196.96	1.355	23740.137	1.842
Activities related to private human health	521553.3	2.099	491327.62	2.086	30225.687	2.346
Art, entertainment, and recreation	58829.047	0.237	49343.298	0.209	9485.7491	0.736
Religious organizations and membership organizations	45297.009	0.182	40546.222	0.172	4750.7863	0.369
Total	24847651	100	23559029	100	1288621.9	100
The share of the added value of tourism from the total	6645142.61	26.743	6215899.006	26.386	429243.609	33.31

**Source:** Iran Statistics Center (2020) and research finding.

Comparing the structure of the tourism sector's share in the value added of Razavi Khorasan Province and other national economies show that the tourism sector in Razavi Khorasan Province has a higher share than other national economies. Also, the two regions have a similar structure in terms of the share of

the sectors in tourism, with the difference that the accommodation sector in Razavi Khorasan province has a significant share of the value-added of this sector while providing space in other national economies does not take a high share. Therefore, tourism is more critical in Razavi Khorasan province's economy than in other national economies.

**Table 4.** Value-added Created by Economic Activities and Tourism Sector of Razavi Khorasan Province and Other National Economies in 2015 (Billion Rials)

Economic sectors	Khorasan Razavi Province			Other national economies		
	Total Value Added	value Added of the tourism sector	The share of the value Added of the whole tourism sector	Total Value Added	Value-added to the tourism sector	The share of the value Added of the whole tourism sector
Residential buildings	7442.5067	744.25	1.15	154248.74	15424.87	1.93
Other buildings	32253.55	4515.5	7	678261.48	94956.61	11.89
Wholesale, retail, except motor vehicles and motorcycles	107663.68	10766.37	16.7	1432386.7	143238.67	17.94
Transportation by intercity railway	1643.7217	1084.86	1.68	16200.327	10692.22	1.34
Other ground transportation	54315.06	27157.53	42.12	757988.79	378994.39	47.46
Water and air transportation	3993.4624	3993.46	6.19	41073.572	41073.57	5.14
Accommodation	9061.5027	9061.5	14.05	19794.32	19794.32	2.48
Service activities related to food and beverages	13556.664	1355.67	2.1	155818.62	15581.86	1.95
Administrative activities and support services	5138.0338	513.8	0.8	81086.189	8108.62	1.02
Activities related to government human health	20320.128	2032.01	3.15	273213.38	27321.34	3.42
Activities related to private human health	22944.253	2294.43	3.56	372965.73	37296.57	4.67
Art, entertainment, and recreation	6380.1181	638.01	0.99	33188.319	3318.83	0.42

Religious organizations and membership organizations	3247.2001	324.72	0.55	27713.665	2771.37	0.35
Total	788607066.7	64482.11	100	14162200068	798573.24	100

**Source:** Research finding.

The calculation results of the increasing coefficients of production and spillover effects show that the most significant increasing coefficient of production in Razavi Khorasan province is related to the production of food products in two regions. This means that applying the policies of increasing one investment unit in the production of food products in both regions will cause the most remarkable growth in that sector's production at the national level. The increasing coefficient of production of this sector in Razavi Khorasan province is lower than other national economies, which could be due to the need for this sector in the province to import from other national economies. On the other hand, the public secondary and technical and vocational secondary education sector in Razavi Khorasan province and other national economies has the lowest increasing coefficient and the lowest production growth potential in the entire economy.

**Table 5.** Comparison of Increasing Coefficients of Production and Spillover Effects of Razavi Khorasan Province and Other National Economies Due to the Increase of One Unit of Final Demand in 2015

Economic sectors	Change in the final demand of Khorasan Razavi province			Changes in the final demand of other national economies		
	Khorasan Razavi	Other national economies (spillover effect)	total effect (National)	Other national economies	Khorasan Razavi (spillover effect)	total effect (National)
Residential buildings	1.573	0.065	1.638	1.998	0.438	2.436
Other buildings	1.398	0.04	1.438	1.705	0.312	2.017
Wholesale, retail, except motor vehicles and motorcycles	1.174	0.014	1.188	1.295	0.113	1.408
Transportation by intercity railway	1.288	0.022	1.31	1.723	0.461	2.184
Other ground transportation	1.179	0.017	1.196	1.457	0.247	1.704

Water and air transportation	1.298	0.024	1.322	1.857	0.557	2.414
Accommodation	1.056	0.007	1.063	1.306	0.263	1.569
Service activities related to food and beverages	1.508	0.045	1.553	1.597	0.153	1.75
Administrative activities and support services	1.21	0.022	1.232	1.335	0.122	1.457
Activities related to government human health	1.095	0.009	1.104	1.197	0.099	1.296
Activities related to private human health	1.163	0.016	1.179	1.318	0.138	1.456
Art, entertainment, and recreation	1.146	0.012	1.158	1.43	0.276	1.706
Religious organizations and membership organizations	1.264	0.022	1.286	1.468	0.228	1.696

**Source:** Research finding.

Regarding the effects of an investment in tourism in Razavi Khorasan province on other economic sectors, according to the amount of investment in tourism in the province during the years 2018 to 2020, an average of about 700 billion rials per year on the amount of investment in tourism in Razavi Khorasan province (excluding land) has been added (statistical yearbook of the General Department of Cultural Heritage, Tourism and Handicrafts of Razavi Khorasan 2019 and research calculations). To calculate the mentioned amount, first, the inflation of investment in the tourism sector of the province is adjusted and then the average investment is considered. Therefore, although the primary statistical information available in this study was for 2016 (the last published input-output table is for 2016), to examine the impact of shocks such as Corona in recent years, the investment growth scenario considering the growth of investment in recent years (2018-2020). Therefore, the average annual increase of 700 billion Rials was considered as the scenario of increasing investment in the tourism sector. Thus, although the primary statistics are related to previous years due to limited access, the investment growth scenarios have been adjusted according to recent years so that recent shocks can also be included in the study.

Then, to examine the effects of changes in investment in tourism in Razavi Khorasan Province on the value-added of other economic sectors at the provincial level and other national economies, two scenarios of an increase of 700 billion Rials are considered simultaneously in all sectors related to tourism and also separately in each section. The results of an increase of 700 billion rials in investment simultaneously in all tourism sectors in Razavi Khorasan province, which with an increase of 700 billion rials in investment in sectors related to tourism in the province, a total of 7,103.73 billion rials in the amount of value added to the activity.

The economic benefits of Razavi Khorasan province are increasing, and the spillover effect of this increase caused the creation of 1437.13 billion Rials in the value added of other national economies. Of the amount of 7,103.73 billion Rials in the increase of the value added of the economic activities of Razavi Khorasan province, 6,386.83 billion Rials (90 percent) of the creation of value added is directly related to the 13 sectors of the tourism industry, and 716.91 (10 percent) is related to It is an indirect effect of other parts. Among tourism activities, the highest value-added created as a result of investment (direct effect of investment) is related to the wholesale sector, retail sales except for motor vehicles and motorcycles (11 percent), and other land transportation. (9.56 percent) and accommodation (residences) (7.91 percent). The lowest direct effect in creating value-added due to the increase in investment in all tourism sectors is related to the activities of residential buildings (3.47 percent) and water and air transportation (3.5 percent). Among the other economic sectors of the province, the most indirect effect of value added is related to residential (private and rented) and non-residential unit services (2.65 percent) and the production of other non-metallic mineral products (1.27 percent).

The spillover effects of this increase in other national economies are in the form of 1437.13 billion Rials in the amount of value added to the economic activities of other national economies, 640.95 billion Rials (44.59 percent) from the creation of value-added, directly related to the 13 sectors of the tourism industry and 796.18 (55.4%) is related to the indirect effect of other sectors. Among tourism activities, the highest value-added created as a result of investment (direct effect of investment) is related to the wholesale sector, retail sales except for motor vehicles and motorcycles (14.4 percent), and other land transportation (12.395 percent) and administrative activities and support services (7.29 percent). The lowest direct effect in the creation of value-added due to the increase in

investment in all tourism sectors is related to the activities related to public human health (0.22 percent) and provision of accommodation (0.387 percent). Among other economic sectors in other national economies, the most significant indirect effect of value added is the production of other non-metallic mineral products (3.549 percent) and agriculture, horticulture, and agricultural services (3.488 percent).

The results indicate that the direct effects of a simultaneous investment in Razavi Khorasan province have a very high contribution in increasing the value added to the economic activities of the province. This effect on other national economies is also significant. However, the indirect effects of increased investment in Razavi Khorasan province on other economies outweigh its direct effects.



**Table 6.** The Effectiveness of Investment in All Tourism Sectors of Razavi Khorasan Province on Other Economic Activities in 2015 (Billion Rials/Percent)

Economic sectors	Razavi Khorasan Province				Other national economies			
	Primary value added	Secondary value added	value added changes	Increase share	Primary value added	Secondary value added	value added changes	Increase share
Agriculture, horticulture, and agricultural services	66,219.78	66,281.34	61.56	0.87	902395.31	902445.43	50.12	3.488
Industrial and traditional animal husbandry	16,607.19	16,628.15	20.96	0.3	181628.7	181641.78	13.08	0.91
Poultry	2,956.89	2,961.17	4.28	0.06	35395.753	35398.49	2.73	0.19
Bee breeding, silkworms, hunting and other agricultural activities	191.88	191.9	0.02	0	8588.0673	8588.12	0.05	0.004
forestry	411.71	412.23	0.52	0.01	9174.4386	9175.73	1.29	0.09
fishing	115.91	115.96	0.05	0	78101.061	78102.02	0.95	0.066
Extraction of crude oil, natural gas and mining support services and extraction of other mines	5,335.07	5,336.20	1.13	0.02	1970427.7	1970480.23	52.49	3.653
Production of food products	29,092.76	29,144.62	51.87	0.73	354509.06	354537.95	28.89	2.01
Production of all kinds of beverages and production of tobacco products	1,997.83	2,001.02	3.19	0.04	11834.947	11837.29	2.35	0.163
Textile production	4,611.58	4,615.38	3.8	0.05	54825.669	54832.26	6.59	0.458
Clothing production	1,245.13	1,245.67	0.54	0.01	33570.327	33571.06	0.74	0.051
Production of leather and related products	1,352.43	1,353.10	0.67	0.01	30822.914	30823.95	1.04	0.072
Production of wood and wooden products except furniture, mats and woven mat materials	3,013.24	3,017.93	4.69	0.07	73275.957	73280.08	4.13	0.287
Production of paper and paper products, printing and reproduction of recorded media	2,054.56	2,060.30	5.74	0.08	47714.248	47723.12	8.88	0.618
Coke production, oil refining products	68.45	68.69	0.23	0	164805.14	164812.91	7.77	0.541
Production of chemicals and chemical products	2,636.79	2,638.01	1.22	0.02	344921.65	344939.59	17.94	1.249
Production of medicines and medicinal, chemical, and herbal products	1,381.33	1,383.84	2.51	0.04	47461.344	47464.18	2.84	0.197
Production of rubber and plastic products	4,746.05	4,767.24	21.18	0.3	92700.149	92727.02	26.87	1.87
Production of other non-metallic mineral products	11,243.76	11,334.13	90.37	1.27	168637.12	168688.13	51.01	3.549
Production of base metals	4,900.50	4,908.53	8.03	0.11	186999.71	187013.48	13.77	0.958
Manufacture of fabricated metal products, except machinery and equipment	2,743.61	2,746.27	2.66	0.04	110073.13	110078.3	5.17	0.359
Production of computer, electronic and optical products	546.42	546.6	0.18	0	28134.158	28134.62	0.46	0.032
Production of electrical equipment	5,121.39	5,129.98	8.58	0.12	50691.977	50698.47	6.49	0.452
Manufacture of machinery and equipment not elsewhere classified	2,425.50	2,427.16	1.66	0.02	67863.74	67865.96	2.22	0.154
Production of motor vehicles, trailers and semi-trailers	15,378.75	15,385.86	7.11	0.1	194520.6	194529.28	8.68	0.604
Production of other transportation equipment	271.16	271.25	0.09	0	10867.89	10868.1	0.21	0.015

Furniture production	900.3	900.7	0.4	0.01	38345.484	38345.95	0.47	0.033
Production of other products	1,176.18	1,181.00	4.82	0.07	13752.753	13757.2	4.44	0.309
Repair and installation of machinery and equipment	544.03	544.43	0.41	0.01	67961.234	67966.1	4.87	0.339
Electricity generation, transmission, and distribution	9,287.72	9,312.57	24.85	0.35	180394.11	180433.38	39.27	2.732
Production and distribution of natural gas	19,272.34	19,283.78	11.43	0.16	641551.37	641588.13	36.76	2.558
Water supply, waste management, sewage and treatment activities	4,056.58	4,072.02	15.44	0.22	56941.471	56961.7	20.23	1.408
Residential buildings	7,442.51	7,688.69	246.18	3.47	154248.74	154259.38	10.63	0.74
Other buildings	32,253.55	32,629.92	376.37	5.3	678261.48	678280.44	18.97	1.32
Wholesale, retail, except motor vehicles and motorcycles	107,663.68	108,445.79	782.12	11.01	1432386.7	1432593.69	207.01	14.404
Wholesale, retail and repair of motor vehicles and motorcycles and repair of computers and personal goods	12,197.58	12,246.49	48.91	0.69	118319.43	118375.8	56.37	3.923
Transportation by intercity railway	1,643.72	1,945.78	302.06	4.25	16200.327	16219.48	19.15	1.333
Other ground transportation	54,315.06	54,994.52	679.46	9.56	757988.79	758166.91	178.13	12.395
Transport by pipe	1,777.30	1,779.33	2.04	0.03	33602.997	33606.09	3.1	0.215
Water and air transportation	3,993.46	4,241.95	248.48	3.5	41073.572	41094.24	20.67	1.438
Warehousing and transportation support activities	1,745.64	1,768.67	23.03	0.32	56531.72	56573.71	41.99	2.922
Post and courier activities	792.19	794.99	2.79	0.04	6057.6328	6060.51	2.87	0.2
Accommodation	9,061.50	9,623.39	561.89	7.91	19794.32	19799.87	5.55	0.387
Service activities related to food and beverages (restaurants, etc.)	13,556.66	14,016.70	460.04	6.48	155818.62	155843.68	25.06	1.744
connections	2,690.53	2,691.64	1.11	0.02	234269.77	234278.79	9.02	0.627
Other information and communication activities	923.33	924.12	0.78	0.01	57660.341	57664.77	4.43	0.308
Banks and financial institutions	4,364.39	4,377.40	13.01	0.18	153823.87	153847.04	23.17	1.612
Compulsory insurance and social security	5,924.72	5,949.54	24.81	0.35	108050.41	108079.69	29.28	2.038
Other financial services and insurance activities	861.02	861.91	0.88	0.01	60874.124	60877.14	3.02	0.21
Services of residential units (private and rented) and non-residential	139,742.71	139,931.27	188.56	2.65	1666004.1	1666157.49	153.43	10.676
Real estate broker services	2,125.40	2,129.11	3.7	0.05	29098.515	29102.49	3.98	0.277
Research and Development	428.63	428.83	0.2	0	19070.942	19071.45	0.51	0.035
Other professional, scientific, and technical activities	9,577.07	9,603.36	26.29	0.37	35953.079	35973.2	20.12	1.4
Veterinary activities	385.27	385.44	0.18	0	6389.3183	6389.54	0.22	0.015

Administrative activities and support services	5,138.03	5,733.03	595	8.38	81086.189	81190.96	104.77	7.29
Public affairs and city services	22,713.71	22,718.40	4.69	0.07	356777.39	356781.97	4.58	0.319
defense affairs	13,985.86	13,987.55	1.69	0.02	218253.04	218255.2	2.17	0.151
Police affairs	10,104.81	10,105.71	0.9	0.01	112452.84	112454.05	1.21	0.084
State primary education	13,946.37	13,946.81	0.44	0.01	153154.2	153154.67	0.47	0.033
Private primary education	761.77	761.79	0.02	0	7846.1696	7846.19	0.02	0.001
General secondary education and government technical ....	16,364.52	16,365.00	0.49	0.01	165162.13	165162.66	0.53	0.037
Public secondary education and private technical and professional secondary education	655.42	655.48	0.06	0	11175.213	11175.27	0.06	0.004
State higher education	3,507.62	3,507.74	0.12	0	79383.495	79383.66	0.17	0.011
Private higher education	5,468.91	5,472.62	3.71	0.05	59769.116	59772.93	3.81	0.265
Other public and private education	1,341.65	1,345.79	4.14	0.06	19132.223	19136.57	4.34	0.302
Activities related to government human health	20,320.13	20,923.77	603.65	8.5	273213.38	273216.65	3.27	0.227
Activities related to private human health	22,944.25	23,490.04	545.79	7.68	372965.73	372975.21	9.48	0.66
Social work	2,413.65	2,414.88	1.24	0.02	31869.082	31870.54	1.46	0.102
Art, entertainment, and recreation	6,380.12	6,861.94	481.82	6.78	33188.319	33204.73	16.41	1.142
Religious organizations and membership organizations	3,247.20	3,751.18	503.98	7.09	27713.665	27735.51	21.85	1.52
Other personal service activities	3,940.30	3,943.22	2.93	0.04	58691.919	58694.98	3.06	0.213
Total	788,607.07	795,710.80	7,103.73	-	14162200.1	14163637.2	1437.13	-
total effect	7,103.73 (100%)				1437.13 (100 %)			
direct impact	6,386.83 (90 %)				640.95 (44.59%)			
indirect effect	716.91 (10%)				796.18 (55.4%)			

**Source:** Research finding.



The general results of increased investment in each of the tourism activities of the province are presented in the table below. According to the obtained results, the increase in investment in sector government human health has created the highest amount of added value, and this sector is in the first place of the total effect due to the increase in investment in the province. After this activity, there is the activity related to wholesale and retail sales, administrative activities, and support services. In fact, due to the high share of value added in the province, the government's human health sector will significantly contribute to creating value-added in the province if the investment increases. In other words, the investment in the province's health tourism will create significant value added for the province. The increase in the share of administrative activities and support services is also due to the increased effects of travel agencies' activities. In addition, according to the investigation of the direct effects of an investment in tourism, the government's human health sector has created the most direct effect in this sector. There are activities related to accommodation, wholesale, and retail, except motor vehicles and motorcycles. Therefore, increasing investment in each of the abovementioned sectors can bring significant value to the province's tourism sector.

Regarding the effects of an investment in Razavi Khorasan province on other national economies, the indirect effects were the most significant effect of this increase. The reason for this problem can be the need to provide the required inputs for the tourism sector in the province from another national economy should be in the form of imports from other regions. In addition, the most value-added was created in water, air transportation, place, transportation through intercity railway, and in the third, Residential buildings. This problem can be due to transportation's influence on tourists' arrival and departure to Razavi Khorasan Province.



**Table 7.** The Effects of Investment Increase Scenarios in Each of the Tourism Sub-Sectors of Razavi Khorasan Province

Economic sectors	Razavi Khorasan				Other national economies			
	Secondary value added	total effect	Direct effect	Indirect effect	Secondary value added	total effect	Direct effect	Indirect effect
Residential buildings	789055.645	448.578	244.279 (54.4%)	204.30 (45.54 %)	14162375	175.19	7.70 (4.39 %)	167.492 (95.61 %)
Other buildings	789121,547	514,481	364,43 (70,845%)	150,05 (29,16%)	14162326	125,73	4.02 (3,2%)	121,713 (96.8%)
Wholesale, retail, except motor vehicles and motorcycles	789238.44	631.374	549.644 (87.05%)	81.73 (12.94 %)	14162256	56.4	6.48 (11.48 %)	49.921 (88.52 %)
Transportation by intercity railway	789019.994	412.928	296.182 (71.73 %)	116.75 (28.27 %)	14162401	201.26	13.37 (6.64 %)	187.895 (93.36 %)
Other ground transportation	789169.166	562.099	497.910 (88.58 %)	64.19 (11.42 %)	14162306	105.99	17.04 (16.07 %)	88.952 (83.93 %)
Water and air transportation	788969.459	362.392	242.742 (66.98 %)	119.65 (33.02 %)	14162439	238.73	13.90 (5.82 %)	224.828 (94.18 %)
Accommodation	789185.294	578.227	557.018 (96.33 %)	21.21 (3.67 %)	14162300	100.18	0.26 (0.26 %)	99.914 (99.74 %)
Service activities related to food and beverages	789214.28	607.213	438.426 (72.20 %)	68.79 (27.80 %)	14162256	55.86	0.11 (0.20 %)	55.744 (99.80 %)
Administrative activities and support services	789224.788	617.722	518.373 (83.92 %)	99.35 (16.08 %)	14162256	56.36	1.88 (3.34 %)	54.478 (96.66 %)
Activities related to government human health	789246.364	639.297	599.292 (93.74 %)	40.00 (6.26 %)	14162241	41.22	0.11 (0.28 %)	41.104 (91.72 %)
Activities related to private human health	789217.349	610.282	545.024 (89.31 %)	65.26 (10.69 %)	14162264	63.79	8.53 (13.38 %)	55.255 (86.62 %)
Art, entertainment, and recreation	789147.592	540.526	479.977 (88.80 %)	60.55 (11.20 %)	14162329	128.49	14.26 (11.10 %)	114.229 (88.90 %)
Religious organizations and membership organizations	789185.68	578.613	494.447 (85.45 %)	84.17 (14.55 %)	14162288	87.94	10.07 (11.45 %)	77.869 (88.55 %)

**Source:** Research finding.



## **6. Conclusion and Recommendation**

In the present research, the two regions' economies of Razavi Khorasan Province and other national economies are investigated by the input-output table. For this purpose, first, the input-output table of two regions was made for these two regions using the input-output table of 2016. The results of the investigation of increasing coefficients and spillover and feedback effects showed that the service sector of residential (private and rented) and non-residential units, with 11.56% of the total output of Razavi Khorasan province is the most important among other sectors in the region and also compared to other national economies has While the share of this sector in other national economies is 7.5% and in the national economy is 7.7%. Accommodation sectors (residences) and service activities related to food and beverages (restaurants, etc..) account for a total of 2.5% of the production share of the province. Also, the mentioned two sectors have a higher share than other national economies and the national economy in the country.

According to the results, the share of consumption, value-added, import from others, and import from outside the world of the total supply for Razavi Khorasan province are 24.3, 61.2, 20.41 and 4.09%, respectively, which shows a considerable difference in the share of value added. The province is from the total supply. Also, the supply structure of other parts of the national economy indicates that in the national economy, value-added has the largest share of the total supply of the economy with a share of 60.11%, which shows the similar structure of Razavi Khorasan province and other national economies. The difference is that more activities have a high consumption share at the level of other national economies. The total value added created from economic activities in Razavi Khorasan province in 2015 is equal to 788607066.7 billion Rials, of which about 64482.11 billion Rials is the tourism sector's share. 8.18% of the total value added of the province is related to the tourism sector.

Among the main activities of the province's tourism sector, the largest share of the value added created in this sector is related to the other land transportation sector (except rail) (27157.53 billion Rials) with a share of 42.12%, followed by the wholesale sector, retail sales except for motor vehicles and motorcycles (10766.37 billion Rials) with a share of 16.7% and accommodation sector (residences) (9061.50 billion Rials) with a share of 14.05%. The lowest share of the total value added of the province's tourism sector is related to religious organizations and member organizations (324.72 billion Rials), with a share of 0.55%. Regarding the tourism sector of other national economies, the total value added created as a result of economic activities in other national economies in 2015

is equivalent to 14162200068 billion Rials, of which about 798573.24 billion Rials is the share of the tourism sector. 5.63 percent of the total value added of other economies is related to the tourism sector.

Comparing the structure of the tourism sector's share in the value added of Razavi Khorasan Province and other national economies shows that the tourism sector in Razavi Khorasan Province has a higher share than other national economies. Also, the two regions have a similar structure in terms of the contribution of sectors in tourism, with the difference that the accommodation sector in Razavi Khorasan province has a significant share of the value added of this sector. The most significant increasing coefficient of production in the Khorasan-Razavi province is related to the production of food products in two regions. Regarding the feedback effects of tourism sectors, the feedback effects of Razavi Khorasan province are smaller than other national economies. The return effects of tourism sectors in the province are not much more significant compared to other provinces, and the growth of production of these sectors in Razavi Khorasan province is more affected by the changes made in this province.

Also, in the next section, the effects of increased investment in the tourism sector of Razavi Khorasan Province on other economic activities in this province and other national economies were examined. For this purpose, according to the existence of various tourism activities, 13 activities were considered, and then their value share added, and investment increase scenarios were investigated. For this purpose, two types of scenarios are considered. In one scenario, the increase of 700 billion rials in investment in all sectors is discussed simultaneously. In the second scenario, the effect of the increase of 700 billion rials in each activity is evaluated separately.

With an increase of 700 billion rials in investment in all sectors related to tourism, a total of 7,103.73 billion rials will add to the value-added of the economic activities of Razavi Khorasan province. The spillover effect of this increase caused the creation of 1437.13 billion Rials in the value added of other national economies. Of the amount of 7,103.73 billion Rials in the increase of the value added of the economic activities of Razavi Khorasan province, 6,386.83 billion Rials (90 percent) of the creation of value added is directly related to the 13 sectors of the tourism industry, and 716.91 (10 percent) is related to the indirect effect of other parts. Among the tourism activities, the most value-added created as a result of the investment is related to the wholesale sector, retail sales except motor vehicles and motorcycles (11 percent), other land transportation (9.56 percent), and

supply and place (residences) (7.91 percent). The lowest direct effect in creating value-added due to the increase in investment in all tourism sectors is related to the activities of residential buildings (3.47 percent) and water and air transportation (3.5 percent).

The spillover effects of this increase in other national economies are in the form of 1437.13 billion Rials in the amount of value added to the economic activities of other national economies, 640.95 billion Rials (44.59 percent) from the creation of value-added, directly related to the 13 sectors. It belongs to the tourism industry, and 796.18 (55.4%) is related to the indirect effect of other sectors. Among the tourism activities, the highest value-added created as a result of the investment is related to the wholesale sector, retail sales except for motor vehicles and motorcycles (14.4 percent), other ground transportation (12.395 percent), and activities administrative and support services (7.29 percent), that the direct effects of a simultaneous investment in Razavi Khorasan province have a very high contribution in increasing the value added to the economic activities of the province.

The general results of increased investment in each of the tourism activities of the province are presented in the table below. According to the obtained results, The increase in investment in sector government human health has created the highest amount of added value, and this sector is in the first place of the total effect due to the increase in investment in the province. After this activity, there is the activity related to wholesale and retail sales, administrative activities, and support services. In fact, due to the high share of value added in the province, the government's human health sector will significantly contribute to creating value-added in the province if the investment increases. In other words, the investment in the province's health tourism will create significant value added for the province. The increase in the share of administrative activities and support services is also due to the increased effects of travel agencies' activities. In addition, according to the investigation of the direct effects of an investment in tourism, the government's human health sector has created the most direct effect in this sector. There are activities related to accommodation, wholesale, and retail, except motor vehicles and motorcycles. Therefore, increasing investment in each of the abovementioned sectors can bring significant value to the province's tourism sector.

Tourism development programs should be considered in line with investment in these sectors.

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**Resources**

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## **Finding Financing Risk Factors in Indonesian Islamic Banks: A Geographically Weighted Regression Approach**

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### **Abstract**

This study aimed to measure Non-Performing Financing (NPF) factors through Gross Regional Domestic Product (GRDP), unemployment rate, office network, consumptive financing, and COVID-19 cases. Cross-section data in 34 Indonesian provinces were analyzed using Geographically Weighted Regression (GWR) through global regression confirmation. The results showed differences between the GWR and global regression. All exogenous variables have spatial variability to endogenous variables. This resulted in variations in local models influencing NPF, including in DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Bali, and West Nusa Tenggara Provinces. Additionally, this study has implications for bankers in mitigating credit risk by maintaining the adequacy ratio of funds and tightening the verification of prospective debtors. Bankers should also restructure financing, monitor portfolio performance, and build digital infrastructure in each regional office by considering the dynamics in the provinces. In addition, the province's representative of the Financial Services Authority and Central Bank offices must coordinate directly supervising Islamic banks in the region.

**Keywords:** Financial Intermediaries, Geographically Weighted Regression, Islamic Bank, Regional Growth, Risk Assessment.

**JEL Classifications:** G21, R11, C31.

### **1. Introduction**

The spread of Coronavirus Disease 2019 (COVID-19) has impacted economic and financial aspects globally because handling the disease requires each country to implement social restrictions nationally and transnationally (Aum et al., 2021; Sharma and Mahendru, 2020). Although the policies have suppressed the spread, all countries received strong shocks to the economic and financial sectors (Atalan, 2020; Cozzi et al., 2020; Nicola et al., 2020; Rabbani et al., 2021; Tisdell, 2020).

Furthermore, COVID-19 promoted a decrease in demand and supply of various products and services, resulting in Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) (Bekaert et al., 2020; del Rio-Chanona et al., 2020; Hassan, Rabbani, et al., 2020). It caused a decline and change in consumption patterns and a decrease in performance for banking sector financing (Bilgin et al., 2021; Christelis et al., 2020; Deloitte, 2020). Social restriction policies also complicate production activities, resulting in declining economic growth in various regions (Vet et al., 2021). Most companies must lay off employees to reduce operational burdens, contributing to 33 million people or 6.8% of global unemployment (International Labour Organisation, 2021). Additionally, the global poverty rate has increased to 150 million people (Economic Commission for Latin America and the Caribbean, 2020; Laborde et al., 2021; Sumner et al., 2020; UNICEF et al., 2021).

The impact of COVID-19 disrupts the conventional economic system and affects the stability of Islamic economic performance, though it is considered a solution to global economic problems (Agustin et al., 2021; Fakhrunnas et al., 2021; Fernandes, 2020; Shafiq, 2020; Zaman, 2013). The leading indicators of the Islamic economy represented by the performance of Islamic banking have also decreased due to VUCA-world conditions (Kasanah et al., 2022). Consequently, Islamic banks have the potential to experience inefficient financial performance (Mufraini et al., 2021; Rizwan et al., 2021). Although Islamic banks have solid fundamentals and consistently contribute to global financial assets of 70% or worth US\$ 2,349 billion (Mohamed and Ahmed, 2021), they cannot avoid the shock caused by COVID-19 (Mateev et al., 2021).

Indonesia is the largest Muslim country worldwide, with 87.2% of 270 million population being Muslim (Central Intelligence Agency, 2019; Hefner, 2021). The country occupies the second vein in the Islamic Finance Country Index and the Most Developed Country in Islamic Finance in 2020 based on demographics, education, research, compliance, and regulatory certainty (Edbiz Consulting, 2020; Mohamed et al., 2020). However, the acquisition of Indonesian Islamic banking assets has not contributed globally (Mohamed and Ahmed, 2021). This is due to the increased risk of Islamic banking financing during the pandemic, which disrupts financial performance (Hassan et al., 2021; Jobst and Solé, 2020). Furthermore, Islamic banking is an intermediary institution highly dependent on economic stability (Firmansyah, 2015; Khasanah and Wicaksono, 2021). This

means that an economic crisis would have a multiplier effect on the economic and financial sectors (BPS-Statistics Indonesia, 2022). Moreover, the spread of COVID-19 has caused a reduction in Gross Domestic Product (GDP) to -5.32%, promoting a 7.07% increase in the unemployment rate. Another impact is the negative fluctuating trend in the financing and Non-Performing Financing (NPF) sectors (Fakhrunnas et al., 2021; Goodell, 2020; Kuzucu and Kuzucu, 2019; Mansour et al., 2021). The government has issued a stimulus policy to restructure financing to Financial Institutions (National Economic Stimulus as Countercyclical Policy Impact of Coronavirus Disease Spread 2019, 2020; Financial Services Authority, 2020; Sukmana et al., 2020; Warjiyo, 2020). However, Islamic banks have not reduced the NPF level because the Indonesian economy has received stronger shocks than other Muslim countries such as Bahrain, Brunei, Kuwait, Malaysia, Pakistan, Saudi Arabia, Turkey, and the UAE (Mansour et al., 2021). The risk of financing Islamic banks cannot be ignored because it can potentially repeat a systemic crisis (Bagus Wiranatakusuma et al., 2020). Islamic banks have a good image as a financing solution with sharia values (Muhammad and Triharyono, 2019), so if Islamic banks go bankrupt because they are unable to control risks (Ahmed, 2009), it has the potential to have the effect of decreasing customer trust in the bank as a whole and creating a bank run that encourages a monetary crisis (Farooq and Zaheer, 2015; Jan et al., 2019).

Economic instability has increased financing risks in NPF through customer delays in payments (Ahmed and Khan, 2007; Damanhur et al., 2018; Mohd Isa and Abdul Rashid, 2018; Priyadi et al., 2021). External factors through decreased GDP increased unemployment, and uncertain business climate to customer moral hazard could increase financing risk for banks (Effendi and Yuniarti, 2018; Habibi and Rusgianto, 2021; Jassaud and Kang, 2015; Mutawali et al., 2019; Parven, 2011; Santosa et al., 2020; Trinugroho et al., 2021; Zheng et al., 2019). Internal factors also have a role in managing financing risks through the efficiency of intermediary functions and service accessibility in the availability of office networks (Edaich and Dymek, 2020; Havidz and Setiawan, 2015; Maulidar and Majid, 2020). However, strict regulations in financing verification by measuring the customers' capacity and ability are more dominant in controlling NPF in Islamic banks (Omar, 2020), and it manage financing risks appropriately (Abbas and Ali, 2019; Firmansyah, 2015; Hassan, Shaikh, et al., 2020; Khanam and Ullah, 2014; Priyadi et al., 2021). Nicola et al. (2020) and Nugroho et al.

(2020) found that COVID-19 is the primary source of risks in the banking sector through social distancing, self-isolation, and travel restrictions. The disease has also promoted the condition of VUCA in the financial sector, enabling banks to determine the best model for mitigating financing risks (Alabdullah et al., 2020; Edaich and Dymek, 2020). When the bank takes too long to adjust to conditions, this impacts financing risks (Adler et al., 2022; Miah et al., 2021). In addition, a poor understanding of financing risks can threaten bank performance through declining profits and revenues (Ebenezer and Omar, 2016; Rehman et al., 2019). The occurrence of defaults can compromise the health of banks through mishandling in managing financing risks (Africa, 2016; Tejo and Hanggraeni, 2020).

Asnawi et al. (2020) and Wicaksono (2022) found that Islamic bank performance is driven by external and internal factors but must consider geographical aspects in mapping a problem (Abeyratne and Cooray, 2017; Ludovic et al., 2020; Wang and Guan, 2017). The geography model is appropriately implemented in the archipelago area (Z. L. Chen et al., 2020; Danon et al., 2020; Gatto et al., 2020; Ludovic et al., 2020). Indonesia is geographically an archipelagic country with 17,504 islands in 34 provinces (Estiningtyas et al., 2021). Therefore, each region requires a specific approach to provide information appropriately (Fauzan et al., 2020; Grydehøj and Hayward, 2014; Mahendradhata et al., 2017; A. Mufraini et al., 2020). The global regression approach or multiple regression model measures a phenomenon without considering the weighting aspects of each location (Chen and Truong, 2012; Fotheringham et al., 2002). Moreover, making decisions based on a single model implemented on the entire data set makes it possible to create gaps in real conditions (Kang and Zhao, 2020). In addition, global assumptions can obscure the geographical role and complexity of phenomena that arise in each region with different characteristics (Chen and Truong, 2012). In contrast, the Geographically Weighted Regression (GWR) approach effectively improves the analysis accuracy in global regression by adding local spatial weights for each location (Permai et al., 2021). The approach solves the problems of spatial heterogeneity and improper autocorrelation in models (Fan et al., 2000; Huang et al., 2010; Tabuchi and Thisse, 2011; Wei et al., 2019). It makes the models approximate phenomena in each geographic location (Chen and Strathearn, 2020; Patterson et al., 2020; Zhang, 2014), and it creates different models and equations in each region depending on the phenomenon in the area

(Permai et al., 2021). In addition, this method has not been widely used to evaluate a policy because most of the research is not on the archipelago. Consequently, it ignores the geographic approach in measuring the performance of Islamic Banking (Wicaksono, 2022).

Most studies focused on global proximity in measuring the risk of Islamic bank financing by involving various methods and variables (Abbas and Ali, 2021; Ali et al., 2021; Kabir et al., 2015; Masood et al., 2012). Priyadi et al. (2021) performed tests with the Auto Regressive Distributed Lag (ARDL) approach for short- and long-term relationship investigations on NPF. Moreover, Bahrul Ilmi (2018) and Misman et al. (2015) used a multiple regression approach to investigate factors affecting global financing risks in Islamic banks in Indonesia and Malaysia. The study used financing variables, labor relationship development, and banking ownership status. Warninda et al. (2019) applied a random effect regression model approach with white diagonal robust standard error and Fama - Macbeth regression. The study aimed to measure the strongest impact globally between *mudharabah* and *musharakah* financing on the risks of Islamic bank financing in the Middle East, South Asia, and Southeast Asia regions. Furthermore, Hidayat et al. (2021) employed a t-test approach and a regression methods panel to evaluate the risk trade-off process. The study compared financing risks to Islamic and conventional banks in the Gulf Cooperation Council (GCC) area. However, there needs to be more literature on measuring the potential financing risks of Islamic banks locally with a spatial approach in the archipelago. Although the global regression approach is often used for decision-making in risk mitigation of Islamic banks, the different characteristics between one region and another are neglected, so analysis and conclusions can potentially become biased (Kang and Zhao, 2020). In addition, this study adopts a Geographic Information System (GIS) approach to map the level of significance in the models formed in each region so that the risk mitigation process can be carried out precisely based on the phenomena that occur in each region instead of generalizing one model in all different regions.

This study aims to measure Islamic bank financing risk factors through the variables of Gross Regional Domestic Product (GRDP), unemployment rate, office network, consumptive financing, and COVID-19 cases. In addition, this study investigated the spatial role of exogenous variables against endogenous variables in the model, which has a relationship of activity between spaces in each province. It verified the differences in the results of global regression and GWR analysis

through a geographical approach based on the weight values of each region through latitude and longitude. Then, predict the variety of models locally and map the significance of spatial models in each province which is useful for providing comprehensive input to Islamic banks and authorities in the post-pandemic risk mitigation process.

## **2. Literature Review**

COVID-19 has made Islamic banks as intermediary institutions more vulnerable to financing risks. The banks must tighten the financing verification process through checks on financial history and customer background (Akram and Rahman, 2018), because increased financing risk impacts liquidity and financial performance (Alzoubi, 2017; Hosen et al., 2021). When the policies taken cannot anticipate the condition of VUCA, banks are predicted to experience a trust crisis from customers. This could cause a bank run, with a systemic impact on various crises in the banking sector (Anginer and Demirguc-Kunt, 2018; Masiukiewicz and Howzan, 2015; Schoors et al., 2019). COVID-19 has caused many large companies to experience defaults and bankruptcies. Moreover, Micro, Small, and Medium Enterprises (MSMEs) that faced the 1998 and 2008 crises have also experienced shocks due to the government's social and operational restriction regulations (Cepel et al., 2020; Fairlie, 2020; Hamburg, 2021). This means that banks must be ready to face default by counterparties through various policies to reduce financing risks during a pandemic (Habibi and Rusgianto, 2021; Hassan, Rabbani, et al., 2020; Maulidar and Majid, 2020).

El-Chaarani et al. (2022) explained significant differences between Islamic and conventional banks in the GCC region during the pandemic. Conventional banks have a better ability to manage financing risks, though the inflation rate and NPF are negatively correlated with financial performance. In contrast, Islamic banks declined after the pandemic (Fakhrunnas et al., 2021; Hassan, Rabbani, et al., 2020; Mateev et al., 2021). Hassan et al. (2022) explained that the pandemic had slowed the growth of Islamic commercial finance oriented toward maximizing profits. The pandemic has created more opportunities for Islamic social finance through the increasingly widespread use of multilateral institutions in helping the community. The decline in Islamic banking performance is also due to insufficient government support. Banks have the potential to experience liquidity problems when people shift to cash orientation amid the pandemic (Koechlein, 2021; Omar,

2020). Although conventional banks are also experiencing shock due to COVID-19, most of the operational funds of government agencies still utilize conventional bank services (Bassett et al., 2020), it indicates fund adequacy is still maintained (Adesina and Olatise, 2019; A. Mufraïni et al., 2020; The Central Bank of Bangladesh, 2022).

The Islamic banking industry was one alternative solution for economic recovery after the 2008 crisis before the COVID-19 pandemic (Alqahtani and Mayes, 2017; Ascarya, 2013), it is because Islamic banks offer financing by eliminating interest in each transaction and applying an approach of trust, compliance, and openness based on Islamic values (Kılıç and Çanakçı, 2022). The banks also used underlying assets based on Profit and Loss Sharing (PLS) (Hussien et al., 2019; Mahdzan et al., 2017; Omar, 2020). This method promotes mutually beneficial contracts for the giver and recipient of funds (Ezeh and Nkamnebe, 2018; Kaabachi and Obeid, 2016; Ozsoy, 2016). Applying interest in conventional bank financing has encouraged the emergence of various economic crises (Fiore and Uhlig, 2015; Ozturk and Sozdemir, 2015). For instance, COVID-19 disrupts various risks systemically (Ivanov, 2021; Kilpatrick and Barter, 2020), with Islamic banks also receiving the same impact as conventional banks due to the pandemic (Barua and Barua, 2021; Jackson et al., 2020)

Islamic banks have tightened the provision of financing and encouraged the government to implement various stimuli to reduce financing risks (Shahchera, 2022). Moreover, the government should conduct a policy rate cut to facilitate banking services, household assistance, workers, MSMEs, and foreign investors to maintain economic and financial stability (Zulfikar, 2019). Furthermore, policies are taken to avoid debt traps in economic sectors because economic growth strongly correlates with the Islamic bank financing risk (Effendi and Yuniarti, 2018; Habibi and Rusgianto, 2021; Jassaud and Kang, 2015; Mutawali et al., 2019). Islamic banks have verified their activities twice as strictly as conventional banks by considering normative rules and Islamic principles (Karim and Shetu, 2020; Khanam and Ullah, 2014). Even, the banks have consistently applied Islamic principles by not providing financing for something *riba*, *maysir*, and *gharar* (Rabbani et al., 2021). The application of Islamic principles in the financial industry is increasingly in demand, and many Islamic financial products and services have emerged worldwide, including Islamic insurance, investment, capital markets, and mutual funds (Alsharari and Alhmoud, 2019; Šeho et al., 2020).

The implementation of risk management is an obligation for the financial industry. The government must direct central banks and financial services authority institutions to implement risk management in each bank because banking is inseparable from problems related to socio-demographic, asymmetric information, moral hazard, and economic, political, and cultural that can increase financing risk (Hassan et al., 2021; Lončarski and Marinč, 2020; Rafay et al., 2020). After the spread of COVID-19, the banking industry has experienced shocks that have increased liquidity and financing risks (Karim et al., 2021; Mustafa, 2020). Therefore, banks need to manage risks properly to avoid losses due to the multiplier effect after the pandemic (Baret et al., 2020). This study adopted the risk management theory as an approach to the middle range theory. The aim was to connect the theory of financial intermediation by developing a theory of location.

Risk management theory contributes to the risk reduction of bank profits based on failure to fulfill debtor obligations (Tursoy, 2018). Banks have conducted a feasibility assessment verification on the provision of financing. However, they cannot ignore macroeconomic factors, activities, and internal banking conditions (Bojinov, 2016). Implementing financing risk mitigation aims to determine the risks bank face in the future, so it helps the bank determine the proportional financing (Liu and Huang, 2022). The risk management process in Islamic banks also adopts shariah compliance implementation, and they prioritize the role of the Shariah Supervisory Board and fatwas of the Ulema Council (Setyowati et al., 2019). The application of shariah compliance elaborates between Islamic norms and values to the operating system in the banking industry by abandoning the practice of *riba* and promoting *maqashid* shariah (Hudaefi and Badeges, 2022; Ullah et al., 2023).

Mitigating financing risks process in Islamic banks considers geographical conditions at branch offices (Asnawi et al., 2020; A. Mufraini et al., 2020; Wicaksono, 2022), because each region has the potential to pose different risks to a business (Snieska et al., 2019). Moreover, the location theory states the importance of involving location in mapping risks to optimize decisions to maximize profits and avoid potential losses (Dubé et al., 2016). In addition, the geography approach explains the differences in activity in each observation area based on the resources and character of each region to explain the problems that are missed in the traditional approach of global analysis by showing the potential

for local variation in the observed area (N. Chen et al., 2017). The geography approach also uses GIS to describe the regularity of the observation location on spatial properties and processes (Sulekan and Syed Jamaludin, 2020), ensuring that the analysis results are oriented towards each region.

GIS is a technology used to accurately analyze geographical aspects spatially through remote sensing (Lee and Jang, 2017). In addition, this analysis will present mapping to help make decisions and solve problems to manage risks for business units (Jebur, 2021). Then, GIS can be used in floating financial institution strategy planning (Maximenko and Maximenko, 2021). It can describe risks more clearly by considering geographical aspects. It makes it easier for banks to understand potential risks before investing, financing, or providing loans in various business sectors. The GIS approach can also provide extensive information related to health, habit, demand, purchasing, and economic conditions (Khan and Yesmin, 2016; Weber, 2018) so that potential risks in financing can be controlled.

### **3. Methodology and Data**

This study aimed to measure Islamic bank financing risk factors based on the GWR approach through economic growth, bank intermediary, and COVID-19. The variables were represented by exogenous variables, including GRDP, unemployment rate, office network, consumptive financing, COVID-19 Deaths, and Islamic Bank NPF.

**Table 1.** Operational Variables

Variable	Symbol	Description	Source
<b>Exogenous Variable</b>			
Gross Regional Domestic Product	GRDP	GRDP Rate in each Province	BPS
Unemployment Rate	Unemployment	Unemployment Rate in each Province	BPS
Office Network	Office Network	Number of office networks in each province	OJK
Consumptive Financing	Consumptive Financing	Amount of Islamic Banking Consumption Financing in each Province	OJK
COVID-19 Deaths	COVID-19	Number of COVID-19 Deaths in Each Province	COVID-19 Task Force
<b>Endogenous Variable</b>			
Non-Performing Financing	NPF	Amount of Islamic Banking NPFs in each Province	OJK

**Source:** Research finding.

**Note:** Central Statistics Agency (BPS), Financial Services Authority (OJK)

Cross-section data in 34 provinces in 2021 were obtained from the Central Statistics Agency (BPS), the COVID-19 Task Force, and the Financial Services Authority (OJK). In the first phase, descriptive statistical analysis was conducted to organize, summarize, and understand data measurements through an overview of the relationships between variables in a sample (Shi and McLarty, 2009; Tzeng, 2011). This testing is critical in analyzing the differences in character in the sample influencing the initial decision (Loeb et al., 2017; Thompson, 2009). Furthermore, the Classical Assumption test was conducted by involving the Normality, Heteroskedasticity, and Multicollinearity Test approaches through Jarque-Bera, Breusch-Pagan Test values and Variance Inflation Factor (VIF) values (Khatun, 2021; Kwak and Park, 2019; Li and Yao, 2019; Shrestha, 2020; Stehlík et al., 2014). The Classical Assumption test results may indicate the presence of spatial influences through nominal values on the equations in the model (Kala et al., 2017; Leung et al., 2000). In the third stage, a global regression model tested the relationship between exogenous and endogenous variables by estimating the following equations (Susanti, 2018).

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_px_p + \varepsilon \quad (1)$$

where  $y$  is an endogenous variable,  $\beta_0, \beta_1, \beta_2, \beta_p$  are model parameter,  $x_1, x_2, x_p$  are exogenous variables, and  $\varepsilon$  is an error. With the observation of several  $n$ , the model to  $i$  is as follows (Lutfiani et al., 2019):

$$y_i = \beta_0 + \sum_{k=1}^p \beta_k x_{ik} + \varepsilon_i \quad (2)$$

where  $i$  is the observation to  $i$ ,  $\beta_k$  is the coefficient of the exogenous variable to  $k$ ,  $x_{ik}$  is the value of the exogenous variable to  $k$  at the point of the observation location to  $i$ , and  $\varepsilon_i$  is an error in the location to  $i$ . In the global regression model, the relationship between exogenous and endogenous variables was considered the same (Duarte-Cunha et al., 2016; Kuhn and Johnson, 2013). This is because it does not involve the approach and weighting of geographical locations in measurement. The global regression model placed linearity in its parameter, assuming the average value in error to be zero and constant (Fahrmeir et al., 2013; Gujarati and Porter, 2009). A comprehensive analysis necessitated an assessment based on the geographical location of the study sample (Fotheringham et al., 2002). In the fourth stage, the GWR model was tested to develop a regression analysis by adopting a geographical approach. This approach was based on non-parametric regression through weighting values in each region. It was based on latitude and longitude coordinates, where each observation in the sample had different weights and coefficient values as modeled in the following GWR equation (Jetz et al., 2005; Lutfiani et al., 2019; Páez and Wheeler, 2009; Permai et al., 2021).

$$y_i = \beta_0(u_i, v_i) + \sum_{k=1}^p \beta_k(u_i, v_i) x_{ik} + \varepsilon_i \quad (3)$$

where  $y_i$  is the value of the exogenous variable for the location to  $i$ ,  $(u_i, v_i)$  is the geographical coordinates in the form of latitude and longitude at the location to  $i$ ,  $\beta_0(u_i, v_i)$  is the interception of the observation location to  $i$ , and  $\beta_k(u_i, v_i)$  is the value of the coefficient of the exogenous variable to  $k$  at a location to  $i$  (Fotheringham et al., 2002). Additionally, the Cross Validation (CV) method was used to determine the Optimum Bandwidth value through the following equation (Ardianti et al., 2021).

$$CV = \sum_{i=1}^n [y_i - \tilde{y}_{\neq i}(b)] \quad (4)$$

where  $\tilde{y}_{\neq i}$  is the estimating value of the  $y_i$  in the observation of the location to  $i$  and  $b$  is the optimum bandwidth, the radius of a pattern in the region, which is

essential for balancing weighting. The determination of CV as an optimum bandwidth model was based on its function to minimize bandwidth values. When the value is large, it could cause bias in the Global Regression analysis (Cho et al., 2010; Farber and Páez, 2007). Spatial weighting was also conducted through parameter estimation based on adaptive gaussian kernels through an adaptive ability. The aim was to adjust conditions at the point of the sample's location to explain the results of spatial calculations with the estimation of adaptive gaussian kernels equations as follows (Fotheringham et al., 2002; Permai et al., 2021).

$$W_{ij} = \exp \left[ -\frac{1}{2} \left( \frac{d_{ij}}{b_i} \right)^2 \right] \quad (5)$$

where  $W$  is a weighting,  $b$  is Bandwidth adaptive in assigning locations to  $I$ , and  $d_{ij}$  is a Euclid between locations. A Goodness of Fit analysis was conducted to determine the difference between Global Regression and GWR. The best model was determined by comparing the Calculated  $F$  value against the  $F$ -table on the Residual GWR value.  $F\text{-count} > F\text{-table}$  implies a difference between the Global Regression and GWR models. This indicates that the GWR model is the best (Fotheringham et al., 2002; Nur Edayu and Syerrina, 2018).

The next stage analyzed the geographical variability tests of local coefficients to determine the spatial relationships between exogenous and endogen variables through the difference in criterion. In this case, a negative value indicated that the variable had spatial heterogeneity and vice versa (Fotheringham et al., 2002). The results of each coefficient value were shown by spatial mapping through an earth map.

#### **4. Results and Discussion**

In the first stage, descriptive statistical data analysis was conducted to determine each variable's characteristics, including the mean, maximum, minimum, and standard deviation values. The data comprised 34 observations carried out in 2021. This analysis focused on the dynamics in GRDP, unemployment, office networks, COVID-19, consumptive financing, and NPF.

**Table 2.** Descriptive Statistic

Variable	Minimum	Mean	Maximum	Std. Dev.
GRDP	-2.47	4.17	16.40	3.58
Unemployment	3.01	5.49	9.91	1.81
Office Network	0.00	72.88	379.00	99.52
COVID-19	264.00	4237.82	30287.00	7307.43
Consumptive Financing	0.00	3555.75	20850.43	5228.54
NPF	0.00	194.81	1839.85	386.82

**Source:** Research finding, using Eviews.

The analysis showed that GRDP had an average value of 4.17 in each province in Indonesia. This means that the pandemic's regional economic growth is growing by 4.17%. However, it must face an unemployment rate of 3.01 – 9.91% and 4,237 cases of COVID-19 deaths in each province. Indonesia has accelerated the post-pandemic economic recovery process (International Monetary Fund, 2022), but it is struggling with the increase in NPF value to 1.83 trillion rupiahs or 194 billion rupiahs in each province. The movement in the NPF value was also driven by the consumptive financing of 20.85 trillion rupiahs. The supervision and assessment controls involved 72 office networks of Islamic banks in each province. Therefore, there needs to be special attention to the increasingly high consumptive financing with the office networks that are not comparable because they do not only function as information and service centers for customers but also supervise financing (Rönqvist and Sarlin, 2016).

Weak economic conditions affect the stability of bank financing in a region (Crocco et al., 2014; Lee and Brown, 2017). This implies the need to carry out strict supervision for every financing activity. Since Indonesia has a heterogeneous dynamic as an archipelagic country, policy-making should consider regional aspects because each region has its characteristics and phenomena (Fauzan et al., 2020; Mufraeni et al., 2020). Islamic banking should also respond to financing risks in GRDP, unemployment, availability of office networks, COVID-19, and the level of consumptive financing to prevent the increase in NPF value.

**Table 3.** Regression Diagnostic

Diagnostic	Indicator	Value	Prob.	Note
Normality Test	Jarque-Bera	17.66	0.00	Not Significant
Heteroskedasticity Test	Breusch-Pagan	66.07	0.00	Not Significant
Multicollinearity	VIF	Condition Number		Not Significant
		16.52		Not Significant

**Source:** Research finding, using GeoDa.

The results of the regression diagnostic on the normality test through jarque-bera values showed that the model is not normal based on probability values of 0.00 or  $p < 0.05$  (Khatun, 2021). Similarly, the results of the heteroskedasticity test through breusch-pagan values showed the presence of heteroskedasticity with a probability of 0.00 or  $p < 0.05$  (Li and Yao, 2019). The VIF value shows a multicollinearity relationship between variables based on a condition number value of 16.52 or  $VIF > 10$  (Shrestha, 2020; Wicaksono, 2022). Therefore, the results of regression diagnostics based on patterns and geographical conditions between regions indicated spatial heterogeneity (Kala et al., 2017; Leung et al., 2000). Diagnostic information was compared between the global regression and GWR models through the classic values of AIC, BIC/MDL, CV, R square, and Adj. R square to determine the best model (Fotheringham et al., 2002). Furthermore, a goodness of fit analysis was performed to ensure differences between the two models by comparing F-count and F-table values.

**Table 4.** Selection of the Best Model

	Model	Classic AIC	BIC/MDL	CV	R Square	Adj. R Square
<b>Diagnostic Information</b>	Global Regression	773.39	784.08	935605043.26	0.79	0.75
	GWR	739.44	772.57	746956568.97	0.96	0.89
	Model	SS	DF	MS	F	F-Table
<b>Goodness of Fit</b>	Global Residuals	9979167705.42	28.00	-	-	-
	GWR Improvement	8431987404.91	17.48	482200317.97	-	-
	GWR Residuals	1547180300.50	10.51	147161051.98	3.27	2.56

**Source:** Research finding, using GWR.

**Table 6.** GWR Model Parameter Estimation

Variable	Min	Lower Quartile	Mean	Upper Quartile	Max	STD
Intercept	10866.92	11684.61	18793.08	22603.45	40873.17	7952.65
GRDP	-1151.93	-82.00	5494.72	736.05	37905.16	11587.37
Unemployment	-1961.29	-1215.32	9037.13	2291.14	54828.54	19089.45
Office Network	-154764.73	-94562.20	-46565.43	-5828.49	2649.47	54495.39
COVID-19	1452.26	6534.38	27787.79	49635.45	73805.08	25230.94
Consumptive Financing	13190.57	20595.31	47826.16	89850.57	97273.70	31322.51

**Source:** Research finding, using GWR.

**Table 7.** Comparison of GWR and Global Regression Models

Variable	GWR			Global Regression		
	F	DIFF of Criterion	F-Table	T	Estimate	T-Table
Intercept	1.04	-24644003.52	2.56	5.63	18421.69	2.04
GRDP	5.58*	-531484095.9	2.56	0.34	1149.37	2.04
Unemployment	9.47*	-993956240.1	2.56	1.06	4010.01	2.04
Office Network	24.58*	-3125986135	2.56	-3.04*	-40997.24	2.04
COVID-19	24.36*	-2855401199	2.56	5.60*	32013.16	2.04
Consumptive Financing	113.98*	-6970831343	2.56	4.32*	47312.55	2.04

**Source:** Research finding, using GWR.

**Note:** \* significant at 0.05.

The diagnostic information results showed that the GWR model has a smaller error than the global regression model based on the Classic AIC value of 739.44, BIC/MDL of 772.57, and CV of 746956568.97. The results of R Square and Adj. R Square also showed that the GWR model has a greater value than the global regression model, which is 0.96 and 0.89. All exogenous variables in the study model affect endogenous variables by 89.13%. It means the analysis of diagnostic information showed that the GWR model explains the diversity of patterns better than the global regression model (Chun et al., 2017; N. Liu and Strobl, 2022; Permai et al., 2021). This is because the GWR model optimizes regression analysis by considering geographical aspects in each observation area (Bourdin, 2019; Permai et al., 2019). Additionally, the goodness of fit results showed significant differences between the GWR model and the global regression model based on comparing F-count and F-table values (Fotheringham et al., 2002; Nur Edayu and Syerrina, 2018) or  $3.27 > 2.56$  on GWR Residuals. The GWR model is appropriate for modeling research (Yu, 2007). A GWR bandwidth section analysis was also conducted using the CV method based on adaptive gaussian parameters. It aimed to determine the Optimum Bandwidth and how the optimal radius of an area is influenced by neighbors (Weber, 2018), as follows.

**Table 5.** GWR Bandwidth Selection

Initial values	Bandwidth	Criterion	DIFF	CV Minimum	Bandwidth Optimum
iter 1	15.16	990415004.18	7.195	746956568.97	6.000
iter 2	10.71	932292810.20	4.447	746956568.97	6.000
iter 3	7.96	786472738.93	2.748	746956568.97	6.000
iter 4	6.26	746956568.97	1.699	746956568.97	6.000
iter 5	6.26	746956568.97	1.050	746956568.97	6.000

**Source:** Research finding, using GWR.

The results of the GWR bandwidth selection through the golden section search were tested up to iter 5 with an optimum value of 6,000 in the search range of 0 to 34 neighbors. The test was conducted up to 5 times to show that each region could influence six neighboring areas (Fotheringham et al., 2017; Ko et al., 2020). A smaller bandwidth means the observation area reachable by the model is also small, and the result is under smoothing (Nakaya et al., 2016; Weber, 2018). In contrast, a value that is excessively large would cause a greater bias. The range of the observation radius in neighboring areas would also be greater, meaning the

model is over smoothing and creates a trait similar to global regression (Charlton and Fotheringham, 2009; Fotheringham et al., 2017). Therefore, it is necessary to search for the optimum bandwidth for the GWR analysis to be sensitive to the weighting value of the observation site. The next stage was estimating the parameters of the GWR model to get a comprehensive analysis of each data used.

The parameter estimation results on the GWR model showed that the GRDP parameter has an estimator parameter value ranging between -1151.93 to 37905.16. GRDP could affect NPF in each province with a range of values between -1151.93 to 37905.16. Unemployment showed the estimated value of parameters influencing NPF in the range of -1961.29 to 54828.54. Moreover, the office network is suspected of contributing between -154764.73 to 2649.47 NPF. COVID-19 has a potential effect in the range of 1452.26 to 73805.08 NPF, while consumptive financing has the potential to contribute to NPF with a range of 13190.57 to 97273.70. It is important to note that the parameter estimates in the GWR model are local and vary, meaning the estimated values at each location could be different. This depends on the analysis of local coefficients through weighting in each observation area (Taus et al., 2013). Furthermore, the results of the GWR analysis estimates with global regression were compared to determine the spatial role of each variable and ensure that the results were robust.

The GWR analysis was based on F-count values  $>$  F-table (Ardianti et al., 2021; Hu et al., 2018). The spatial role of each variable was determined through positive and negative values in the Difference (DIFF) of the Criterion (Bourdin, 2019; Zhu et al., 2020). The positive and negative values indicate that the model used has no and has spatial variability, respectively. The spatial variability implies the potential to have variations in geographical local coefficient values (Fotheringham et al., 2002; Nakaya et al., 2016; Weber, 2018). The analysis showed that all exogenous variables significantly influenced NPF. GRDP, unemployment, office network, COVID-19, and consumptive financing had spatial relationships with NPF with significance values of 5.58, 9.47, 24.58, 24.36, and 113.98, respectively, all exceeding 2.56. The variables had DIFF of Criterion of -531484095.9, -993956240.1, -3125986135, -2855401199, and -6970831343, respectively. The results indicated that the variables have a significant relationship of variability and spatial heterogeneity to NPF in the general observation site. Moreover, the global regression results showed significance in variable office networks, COVID-19, and consumptive financing, with a comparison of T-count and T-table values (Bari, 2022; Wiranto et al., 2020; Yu, 2007). Spatial potential

in GRDP and unemployment variables were found through global regression. This is because the test results would be assumed to be the same and apply to each observation region (Legg, 2010; Weber, 2018). GWR analysis presented comprehensive measurements by considering geographical conditions and phenomena in each region to display different observation results (Taus et al., 2013; Yu, 2007).

The economic VUCA has negatively affected the performance of companies in each region (Baker et al., 2016), because the spread of COVID-19 has had a worse impact than in previous crises (Worley and Jules, 2020). Islamic banks could restrict financing to anticipate the risk of economic uncertainty to intermediary performance (Bilgin et al., 2021). Banks have conducted strict supervision and assistance but they cannot control the disruption of supply and demand for goods and services (Amiti et al., 2017; McKibbin and Fernando, 2020a), meaning the risk of debtor depletion rates would increase (Nugroho et al., 2020). Each region has a different ability to respond to risks. However, economic growth is essential for banks to map the financing risks. When a company experiences a decline in economic growth, it impacts the stability of the banks' financial performance debtors with increase the NPF value in Islamic banks (Chalid and Bella, 2021; Kadir et al., 2021; Kuzucu and Kuzucu, 2019). In line with Fakhrunnas et al. (2022), Damanhur et al. (2018), and Suprayitno and Hardiani (2021) that economic growth in an area contributes greatly to predicting potential defaults experienced by banks. If the economy grows well, there is a small probability of default conditions. In contrast, when economic growth decreases, it will encourage an increase in NPF for Islamic Banks, so Islamic Banks need to carry out a risk mitigation process in each of their target areas (Santoso et al., 2019).

The economic shocks from uncertain conditions have resulted in recessions in most countries, decreasing economic activity and demand for labor (OECD, 2021; Raimo et al., 2021). This condition worsens with many companies experiencing bankruptcy, promoting massive terminations (Blustein et al., 2020; Boratyńska, 2021; Wang et al., 2020). Furthermore, increased unemployment would impact the financial ability of households to pay the loan (Cooper et al., 2021). So, Islamic bank raising concerns on loan repayment during the pandemic (OECD, 2021; The World Bank, 2020). The potential financing return rate would largely depend on the number of unemployed in each region because the conditions of one region to another cannot be confused. Following Isaev and Masih (2017),

the unemployment rate strongly influences the increase in NPF in Islamic banks because the greater the number of unemployed, the potential for problematic financing will increase. The amount of unemployment reflects the economy in an area, meaning that this condition illustrates the inability of a region to carry out financing due to the large number of debtors who have the potential to lose their jobs and income (Louzis et al., 2012). In addition, Degl'Innocenti et al. (2017) and Avetisyan (2021) showed that the spread of bank office could serve to maintain the stability of NPF values because a debtor's residence or business close to the branch office makes supervision and assistance in financing to run more efficiently (Ansong et al., 2015; Sholihin et al., 2018). Additionally, distance determines the amount of financing and eligibility for a debtor to receive funding (Liberti and Petersen, 2019; A. Mufraïni et al., 2020; Richards et al., 2008)

The spread of COVID-19 affects the risk of Islamic bank financing because it is handled differently by each province according to the increases in cases (Beirne et al., 2021; Erfani and Vasigh, 2018; McKibbin and Fernando, 2020b; Nugroho et al., 2020). When COVID-19 sufferers increase, so the government tightens activities. However, decreasing the number of affected people would promote easing the restrictions, allowing economic and financial activities to run normally (Wicaksono, 2022). It means that increasing social restrictions will encourage the potential increase in NPF through a decrease in income and the rate of return on debtor financing (Aldasoro et al., 2020; Flögel and Gärtner, 2020; Islamic Development Bank, 2020). Moreover, Žunić et al. (2021) explained that COVID-19 has influenced NPF. However, it was covered by the restructuring of financing by the government, so defaults were not revealed on the bank's financial statements. While Kryzanowski et al. (2023) revealed that the influence of COVID-19 on NPF arose because it was a new phenomenon for human life that had never been done before. Hence, it took time to create the best scenario so that its problems would not strongly affect the banking industry.

Debt arising from Consumptive Financing also increases NPF because financing is based on non-productive consumptive actions. When VUCA-world conditions cause changes in household income, NPF increases (Arsyianti and Kassim, 2021; Jensen and Johannesen, 2017; Teppa, 2014). Although consumptive financing is more profitable than capital financing for Islamic banks, more risks emerge during pandemic conditions (Muhammad et al., 2020). Ilmi (2018) and Priyadi et al. (2021) said that financing plays an important role in increasing NPF through delays in profit sharing by borrowers and customer failure to make timely

collections. Meanwhile, Trinugroho et al. (2021) conveyed that there is a high credit risk potential due to the moral aspect of hazard in financing contracts, so there is a need for better risk mitigation in Islamic banks. This study conducted a geographical analysis of local coefficients to show diversity in each province in responding to the risk factors of Islamic bank financing.

**Table 8.** Geographical Local Coefficients

No	Province	Significant Variable
1	DKI Jakarta	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
2	West Java	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
3	Central Java	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
4	DI Yogyakarta	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
5	East Java	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
6	Bali	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
7	West Nusa Tenggara	GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing
8	Maluku	Office Network, COVID-19
9	Papua	Office Network, COVID-19
10	Lampung	COVID-19, Consumptive Financing
11	DI Aceh	Office Network, COVID-19, Consumptive Financing
12	North Sumatra	Office Network, COVID-19, Consumptive Financing
13	Bengkulu	Office Network, Consumptive Financing

**Source:** Research finding, using GWR.

The geographical local coefficients analysis results showed that only 13 of the 34 provinces have local spatial dynamics significantly influencing NPF. These include DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Bali, and West Nusa Tenggara. The variables affecting NPF are GRDP, Unemployment, Office Network, COVID-19, and Consumptive Financing. The influential variables in Maluku and Papua are Office Network and COVID-19, while those in Lampung are COVID-19 and Consumptive Financing. Office networks, COVID-19, and Consumptive Financing affect NPF in DI Aceh and North Sumatra

provinces. Meanwhile, Office Networks and Consumptive Financing influence NPF in Bengkulu. This study also showed that each region has different characteristics (Hill et al., 2008; Tabuchi and Thisse, 2011). There is a need for a special approach to mitigating risks in financing Islamic banks (A. Mufraini et al., 2020; Wicaksono, 2022). Geographical conditions cannot be generalized because banks deal with financing risks differently in each province depending on the economic, social, political, and infrastructure conditions (Sellar et al., 2019). Moreover, Principi (2022) shows that the risk mitigation process cannot run optimally if the bank only sees phenomena that occur in one region without considering other regions because the orientation of handling financing risks involving phenomena and conditions in the entire office network can reduce the risk of loss in Islamic bank financing (Le et al., 2020). A geographical coefficients map analysis was also conducted to determine the distribution of R Square significance values in the Model.



**Figure 1.** Geographical Coefficients Map

**Source:** Research finding, using GeoDa.

The results of the geographical coefficients map in each province were divided based on the value of R Square into five categories, including  $< 0.93$ ,  $0.93 - 0.94$ ,  $0.94 - 0.97$ ,  $0.97 - 0.98$  and  $> 0.98$ . The category of  $< 0.93$  has 21 provinces, including Bangka Belitung, Gorontalo, Riau, Riau Islands, South Sulawesi, South

Sumatra, West Kalimantan, Jambi, Banten, South Kalimantan, North Sulawesi, North Kalimantan, West Sulawesi, North Maluku, Central Kalimantan, East Nusa Tenggara, West Papua, Southeast Sulawesi, West Sumatra, East Kalimantan, and Central Sulawesi. The 0.93 - 0.94 category has Bengkulu, 0.94 - 0.97 has DI Aceh and North Sumatra, 0.97 - 0.98 has Lampung, Papua, and Maluku provinces, while  $> 0.98$  has seven provinces with the highest R square value. These are DKI Jakarta, Central Java, West Nusa Tenggara, East Java, DI Yogyakarta, West Java, and Bali. Therefore, the model developed in this study contributes to NPF risk mitigation in the seven provinces included as centers of Islamic finance growth in Indonesia.

## **5. Conclusion**

This study aimed to measure the risk factors of Islamic bank financing in each province through the variables GRDP, unemployment, office network, COVID-19, and consumptive financing. It developed a regression analysis with a geographical approach based on regional weighting at latitude and longitude coordinates. Each observation on the sample allowed to have different weights and coefficient values. Additionally, this study sought to conduct spatial mapping in each province to provide comprehensive input to policymakers to implement risk mitigation in Islamic banking after the pandemic.

The study results showed differences between the GWR model and global regression. The GWR model has proven more precise in modelling factors influencing Islamic bank financing risks through comparison at the stage. Then, all exogenous variables have the potential to have an impact on NPF in each region. In addition, the GWR model can show an undisclosed relationship in the global regression approach. In contrast, the global model only shows the relationship between Office Network, COVID-19, and Consumptive Financing to NPF. Meanwhile, the GWR model reveals a relationship between all exogenous variables to NPF because the GWR model is a development of the global regression model by utilizing geographical and spatial approaches. In addition, this study reveals variations in models on financing risks in Islamic banks in each province based on geographical local coefficients analysis. The results of the analysis show that there are only 13 provinces that have model variations, including the provinces of DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, Bali, and West Nusa Tenggara with models that affect NPF in the form of GRDP, Unemployment, Office Network, COVID-19, Consumptive Financing.

Then, Maluku and Papua province with Office Network and COVID-19, Lampung province with COVID-19 and Consumptive Financing, DI Aceh and North Sumatra provinces with Office Network, COVID-19 and Consumptive Financing, and Bengkulu province with Office Network and Consumptive Financing. In addition, the Geographical Coefficients Map shows that seven provinces have a significance level of  $> 0.98$  in the model formed in each region, the majority of which are concentrated on the island of Java, namely DKI Jakarta, Central Java, West Nusa Tenggara, East Java, DI Yogyakarta, West Java, and Bali.

This study contributes to developing Islamic financial literature, especially in mitigating the financing risks of Islamic banks in an island country. Most studies use a global approach involving various methods and variables, so there still needs to be more literature. The global approach is often used as the basis for decision-making in the risk mitigation process. However, there are different dynamics between regions and regions, so decision-making often needs to be improved. This research has implications for mitigating the financing risks of Islamic banks in each province by maintaining liquidity levels. In managing risks, this research advises Islamic banks to tighten the verification of prospective debtors through the selection of proposals and a comprehensive assessment of collateral assets. Then, banks need to restructure financing considering each trustee's economic condition. In addition, there is a need to supervise portfolio performance by monitoring projects or asset activities and diversifying creditor exposures. Islamic banks must build digital infrastructure through GIS in each regional office by considering the dynamics in each province, making it easier for banks to predict the risks that can occur. In addition, the Central Bank and the Financial Services Authority must standardize Islamic banks' rules to create legal certainty in the new activity. Then, the government needs to ensure that every employee of an Islamic bank has a competency certification in financing management so that the supervisory function can run optimally. In addition, it is necessary to optimize the role of representatives of the Financial Services Authority and Central Bank offices in the region to conduct direct supervision in regulating the proposals of prospective debtors and recipients of Islamic bank financing restructuring in each province. However, each bank needs to disclose the value of financing restructuring in the financial statements so that it does not obscure the potential for an increase in NPF that may occur in the future. The Financial Services Authority is also expected to impose sanctions on Islamic banks that violate regulations related to the level of bank health. The study was limited to assessing financing risks in 34 provinces through

economic growth indicators, intermediation functions, and COVID-19 as exogenous variables. Therefore, further research is expected to involve more exogenous regions and variables to measure the risk factors of financing in Islamic banks in the future.

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## **A Survey of Islamic Business Literature (1985-2022): A Hybrid Approach**

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### **Abstract**

Islamic Business is a business activity related to Islamic principles. This study explores the development of research on Islamic business from 1985 to 2022. This study uses a comprehensive bibliometric analysis approach that combines bibliometrics and content analysis (Hybrid Approach) to analyze current Islamic business research trends. Data is collected through the Scopus database with the keywords “Islamic Business” OR “Business”. The initial data search discovers 2,066 documents and is screened according to the search topic. After the selection stage, there are 232 documents that are analyzed using R Biblioshiny software and Vosviewer. This research produces an analysis of authors, countries, institutions, subject areas, and trends on topics that influence future research. In the content analysis stage, 232 articles were classified into four sub-topics, namely: 1- Islamic business technology (30 articles), 2- Islamic banking industry (75 articles), 3- Islamic business management (77 articles), and 4- business ethics and halal-haram (50 articles). There are several keywords that rarely appear as potential topics to be researched, such as the following keywords, Shariah governance (2), macroeconomic variables (2), logistics (1), Islamic insurance (1), Ijarah (1), Islamic stock portfolio (1), and Uganda (1).

**Keywords:** Bibliometric, Content Analysis, Islamic Business.

**JEL Classification:** M21, M29, Y91, Z12.

### **1. Introduction**

Islamic Business is a business activity related to Islamic principles. Islamic business activities are activities that are not only oriented towards profitable entrepreneurs but also pay attention to halal and haram rules in business (Gümüşay, 2015). In Islamic business, innovation in marketing is an effort to respond to customers and respond to competitors in improving marketing performance in accordance with business ethics (Gait and Worthington, 2008). Business is an

activity of exchanging goods, services, or money that is mutually beneficial (Fararah and Al-Swidi, 2014; Yuspin and Wardiono, 2017). Business refers to the buying and selling of goods and services, which is an activity of a business actor who carries out business activities in the form of producing and distributing goods or services, seeking profit, and trying to satisfy consumer desires for the goods or services offered (Gait and Worthington, 2015). Islamic business is also a consideration for companies in marketing to increase sales of goods (Febriandika et al., 2022).

The term business is associated with the word “Al-Tijarah” which is a term that is often used in terminology from Islam and the Quran (Rachmiatie et al., 2022a). “Al-Tijarah” refers to managing property for profit. The basic rules of business are set out in the Al-Quran and Hadith regarding Islamic values that must be obeyed (Rachmiatie et al., 2022a). Nordin et al. (2022) revealed that the development of modern Islamic business is influenced by the role of people who live and are bound by their beliefs. From the Islamic point of view, business is not only focused on profit but also oriented toward the values of the Muslim faith (Hashim, 2012). This also applies to the application of Islamic business ethics at the level of business industry guidelines. The Islamic perception of business ethics is not only beneficial but also based on humanity (Febriandika et al., 2023), such as working for the welfare of Muslims (Abdelzaher et al., 2019; Alam et al., 2021)). The implementation of Islamic business principles can be realized in pricing policies, consumer protection, and employee management (Sukamto and Triyuwono, 2022).

This study contributes to Islamic business literature. This study describes the basic characteristics of publications in Islamic Business, including progress on topics and articles that have the most influence on publication, as well as the emergence of keywords that have the most influence on writing, starting from current keywords to future trending keywords. In this study, a review of research publications in Islamic business is carried out on the classification of subjects in Islamic business research. This study uses a comprehensive bibliometric analysis approach that combines bibliometric methods and content analysis to review 232 publications from 1985-2022. Finally, this paper describes the current Islamic business to provide suggestions for future research.

The term statistical bibliography was first used by Hulme (1923). The term was used to mean the scientific process of science and technology by calculating documents. In his work, Hulme (1923) summarized the writings of Cole and Eales, who produced original work on the growth of patents in England. Bibliometrics

was popularized by Alan Pitchard in 1969 in his work entitled statistical bibliography or bibliometrics (You et al., 2022). Bibliometrics was developed from the interest of scientists from the 20th century to the present about the dynamics of science as reflected in the production of scientific literature. It becomes increasingly complex with the use of data processing applications and in combination with content analysis. This research uses a comprehensive bibliometric analysis method by combining bibliometrics and content analysis. Studies that describe and map the flow of Islamic business research are still rare.

Islamic business characteristics are businesses that are in accordance with Islamic law (Fatema et al., 2018). A business does not only include honesty and fairness in a trade, but also business in an Islamic perspective has a business concept that is free from elements of falsehood, damage, and injustice (Kadirov, 2014). Business is not only related to humans but also related to God (Febriandika, 2020b). Ethical behavior in the Islamic business system is important because ethics in a business can benefit this world and in the hereafter. Substantively and fundamentally, good ethics in business will create good business (Ullah et al., 2018). This research can provide information about the development of Islamic business research from time to time. This study is able to assist practitioners and academics in understanding the map of Islamic business development so that they can make appropriate policies.

## **2. Literature Review**

Literature research on business trends in Islamic fintech has been carried out by Dawood et al., (2022). The study collected Scopus-indexed research articles on Islamic fintech from 2016-2022. There are 36 articles discussing the trends and challenges of the Islamic fintech business. These findings show that Islamic fintech is a promising field because it has great opportunities. The availability of capital and the great demand for Muslim markets make Islamic banking and financial products a potential business. Salesa et al. (2022) tried to test whether business research forms a circle or not by using a systematic and bibliometric review of the circular economy research approach. The aim of this study is to review the status of CE research from a business, economics, and managerial research (BEM) perspective.

In another study, Chae (2022) conducted a bibliometric analysis focusing on Digital Business Research which is using WoS-indexed journals. This study only focused on basic data such as author origin, journal origin, and other typical bibliometric information without using content analysis. This research focuses on

mapping the flow of digital business research from time to time. Similar to previous research, Aziz et al. (2021) conducted bibliometric research on Digital And Financial Inclusion Between 2014-2020. Using the same method, Rusydiana et al. (2021) focused on the theme of Islamic Accounting Research using a database from the journal Indexed by Dimendions.ai.

As far as tracing from previous research, no one has conducted research that focuses on Islamic business. Most studies use only one method, namely bibliometrics or content analysis/systematic literature review (SLR) methods. Although there are some studies that use a combination method, the scope of the topic is not Islamic business. Therefore, this research is important to be carried out as a mapping of the patterns and trends of Islamic business research.

### 3. Methods

This study uses a comprehensive bibliometric analysis approach that combines bibliometrics and content analysis (Hybrid Approach) to analyze current Islamic business research trends. This study collects research papers from journals indexed by the Scopus database. The data collection uses the keywords "Islamic AND Business" OR "Business" with the categories of article, title, abstract, and keywords in the period 1985-2022. The data are categorized based on the number of publications per year, journals containing articles in the field of Islamic Business, authors, countries, the most influential journals, institutions participating in research and publication trends on Islamic Business themes which are analyzed through Software R Biblioshiny and Vosviewer. After being processed using the data application, content analysis is used. This study uses a comprehensive bibliometric analysis approach (Hybrid Approach) that combines bibliometric and content analysis to analyze the data (Ellegaard and Wallin, 2015).

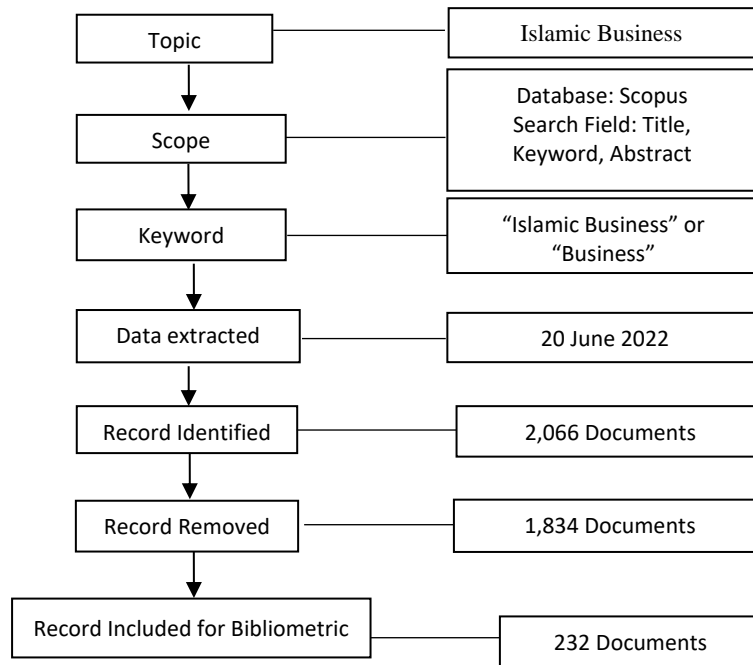
The following is a keyword search through the Scopus Database with Screening according to the field of Islamic Business:

*TITLE-ABS-KEY ( Islamic AND business ) AND ( LIMIT-TO ( OA , "all" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( SUBJAREA , "BUSI" ) OR LIMIT-TO ( SUBJAREA , "ECON" ) OR LIMIT-TO ( SUBJAREA , "COMP" ) OR LIMIT-TO ( SUBJAREA , "ENGI" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) )*

Bibliometric analysis is used to present the development of literature on Islamic Business. This bibliometric analysis allows researchers to investigate the current topic of Islamic business from previous research based on quantitative and qualitative approaches (Yan et al., 2018). Glänzel (2003) explains that bibliometrics has three main targets for current bibliometric research, namely:

1- Bibliometrics for bibliometrics (methodology); 2- Bibliometrics for scientific disciplines (scientific information); 3- Bibliometrics for science policy and management (science policy).

The following is the flow of the research that is explained through Figure 1.



**Figure 1.** Research Method Flowchart

**Source:** Research finding.

Data were obtained from the Scopus database using the keywords Islamic business through the categories of abstract, keywords, and author. An initial search on the keyword "Islamic business" yielded 2,066 documents classified by subject area. The selected document types were only articles, and the results of the search were 232 documents that were analyzed through bibliometric analysis.

The main objective of this research is to provide a comprehensive analysis of Islamic Business by answering several main research questions, namely:

1. RQ1: What are the trends toward Islamic Business research based on the number of publications per year?
2. RQ2: What are the top 10 journals that publish Islamic Business research?
3. RQ3: Who are the top 10 authors, countries, and institutions that have contributed the most to Islamic Business research?

4. RQ4: What are the main research topics that have the most influence on the field of Islamic Business?
5. RQ5: What are the trending topics for Islamic Business?
6. RQ6: What are the potential future topics for the field of Islamic Business research?
7. RQ7: What are the areas of research through analysis of the content of the article?
8. RQ8: What methods are used in Islamic Business research?

Based on the main questions of the research, the writer will conduct analysis based on the questions below: 1- Annual publication and trending quotes on Islamic Business; 2- Publication activities by institutions, authors, journals, and countries on Islamic business; 3- Co-Authorship analysis to identify collaboration networks for several researchers; 4- Co-Occurrence and Co-Citation analyzes look for the main research topics.

#### 4. Results

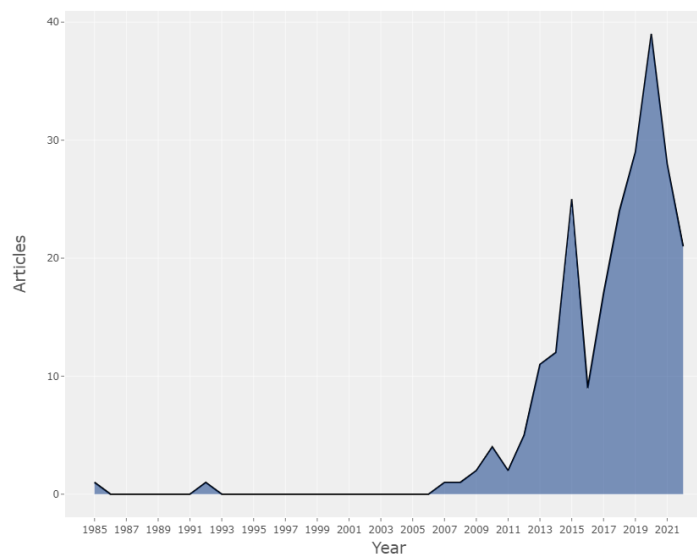
This study examines the publication trend of Islamic business literature, sources, and writing research that contributes to publishing articles on Islamic business. In table 1, general information related to Islamic business articles is collected. Table 1 shows that there are 232 documents on Islamic Business from 1985-2022. From 1985-2006, Islamic Business Research did not experience any development. Research on Islamic business began to increase drastically in 2007-2020, although it decreased in 2011 and 2016. It was recorded that in 2020 the number of Islamic business research was at the peak in terms of the number of publications and decreased in 2021.

**Table 1.** General Information

<b>Information</b>	<b>Result</b>
Main Information	
Time Range	1985-2022
Source (Journals and Conference Proceedings)	123
Document	232
Average year of publication	8.58
Average citations per document	4.48
Average citations per year per document	13.91
References	12515
Document Contents	
Keyword Plus (ID)	95

Author Keyword (DEE)	837
Author	
Author	587
Authors of single-authored documents	45
Author Collaboration	
Single written document	54
average Co-author of the document	2.76
International Co-author (%)	30.17

**Source:** Research finding.

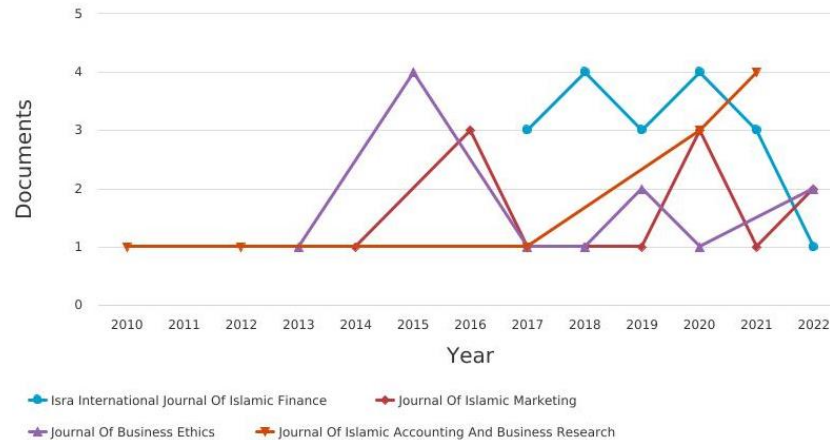


**Figure 2.** Islamic Business Publication Trend per Year

**Source:** Research finding.

Figure 2 illustrates the overall pattern of a surge in interest in the topic of Islamic business, which has increased since 2006. 587 authors were involved in this research topic from 1985-2022. Collaboration between authors has an average of 2.76 authors. Research collaboration is useful for authors to improve the quality of articles with a clear division of tasks (Mokhtar et al., 2017).

Table 2 shows published articles based on the ten highest published journals in Islamic Business from 1988 to 2022, while Figure 3 shows the number of publications per year from the four most published journals on the topic of Islamic business in the last 13 years.



**Figure 3.** The Four Most Published Journals in Islamic Business in the Last 13 Years

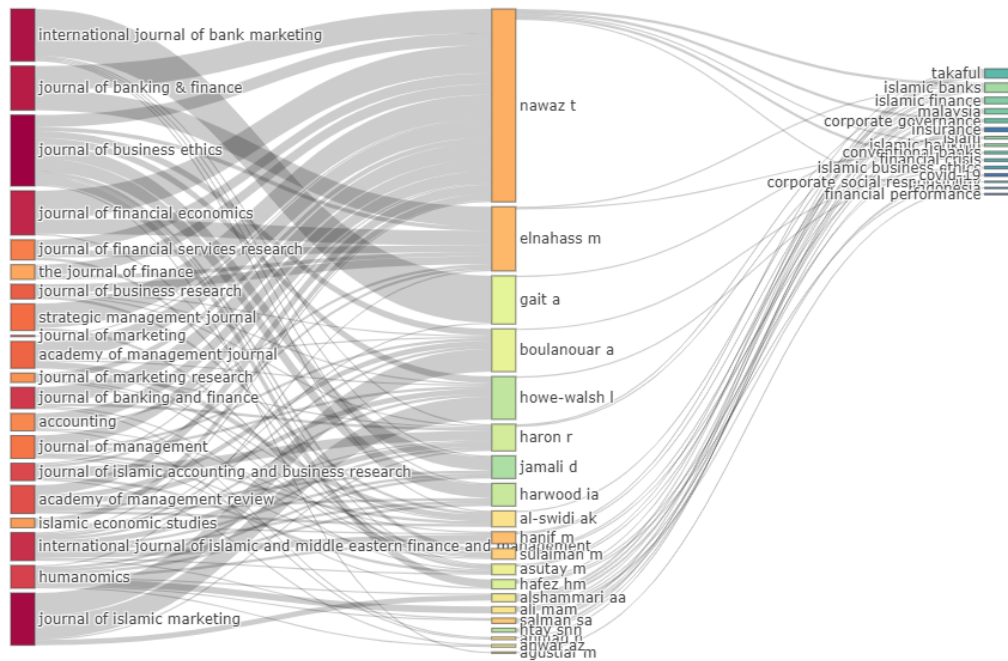
**Source:** Research finding.

Table 2 shows the top 10 journals with the most publications in Islamic Business research, with a total data analysis of 232 documents from 1985 to 2022. Isra International Journal of Islamic Finance is the first rank in the publication of Islamic Business topics with 18 documents. The second rank is the Journal of Islamic Marketing, with a total publication of 13 documents. The third rank is Asian Social Science, and the fourth is the Journal of Business Ethics, with 12 documents published.

**Table 2.** Top 10 Journals with the Most Publications

Name of Journal	Rank	Frequency
Isra International Journal of Islamic Finance	1	18
Journal of Islamic Marketing	2	13
Asian Social Science	3	12
Journal of Business Ethics	4	12
Journal of Islamic Accounting and Business Research	5	10
Journal of Social Science Research	6	6
Mediterranean Journal of Social Science	7	5
Corporate Ownership and Control	8	4
International Journal of Financial Research	9	4
Journal of Open Innovation Technology, Market, and Complexity	10	4

**Source:** Research finding.



**Figure 4.** Top 10 Journals Based on Journal Name, Author, and Topics

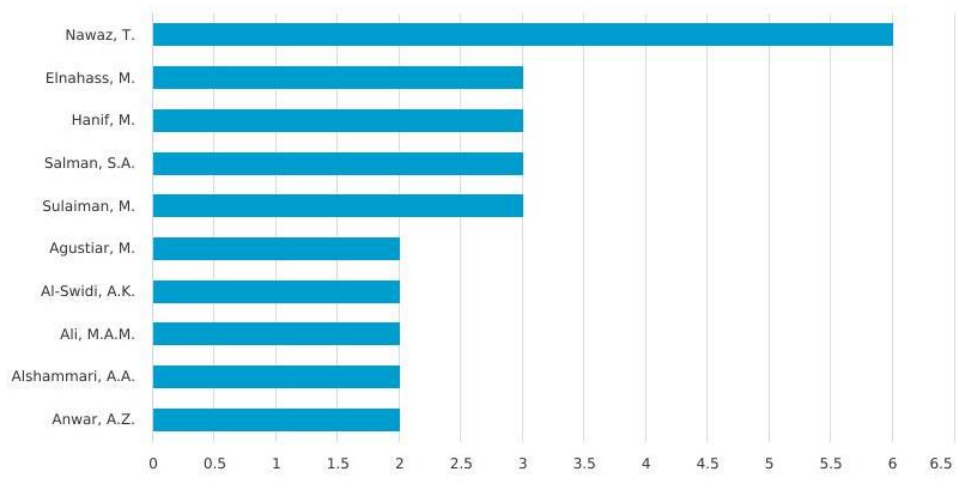
**Source:** Research finding.

Figure 4 is a chart of The Three Fields Plot processed by R Biblioshiny, which depicts three elements, namely: a list of journal names, authors, and a list of topics used. The three elements are illustrated with gray lines showing the interrelationships between the elements according to their origins in the journal. Each journal shows the respective authors who have published there. Topics will be displayed through gray lines associated with the author's research topic. In the first part of the graph, there are the top 20 journals with the topic of Islamic Business. Journal of business ethics is the journal that publishes the most Islamic business research based on the author in the picture. It is depicted as a dark red rectangle and is associated with the authors Nawaz T, Elnahass, Gait, Boulanouar, Howewalsh, Jamal, Harwood, Solomon, Hafez, and Agustiar.

Several authors from published journals linked to the previous section, such as the author's name Gait A, are associated with the international journal of bank marketing. In addition, each of these authors will be related to the topic of keywords on the right side. Nawaz T is the author with the highest number of publications on the topic of Islamic business, which is illustrated as an orange rectangle. In the third part, there are research keywords that often appear in articles.

There are 20 keywords that are often used in Islamic business research journals, namely, the green part of Tosca (Islamic Banks) and dark green (Islamic Finance).

Figure 5 shows the productivity of journal publications for the top 10 researchers with the topic of Islamic Business from 1985-2022 indexed by Scopus, which ranges from each author publishing a number of 2-5 publications per author. Nawaz has the highest productivity of journal publications with six publication documents, while Elnahass, Hanif, Salman, and Sulaiman each have three publications. Agustiar, Al-Swidi, Ali, Alshammari, and Anwar have two documents for each author.

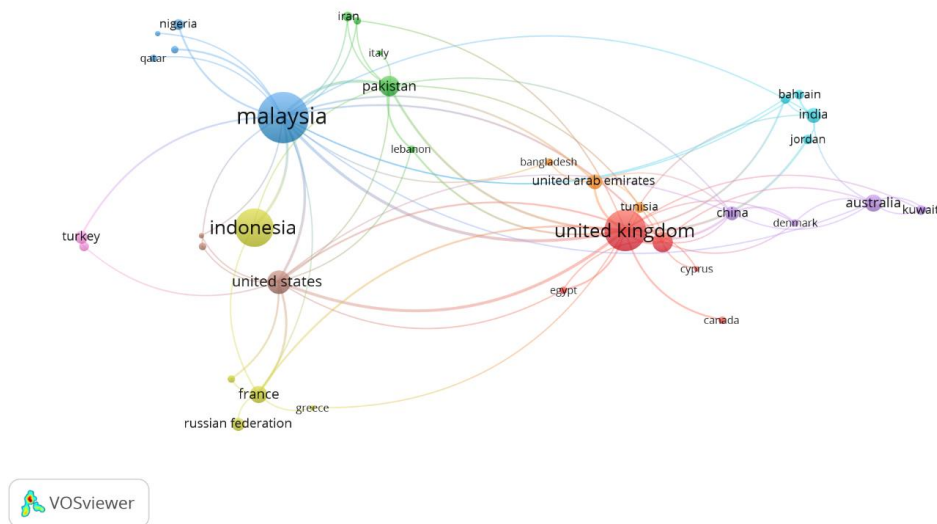


**Figure 5.** Top 10 Authors of Islamic Business Research

**Source:** Scopus.com

Figure 6 shows the countries with the highest contribution to Islamic Business. There are three most prominent countries, namely Malaysia, followed by the United Kingdom, and Indonesia. Malaysia and Indonesia are countries with a majority of Muslims, while the United Kingdom, as a non-majority country, has succeeded in being in the second position. Figure 6 shows the collaboration of the author's country in the field of Islamic business research. Circles that are connected to each other indicate cooperation between countries. The larger the circle size, the larger the country's publication number. Malaysia, the United Kingdom, and Indonesia have the most prominent circles among other countries, which means they dominate the study. These three countries are central points for Islamic business studies, whereas other countries conducting Islamic business studies have networks with Malaysia, the United Kingdom, and Indonesia.

Table 3 shows the countries with the highest number of publications. It can be seen that the highest number of publications is in Malaysia, with the results of documents published through the Scopus database as many as 78 documents, followed by the United Kingdom with a total publication of 51 documents, and Indonesia with 44 documents.



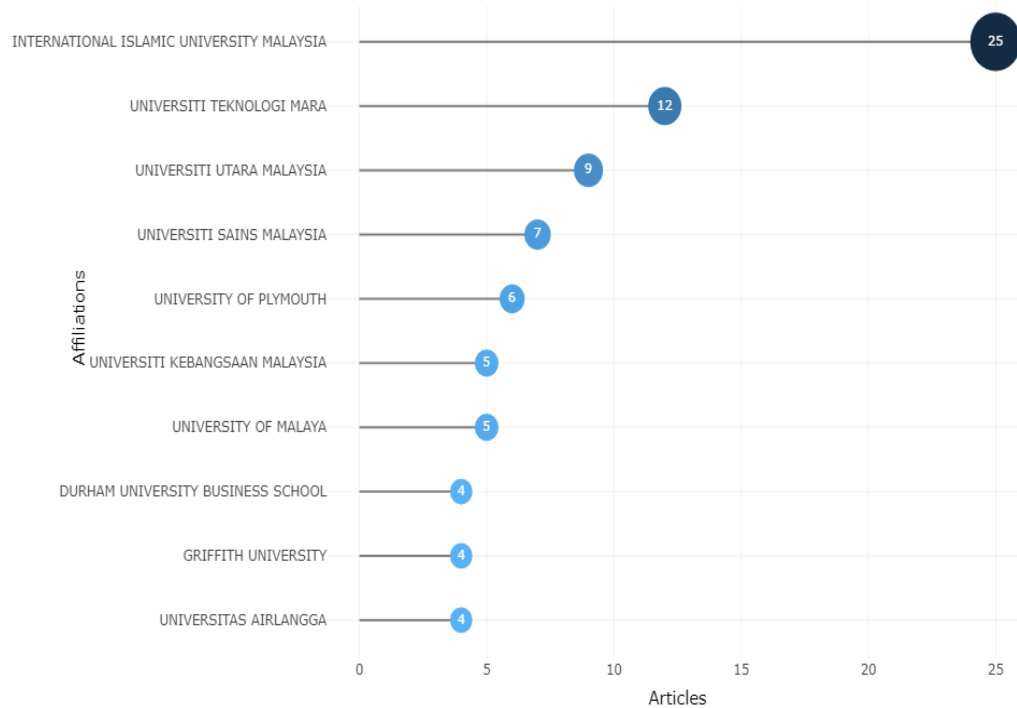
**Figure 6.** The Collaboration of the Author's Country  
**Source:** Research finding.

**Table 3.** Top 10 Author Countries by Number of Publications

Country	Number of documents
Malaysia	78
United Kingdom	51
Indonesia	44
United States	17
Pakistan	12
Saudi Arabia	12
Australia	9
France	9
India	7
United Arab Emirates	7

**Source:** Research finding.

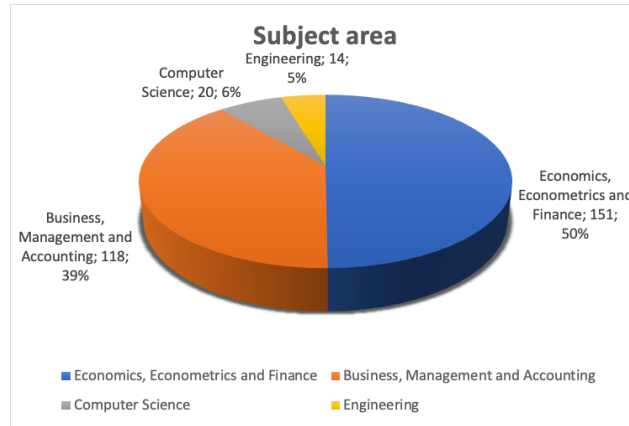
Figure 7 shows 10 of the total 319 institutions that have the highest Islamic business research. International Islamic University Malaysia with 25 articles, followed by Universiti Teknologi Mara with 12 articles published.



**Figure 7.** Top 10 Institutions by Number of Publications

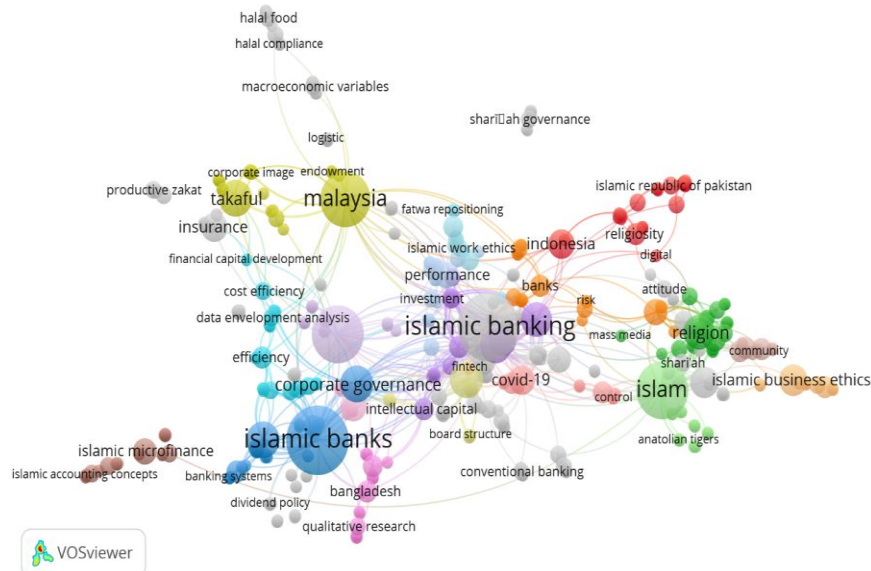
**Source:** Research finding.

Figure 8 shows that there are four subject areas for the topic of Islamic Business, namely 1) Economics, Econometrics, and Finance, with a total of 50% or 151 documents, 2) Business Management and Accounting as much as 39% or 118 documents, 3) Computer Science as much as 6% or 20 documents, and 4) Engineering as much as 5% or 14 documents.



**Figure 8.** Main Subject Area  
**Source:** Research finding.

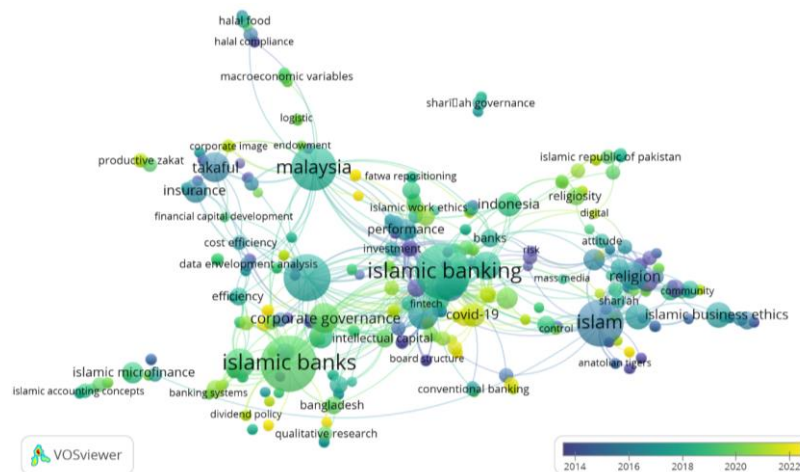
Figure 9 Shows clusters of trending topics in Islamic business that contribute to the influence of Islamic business growth. Figure 9 shows a visualization of items (keywords) related to the research topic that is labeled and symbolized as circles by default in Vosviewer. The more often the keyword appears, the bigger the circle. The size of the circle indicates the importance of the keyword. The nine keywords are the result of the extraction process from 1620 keywords. Only 481 of 1620 keywords match the topic of Islamic business. The 481 keywords were analyzed and resulted in 9 prominent clusters, which were shown in different colors.



**Figure 9.** Network Visualization of the Main Topic

**Source:** Research finding.

Figure 10 shows the data visualization of the potential future topics of Islamic business. The analysis map contains keywords that have the potential to become future topics based on frequently used patterns from 2014-2022. The year information under the right corner is written with the number of years and a color chart that indicates the type of cluster in the research keywords used from 2014-2022. In data visualization, there are four-color clusters where the lighter the color, the higher the potential for use in the future. Dark colors are clusters with keywords that are used the longest and are rarely used in the future. A light color indicates that the keyword has not been widely used before and has a high potential to be used in the future. Research topics in 2022 have a high potential for future use based on color cluster analysis.



**Figure 10.** Overlay Visualizations in Islamic Business Topics

**Source:** Research finding.

Figure 10 shows that there are several keywords that rarely appear as potential topics to be researched, such as the following keywords, Shariah governance (2), macroeconomic variables (2), Logistics (1), Islamic insurance (1), *Ijarah* (1), Islamic stock portfolio (1), and Uganda (1).

**Table 4.** Cluster Analysis Results

No.	Cluster	Main Keywords (Big Circle)	Keywords (Small Circle)
1	First cluster	Islamic Banking (27), financial crisis (8), Business (7), Indonesia (5), Banking (7), Sustainability (4), Attitude (2),	Financial performance (4), Financial distress (1), Consumer behavior (1), covid-19 (5),
2	Second cluster	Islamic finance (19), takaful (8), insurance (5),	Certification (1), financial capital development (1), cryptocurrency (1), financial inclusion (3), Stability (2), efficiency (3),
3	Third Cluster	Islamic Banks (28), financial stability (5), corporate governance (8), Conventional bank (8), Bank financing rate (1), Banking (7),	Board business (3), Bangladesh (3), qualitative research (3), Corporate social responsibility (8), Financial crisis (8), the central bank (1),
4	Fourth cluster	Malaysia (18),	Halal Tourism (2), Dividend yield (1), Corporate image (1), governance (2), Bank Financing (1), data envelopment analysis (2), consumer behavior (1), downward accountability (1)
5	Fifth cluster	Islam (19), religion (7),	Accountability (3), culture (4), financial reporting (1), finance (2),
6	Sixth cluster	Islamic business ethic (6), business ethic (3), and corporate social responsibility (6).	No keyword

**Source:** Research finding.

In the classification of this analysis, Islamic Business publications have two types of basic methods, namely quantitative and qualitative. Table 5 shows the types of methods used by 232 research papers.

**Table 5.** Classification Based on Research Method

Method	Method type
<b>67 Documents (Quantitative)</b>	<ul style="list-style-type: none"> <li>• Correlation analysis (1)</li> <li>• Unbalance data analyst (1)</li> <li>• Structural equation (3)</li> <li>• Envelopment data analysis (1)</li> <li>• SEM (5)</li> <li>• Partial least Square-SEM (PLS-SEM) (9)</li> <li>• Empirical Testing (1)</li> <li>• Descriptive quantitative analysis (1)</li> <li>• Generalized method (GMM) (4)</li> <li>• Beta and sigma convergence approach (1)</li> <li>• Multi-stage (1)</li> <li>• Structural-Conduct-Performance (SCP) (1)</li> <li>• Purposive Technique (1)</li> <li>• Explanatory (1)</li> <li>• ECA Method (1)</li> <li>• Grounded Theory(1)</li> <li>• Cross-sectional (1)</li> <li>• Theory of Consumption Value (TCV) (1)</li> </ul>
<b>165 Documents (Qualitative)</b>	<ul style="list-style-type: none"> <li>• Empirical research (5)</li> <li>• Semi-structured interviews (5)</li> <li>• SWOT Analysis (1)</li> <li>• Secondary data (1)</li> <li>• Constructivist approach (1)</li> <li>• Descriptive analysis (1)</li> <li>• Difference analysis (1)</li> <li>• Literature study (91)</li> <li>• Comparative Analysis (1)</li> <li>• Similarity analysis (1)</li> <li>• Inductive approach (1)</li> <li>• Tabayyun approach (1)</li> <li>• FGD Method (1)</li> <li>• Post-positivism (1)</li> <li>• Comparative Study (8)</li> <li>• Relevant literature (3)</li> <li>• Descriptive study (3)</li> <li>• Case study (2)</li> </ul>

**Source:** Research finding.

## 5. Discussion

At the content analysis stage, 232 articles were classified into four sub-topics, namely 1) Islamic business technology (30 articles), 2) Islamic banking industry (75), 3) Islamic business management (77), 4) business ethics and halal-haram (50). The literature that discusses the role of technology in Islamic business is important for building a sustainable business. Technology has become a key driver for all business operations, which has dramatically changed the wireless communication marketing paradigm that has a positive relationship between mobile and email marketers on consumer impulse buying tendencies (Waheed et al., 2018).

E-auction technology is a good e-commerce application, although some studies reveal doubts about the application from an Islamic perspective. The identification generated by experts shows that the application is promising in terms of collaboration in a business, including Islamic business (Al-aaidroos et al., 2019). Some companies create appropriate marketing strategies to identify potential growth areas and areas of improvement in takaful business practices (Mokhtar et al., 2017).

Kamaruzaman et al. (2018) explain the potential of the design of Satoshi Nakamoto, who designed a so-called revolutionary blockchain as the engine behind the virtual currency. The technology is an online ledger that records every transaction made in an irreversible way. In terms of technology tourism, it has a good strategy for overcoming operator constraints in the Islamic tourism business (Junaidi, 2020). The enforcement of sharia rules in technology shows how the rules in a financial institution, where Islamic financial information systems can be used to make decisions for daily business activities (Alsmadi and Zarour, 2015). This has the opportunity for sharia business institutions to capture the millennial generation as a market share to introduce sharia business products and contracts through the digitalization of Islamic businesses and unique segmentation. This opportunity is used to consider and expand the market in Indonesia (Bakry et al., 2021).

The establishment of a new network is needed to specialize the national network of manufacturing and distribution of halal products through developed exports. (Da Cunha et al., 2016). The enforcement of sharia rules from the point of view of information technology shows how these rules are applied in a financial institution (Alsmadi and Zarour, 2015). The findings in Malaysia introduce *retakaful* among the takaful operators who will create a mutually beneficial business environment (Htay et al., 2014).

The literature on banking in Islamic business is the second most popular research topic, with as many as 75 articles. Islamic banks play an important role in driving the pace of economic growth by assisting in policymaking to improve the current banking industry. Ashurov and Othman (2019) shows evidence of how efficient Islamic banks are in carrying out their role in determining Islamic financing. Islamic banks are able to reduce financial constraints and increase efficient capital allocation in the area of Java by achieving good efficiency (Zulkhibri, 2018; Cahyono and Laila, 2017). Islamic banking carries out business activities based on sharia principles. The contract is regulated according to an agreement that does not conflict with Islamic law between a bank and another party to save and or finance an activity or business (Purwanto, 2018). Islamic banking activities are carried out on the basis of Islamic law, namely the Qur'an and Hadith (Maswood and Lokeswara Choudary, 2015). Islamic financial institutions were established to ensure adequate financing for all components of the ecosystem during the entire life cycle (Tahiri Jouti, 2019). Islamic banks become a vital tool in furthering SDGs by providing effective communication between stakeholders, focusing on the actual economy, and taking sides on SMEs. Furthermore, a prior study indicated that Islamic banking's increased market share substantially impacted speeding up the recovery process during the epidemic. As a result, considerable government support is required to increase economic development contribution to achieve the SDGs, particularly during the crisis period.

Nawaz (2019) finds new insights into the Islamic banking business model by considering the effect of investment in human capital and features of corporate governance on market performance in Islamic banks. The financial crisis may have further boosted the impact of investments in human capital on the performance of a market. The influence of resources is not only tangible on finance but can be in the performance of accounting and market-based companies from two bank business models, namely conventional banks and Islamic banks (Nawaz, 2016). The crowdfunding concept is recommended as a funding solution for small and medium enterprises and startup companies. The development of a sharia crowdfunding model based on a website platform is a form of innovation to provide alternative funding for startup companies that are expected to grow into sustainable businesses (Hendratmi et al., 2020).

Islamic microfinance is a growing industry in some countries, but it is a fundamental role of sharia-led financial intermediaries to improve lives and solve problems in the economy (Mansori et al., 2015). Malaysia tries to promote itself as a center of Islamic finance and government by promoting the Islamic finance

industry. Malaysia introduced a Retakaful among takaful operators to create a mutually beneficial business environment (Htay et al., 2014). Islamic banks show a level of efficiency in carrying out their role as suppliers of capital for businesses and entrepreneurs (Zulhibri, 2018). Islamic banks tend to be more risk-resistant compared to conventional banks based on observations in the 2009-2014 period (Grassa et al., 2020). In the research of Atici (2018), there is a causal relationship between Islamic banking and economic growth, which shows that efforts to improve the regulatory system underlying Islamic banking (participation) have a positive contribution to economic growth. However, the industry in the petroleum business that uses funds from conventional banking has a greater advantage than Islamic banking. In contrast, Islamic banking has a greater advantage in Iran (Effendi, 2019). Therefore, Islamic banking institutions play an important role in a business to encourage the rate of economic growth by making a policy to improve the current banking industry. Second, the concept of crowdfunding is recommended as a funding solution for small and medium enterprises and startups.

77 documents in the literature discuss management in Islamic business. Understanding the principles of human resource management (HRM) can help improve the quality of the Islamic business industry (Branine and Pollard, 2010). Islamic business needs to develop through innovation and improvement of managerial quality in order to grow and increase profitability (Da Cunha et al., 2016). Management is a series of activities that include planning, organizing, implementing, and controlling to achieve certain goals (Widiastuti et al., 2021). In this case, Islam also encourages entrepreneurial activity at the micro, medium, and macro levels through Islamic and honest managerial improvement (Gümüşay, 2015).

Business ethics is designed to apply the theory of standards of truth to business practice. This can be taken into consideration for business activities and product design (Alotaibi et al., 2022). A value chain is an activity required by a company operating in a particular industry to provide a valuable product or service to the market. The value chain plays an important role in the development of good business units by exploring the implications for HRD and practice in a company (Kangarlouei and Alghyani, 2015; Howe-Walsh et al., 2015).

Corporate governance has become an effective mechanism for managing business operations that have a major impact on financial performance (Tazilah et al., 2021). In the development of business management, there are four components to strengthen growth and development in a business, namely, production, business transactions, marketing, and the role of the government based on Islamic creed,

Islamic law (sharia), and morality that act as good business causality (Nordin et al., 2022). In business management, there are three considerations related to the application of ethics in business, 1) choosing the right name is an important aspect of successful branding and marketing of products or services, 2) food products that are in accordance with ethical principles and image are important issues in people's brand choices, 3) market business strategy brings success through proper design and implementation (Saidi, 2009). Shafiq et al. (2017) show that the field of Islamic marketing is developing considering the public's belief in Islamic advertising. In addition, the development of Islamic business has a positive impact on the entrepreneurial motivation and competitiveness of companies (Hove et al., 2014).

Since 2000 the halal industry market has received attention through the many products and services that have emerged using the halal label (Da Cunha et al., 2016; Febriandika et al., 2023). Obedient Muslims will follow the rules of their religion obediently, especially in choosing products and services (Febriandika et al., 2020a). Therefore, the demand for halal products forms a potential market in the business world. Several research models are designed to find out the interest in buying halal products through halal images, attitudes, subjective norms, and behavioral control (Suki and Salleh, 2016). Displaying a halal image aims to let consumers know that every product in the store is a halal product (Bakar et al., 2018). Halal certification on a product can increase the value of a product because the halal certification can encourage customer buying interest (Hayat et al., 2013).

Many studies try to examine the factors that can increase purchase intention on halal products (Fatema et al., 2018). Islamic business provides a dominant system to be the key in forming three business mechanisms, namely 1) importing religious practices as business practices, 2) religious values as the rationale for carrying out a business action, 3) family religious values define business taboos by avoiding the evil eye (Kavas et al., 2020).

Theoretical and practical implications of this research are expected to provide insight to Islamic business practitioners and academics in formulating strategies to deal with the dynamics of Islamic business development. It is hoped that Islamic business managers, especially Islamic banking, will be able to see the potential and challenges after the pandemic since many studies have discussed the issue of this pandemic. Islamic banks become a vital tool in furthering SDGs by providing effective communication between stakeholders, focusing on the actual economy, and taking sides on SMEs. Furthermore, a prior study indicated that Islamic banking's increased market share substantially affected speeding up the

recovery process during the epidemic. As a result, considerable government support is required to increase economic development contribution to achieve the SDGs, particularly during the crisis period. The lessons learned from this research are related to the essential concepts of Islamic business, which are based on ethical and moral principles. Existing policies have to be examined and redesigned to strengthen the contributions of Islamic business to economic growth. The participation of government substantially improves the effectiveness of Islamic business. As a result, the government must take vital steps to hasten the development of Islamic economic institutions by applying all of Islamic economics' principles.

## 6. Conclusion

This study examines the publication trend of Islamic business literature, sources, and writing research that contributes to publishing articles on Islamic business. This study collects research papers from journals indexed by the Scopus database ([www.scopus.com](http://www.scopus.com)). The data collection uses the keywords "Islamic AND Business" OR "Business" with the categories of article, title, abstract, and keywords in the period 1985-2022. The data are categorized based on the number of publications per year, journals containing articles in the field of Islamic Business, authors, countries, the most influential journals, institutions participating in research and publication trends on Islamic Business themes which are analyzed through Software R Biblioshiny and Vosviewer.

There are 232 documents on Islamic Business from 1985-2022. From 1985-2006, Islamic Business Research did not experience any development. Research on Islamic business began to increase drastically in 2007-2020, although it decreased in 2011 and 2016. It was recorded that in 2020 the number of Islamic business research was at the peak in terms of the number of publications and decreased in 2021. In the content analysis stage, 232 articles were classified into four sub-topics, namely: 1) Islamic business technology (30 articles), 2) Islamic banking industry (75 articles), 3) Islamic business management (77 articles), and 4) business ethics and halal-haram (50 articles). There are several keywords that rarely appear as potential topics to be researched, such as the following keywords, Shariah governance (2), macroeconomic variables (2), Logistics (1), Islamic insurance (1), *Ijarah* (1), Islamic stock portfolio (1), and Uganda (1). Research topics in 2022 have a high potential for future research.

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## The Impact of Technological Innovation on Labor Market: Evidence from Low- and Middle-Income Countries

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### Abstract

With all the technological advancements over the world, a great interest is on its effect on jobs. Technological change takes away or creates more jobs for human? This debate has been going on for a long time and still ongoing in different countries. The limited studies on the topic in low and middle incomes countries gives us the opportunity to study a subject that have not yet been sufficiently addressed, specially that technology is changing work in these countries day by day as it was demonstrated in the covid19 pandemic. To be more objective in presenting the research finding we used a literature review based on the meta-analysis method. We tried to synthesize and summarize the results of 19 studies by using a quantitative method that allowed us to report 531 estimations. Three reference models were distinguished: Derived labor demand model (DDM) developed by Van Reenen (1997), skill share model (SSM) created by Machin and van Reenen (1998) and the most recent: innovation decomposition model (IDM) used by Harisson et al. (2014). The review found that the effect of technology varies depending on the type of innovation, for process innovation work can be more efficient and less time-consuming for skilled workers although unskilled workers are more likely to be replaced by automated processes. For product innovation the effect is positive on total employment, we may consequently state the validity of Skill biased technological change hypotheses (SBTC) for low- and middle-income countries. However, the presence of publication bias and heterogeneity limits the generalizability of these results.

**Keywords:** Employment, Meta-Analysis, Process Innovation, Product Innovation, Technology.

**JEL Classification:** E24, O31, O32, O33.

### 1. Introduction

The development of technologies all over the world creates considerable uncertainty. Automation, artificial intelligence and robotics has reshaped the

workplace and the challenges in labor markets are growing. In one hand it brings the promise of higher productivity and efficiency (job creation effect). In the other hand it raises questions about the way it is replacing some jobs and changing the nature of others (job destruction effect).

Technology is defined by OCDE (1996) as "the state of knowledge concerning the means of transforming resources into products" or as "the machines and equipment developed through the application of scientific knowledge". Since the first time that Jacob Bigelow used in 1829 the term technology in his work "Element of Technology". Several authors have written on the subject. Technology resulting from advanced research and development activities was introduced by the new theory of economic growth as a main engine of economic growth (Romer, 1986; Aghion and Howitt, 1992). The production of a new technology involves two types of processes: invention and innovation. The first involves the formulation of scientific theories or processes while the second is the direct application of this knowledge for a useful purpose whether it be a process innovation (procedure innovation) by introducing new ways or product innovation by making changes to the existing product or introducing new one. Addressing the technology in its different aspects can help us understand its effect on jobs, skills and the nature of work itself.

According to our research, theoretical and empirical studies relating to the impact of technological innovation on employment in developed countries can be classified by reference to three hypotheses: Skill-based technological change (SBTC) hypothesis (Katz and Murphy, 1992; Bound and Johnson, 1992; Machin et al., 1998; Autor et al., 1998; Falk and Seim, 1999; Barteland et al., 2007; Gera, 2001; Gregory et al., 2001; Pivaand et al., 2005); Capital-skill complementarity hypothesis (CSC) (Berman and al., 1994; Golden and KATZ, 1998) and recently the routine-based technological change hypothesis (Autor et al., 2003; Acemoglu and Autor, 2011; Bessen, 2015; Graetz and Michaels, 2018; Frey and Osborne, 2017; Hemous and Morten, 2018; Agion et al., 2019; Acemoglu and Restrepo, 2020).

While the majority of studies analyzing the effect of technological innovation on employment have much been researched in developed countries our work focuses on analyzing this subject in countries classified by the World Bank as low and middle-income countries that have not been sufficiently studied. It was inspired from the empirical sample studied by Ugur and Mitra (2017) that we have extended to 19 studies in order to capture a more complete picture. Based on meta-

analysis method to combine the results of multiple studies to provide a quantified and reproducible synthesis.

The remainder of this paper is organized as follows: Section II introduces the theoretical analysis, Section III presents the methodology Section IV present the findings and discusses the results, and the last section concludes and offers recommendations for future research and practice.

## **2. Theoretical Analysis**

Apart of understanding the relation between technological innovation and employment, the theoretical analysis in this section is devoted to present a synthesis of the various reflections and articles that have covered the topic. Certainly, the subject has interested many authors that we cannot quote all especially in developed countries. However, we chose to focus our reflection on developing countries that presents a context not sufficiently studied, the thing that could give more value to our article. More explicitly, the objective of this section is to present an evaluation of the empirical models used to analyze the relation between technological innovation and employment in developing countries.

One of the most recent systematic revues published by Kerestin et al. (2022) shows that the availability of data allowed the author to expand the study to 127 contributions published between 1988-2021. This study has gone beyond the traditional analysis based on SBTC hypothesis commonly used in developing countries to deepen the analysis using additional factors in particular: Robotization digitalization or Information and Communication Technology. According to their work the replacement effects of new technologies on employment is based on the use of robots, this moved the debate currently to the effect of technological change on jobs that are sensitive to automation and lead to the identification of routine or non-routine jobs. Likewise, we have found that the most recent and comprehensive analyses from 2010 to 2022 are those of the developed countries because they have rich databases such as (PIAAC<sup>1</sup>, International Federation of Robotics (IFR), EU Labor Force Survey (LFS) ...) that analyze the technology in its various aspects with more details, thing that have allowed them to increase the analysis from one level to another.

Understanding the relation between technological change and employment is the mean to verify the capability of this technology to transform a given set of inputs into outputs (Ruttan, 1959) destroy or create jobs to extent that it makes

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<sup>1</sup>. Survey of Adults Skills

production processes more efficient and enabling firms to produce the same goods with less labor and capital.

Articles on less and middle-income economies dealing with this subject are based on three references models: ‘Derived Labor Demand model’ (DDM) proposed by Van Reenen (1997), ‘the skill structure model’(SSM) developed by Machin and Van Reenen (1998) and extended by Acemoglu (1998) and finally ‘the innovation decomposition model’s (IDM) presented by Harrison et al. (2014).

### 2.1 Derived Demand Model

The stochastic representation of Van Reenen (1997) is reproduced below. The starting point comes from a CES production function:

$$Y = A[(A_L L)^{(\sigma-1)/\sigma} + (A_K K)^{\sigma/(\sigma-1)}]^{\sigma(\sigma-1)} \quad (1)$$

where  $Y$  is production,  $L$  is employment, and  $K$  is capital.  $A$  is a parameter that embodies technology, neutral in the sense of Hicks;  $A_L$  is a parameter that reflects the increase in the labor factor, neutral in the sense of Harrod; while  $A_K$  represents technical change, neutral in the sense of Solow. Van Reenen (1997) assumes perfect competition for his model.

Indeed, Van Reenen (1997) replaces the unobservable technology term  $A_L$  and  $A_K$  with a measure of innovation so that the stochastic form of the demand function becomes:

$$l_{it} = \alpha Inno_{it} + \beta w_{it} + \gamma k_{it} + \tau_t + \mu_{it} \quad (4)$$

where  $i$  is the company,  $t$  the period,  $\mu_{it}$  is an error term.

In order to deal with the endogeneity problems the users of this model bring lags or instrumental variables to derive the innovative aspect of the firm; it therefore requires long series of data to give us several conclusions.

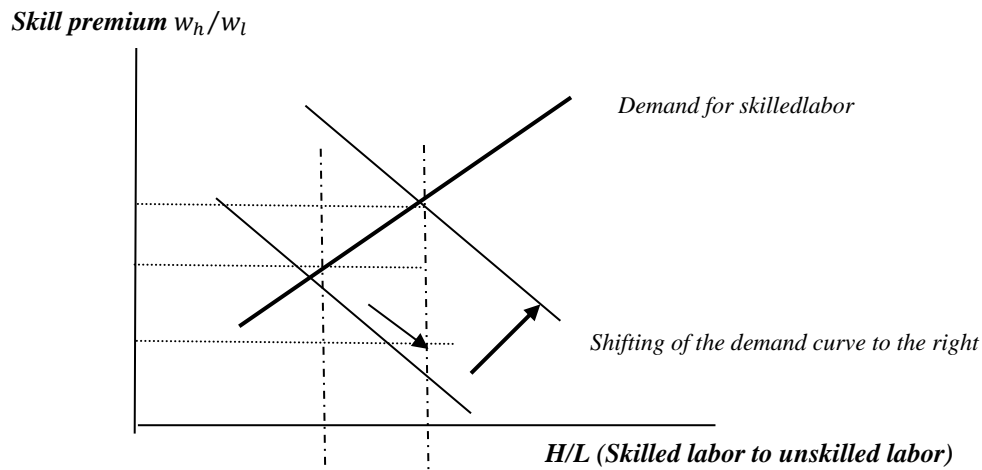
### 2.2 The Skill Structure Model (SSM)

By qualification, the theoretical model developed by Machin and Van Reenen (1998) to understand the impact of technological progress on the labor market were established on the basis of the hypothesis of skill-biased technological change (SBTC) that was the object of the majority of studies in developed countries in the 1990s. Among the models used to check the validity of this hypothesis, the model of Machin and Van Reenen (1998) stands out.

$$\begin{aligned} \Delta SHARE_{ijt} = & \alpha_j \Delta \log(K_{ijt}) + \beta_j \Delta \log(Y_{ijt}) \\ & + \gamma_j \Delta \log(R\&D/Y)_{ijt} + \eta_{jt} D_{jt} + u_{ijt} \end{aligned} \quad (3)$$

where  $\Delta SHARE$  denotes the part of skilled employees in the wage bill for an industry  $i$  in a country  $j$  at a time  $t$ . The ratio of R&D expenses to production measures technological change. In Equation (5), capital is assumed to be a quasi-fixed. Consequently, the evolution of the demand for skilled workers depends on spending on research and development. In addition, the skill-sharing model by Machin and Van Renen (1998) also allows substitution between the labor and capital factors for the two types of employment (skilled and unskilled).

Following the same logic, Acemoglu (1998) developed a theoretical model based on the work of Aghion and Howitt (1992). The specificity of Acemoglu's work lies on the fact that technology is endogenous, expressed as a function of relative price and as a function of the ratio  $H/L$  of skilled labor compared to unskilled labor  $\frac{A_h}{A_l} = f(p, H/L)$ . As shown, the analysis of Acemoglu can be summarized in the graphic below:



**Figure 1.** Technological Change and Demand for Skilled Labor

**Source:** Acemoglu (1998).

Therefore, it looks clear that the SBTC hypothesis is based on the assumption that technological progress augments the labor productivity of skilled workers by more than it does that of unskilled workers, thereby shifting to the right the labor demand curve for skilled workers further than that of unskilled workers.

The key insight Acemoglu's framework is that, since technology is endogenous, it predicts for skilled workers an increase in the skill premium<sup>1</sup>, when SBTC induces an acceleration in the demand for skilled relative to unskilled

<sup>1</sup>. The wage of skilled relative to unskilled workers.

workers, and a decrease in the skill premium when there is an acceleration in the supply of skilled relative to unskilled workers.

Note that SSM framework suppose that the substitutability between technology and skilled workers is less than that between technology and unskilled workers, therefore SSM framework can provide us a meaningful result when the data used relates to the type of activities that could be automated.

### 2.3 The Innovation Decomposition Model (IDM)

A third type of model is the one of Harrison et al. (2014), it is often used to interpret survey data established in accordance with the Enterprise Survey, it is also a model that distinguishes between product innovation and process innovation, it was the subject of several studies dealing with the relationship between technological innovation and employment. For Harrison et al. (2014) the employment growth rate is expressed in terms of the production growth rate of the new and old product. The stochastic equation is:

$$l_i - y_{1i} = \alpha_0 + \alpha_1 d_i + \beta y_{2i} + u_i \quad (4)$$

where  $l$  is the growth rate of employment,  $y_{1i}$  and  $y_{2i}$  are the growth rates of sales of new and old products with  $u_i$  an error term that refers to unobserved random disturbances. Therefore, the Harrison et al. (2014) distinguishes between process innovation measured by a dummy variable and product innovation measured by the sales growth rate of a new product.

Studies that use IDM often use data from the Community Innovation Survey (CIS). These surveys are regularly conducted by statistical offices to assess the innovativeness of firms and regions. Typically, the surveys allow distinguishing between process and product innovation and, in some cases, organizational innovation. Process innovation is measured by survey questions asking firms to report whether they implemented a new improved production method that was empirically transformed into a dummy variable. The same, product innovation is evaluated based on a question asking firms whether they recently introduced a new product, then it is calculated by variation of sales.

We can deduct from this that the frontiers between product innovation and process innovation will not be always clear, as consequence including both types in the same model can involve ambiguities when interpreting results. The same, the introduction of a product innovation may coincide with input changing requirements as seen in the quantity and type of labor. This is why labor-saving technological change does not necessarily lead to layoffs, those employees that are no longer required to produce find other useful tasks within the firm.

The difference between Derived Labor Demand Model (DDM) and innovation Decomposition Model (IDM) is the omission of wages in the latter. Wages disappear in IDM because labor demand is determined by production growth rate of the new and old product and considered wages as given. In addition, the Skill Structure Model (SSM) suppose that the rate of substitution between inputs (capital and labor) depending on the type of skills is not constant. It seems that the innovation decomposition model (IDM) suffers from inherent limitations, the variable  $y_{1i}$  includes some employment implications that needs further information to be separated: the possible increase in demand for old product, the compensation effect of a decrease in the old product price due to process innovation and the reduction of old product demand.

In summary, it is challenging to verify the validity of SBTC hypothesis for low- and middle-income countries and whether or not technological change is labor replacing. We pointed out from our researches that the lack of data is the main factor that limits the analysis. The use of simple undeveloped variables such as sales of new product, R&D expenditure or dummy variable to capture the innovative character of a firm do not take into account automation and technical criteria and does not make it possible to deepen the analysis on others aspects and have indeed precise results, moreover some measures does not reflect the nature of tasks executed by employees such as diplomas/qualification or number of workers/hours. As results the analyses in developing countries are limited to SBTC hypothesis and the effect of technological innovation is likely heterogeneous across industries and occupations.

### **3. Data and Methodology**

The aim of this section is to present the methodology adopted. It presents the models and methods adopted and explain the steps followed. In our work in order to have an effective understanding of the existing links between technological innovation and employment.

In so far, as there is an important study dealing with our subject, we chose to use meta-analysis method to have a better integration of empirical results, it takes into consideration moderating factors and provide a quantified and reproducible synthesis of the existing literature.

Our study was inspired from the empirical sample studied by Ugur and Mitra (2017) that we have extended to 19 studies published between 1976 and 2020 followed by PRISMA 2020 guidelines from several research platforms such as: JSTOR, Proquest, ScienceDirect, EconLit and SSRN, Springer, Web of Science.

The goal is to extend the period to capture a more complete picture of the effects of technological innovation in low- and middle-income countries for each model examined. The research was performed using terms that appeared either in the title, abstract, or list of keywords of studies that provides empirical relationship between labor combined with technology or innovation.

We first codified these studies and achieved 530 effect sizes<sup>1</sup> by a set of common moderating factors<sup>2</sup> such as: type of publication, estimation method, type of job, type of innovation, type of model, sector and country/region covered by the study (Table A1 in the appendix). Second, we used funnel plots to show the degree of heterogeneity and selection bias. It is the simplest and most commonly used method to detect publication selection bias (Sutton et al., 2000a). Third we adopted the approach recommended by Stanley and Doucouliagos (2012) (Figure A1 in the appendix) in order to confirm the absence of asymmetry deduced from the funnel plots and identify the existence and the nature of the relationship between technological innovation and employment, it is based on conducting a bivariate estimation using PET/FAT tests (Precision-effect testing/Funnel-asymmetry testing) calculated according to the following expression:

$$t_i = \alpha + \beta \left( \frac{1}{SE_{CCP_i}} \right) + \vartheta_i \quad (5)$$

In the light of the results provided by the PET/FAT tests, we proceeded to a PEESE estimate (The precision-effect estimate with standard error) to produce economic conclusions. The PEESE estimate takes into account the selection bias and the non-linearity of the relationship between effect sizes (According to the Figure A1 in the appendix for investigating and correcting bias).

Finally, we tried to determine the sources of the heterogeneity, identified by using a multiple meta-regression (MMR) in which we integrate the moderating factors (see the appendix for more technical details). It is based on the following reformulation:

$$t_i = \delta_0 + \delta_1 \left( \frac{1}{SE_{CCP_i}} \right) + \sum_2^k \delta_k (Z_{ki} / SE_{CCP_i}) + \epsilon_i \quad (6)$$

where  $1/SE_{CCP_i}$  is the precision,  $Z_{ki}$  is a vector of moderating factors.

We estimate MMR with five estimators (fixed effect estimates, fixed effects estimates with bootstrapped standard errors, hierarchical method estimation with random slopes and intercepts, hierarchical method estimation with random

<sup>1</sup>. Measures the strength of the relationship between two variables.

<sup>2</sup>. The variables susceptible to be associated with the results of the study.

slopes/intercepts and bootstrapped standard errors, weighted fixed effects estimates using  $1/N$  as weights), the interpretation of results is based on the estimation that provides the lowest AIC and BIC values between OLS, fixed effects, and hierarchical model estimations.

#### **4. Result and Discussion**

Starting with the codification of the empirical studies included in our sample we dressed a table (see Table A1 in the appendix) where estimates are reported by length of study and classified by: type of innovation, type of employment (skilled or unskilled) and by type of models (SSM, DDM and IDM) described above. It displays the median value of the effect size measured by the partial correlation coefficient (PCC).

Our sample have nine ( $n=9$ ) studies supporting Derived Labor Demand Models (Conte and Vivarelli, 2011; Lundin and Fredrik, 2007; Mitra, 2019; Mitra and Jha, 2015; Oberaj and Iftikhar, 1981; Otsuka et al., 1994; Raju, 1976; Saafi, 2014; Merikull, 2010), and nine ( $n=9$ ) studies using Innovation Decomposition Model (Benavente and Lauterbach, 2008; Cirera and Sabetti, 2019; Crespi et al., 2019; Medase and Wyrivich, 2021; Okum et al., 2019; Avenyo et al., 2019; Sithole and Buchana, 2020; Aboal et al., 2015; Elejalde, 2015) but only one study used Skill Share Model (Almeida, 2010). The latter clearly shows that technological change is biased toward skills by showing that a lower skilled worker tends to be replaced by higher skilled workers in East Asia.

Note that although the majority of these studies used Ordinary Least Squares (OLS) and instrumental variables IV as estimation method and survey data collected by local institution or World Bank (CIS); The majority of contribution focused on the manufacturing sector, while few of them examined the agricultural one ( $n=3$ ). In this regard, it looks clear that it is not possible to use dynamic panel because technology is not presented by variable with large temporal structure of data for developing countries.

Studies based on (DDM) and (IDM) use as measure of innovation: variable dummy, trade value, R&D expenditure or total factor productivity.

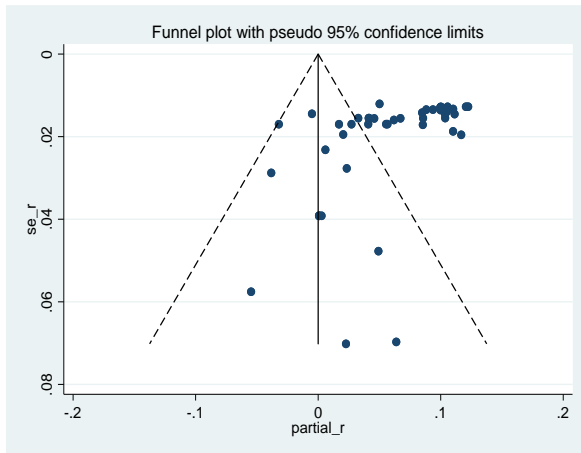
Despite the fact that the nine studies were based on the most recent model IDM they have covered old periods. The most recent period is 2015 studied by Cirera and Sabetti (2019). The lack of recent data only allows the analysis based on SBTC hypothesis in developing countries instead of RBTC hypothesis that needs recent and supplement data.

Statistically, concerning the effect size value, it varies between 0.98 (Mitra, 2019) and -0.017 (Lundin and Fredirik, 2007) while the median t-value exceeds "2" in six studies. At this step we can reach no conclusion as to the relation between technological innovation and employment, which led us to use funnel graphs<sup>1</sup> (Figure 2) to look for possible biases in the selection of publications and identify the presence of heterogeneity.

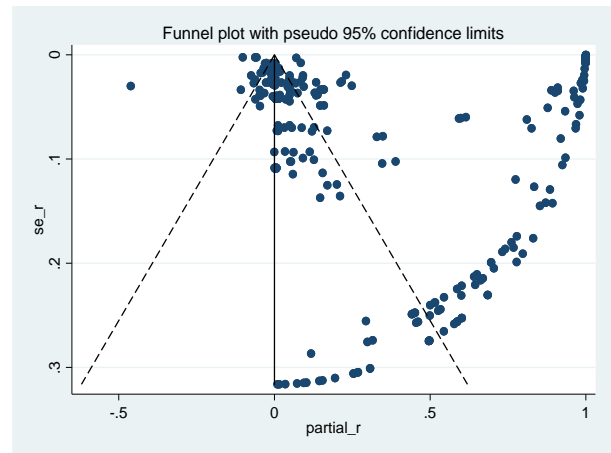
Therefore, we divided our sample into four groups according to the type of innovation (process/product) and to the qualification of the job (skilled/unskilled). Again, we applied this distribution to studies based only on innovation distribution model (IDM) as they make up the share of the most recent studies in our sample (Table A2 in the appendix).

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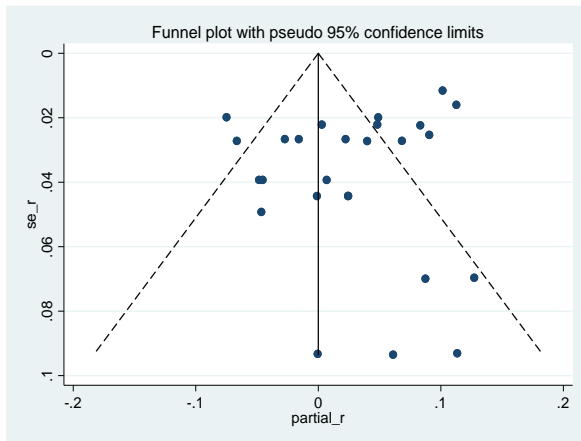
<sup>1</sup>. Funnel plots proposed the first time by Light and Pillemen (1984).



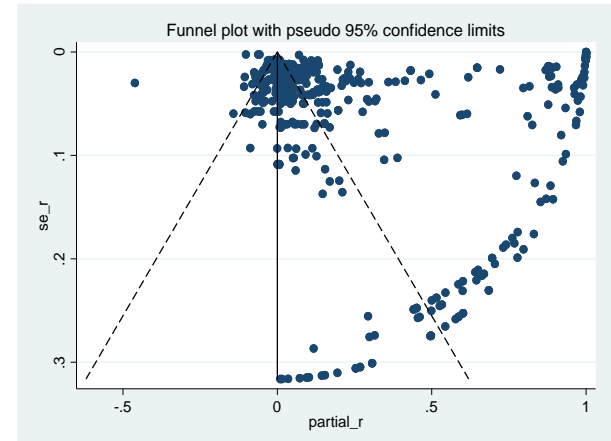
A. Process innovation and skilled-labor demand  
Residual variation due to heterogeneity 72.46%



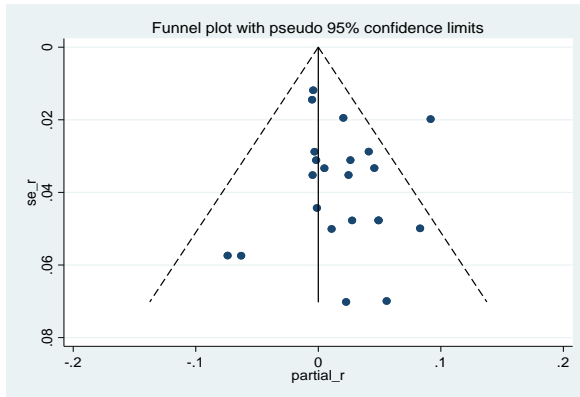
B. Process innovation and mixed-skill labor demand  
(Skilled, Unskilled) Residual variation due to heterogeneity: 97.16%



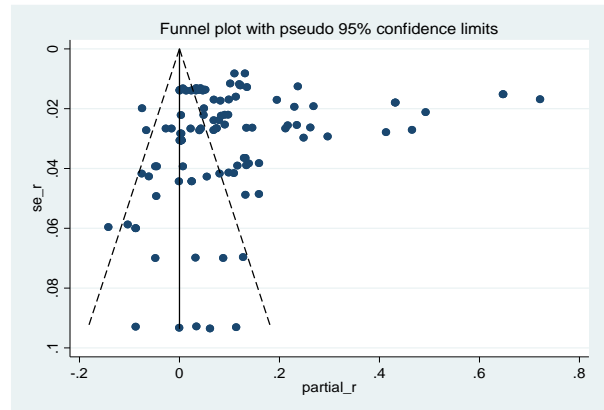
C. Product innovation and mixed-skill labor demand  
Residual variation due to heterogeneity 99.78%



D. Full sample (all innovation and skill types)  
Residual variation due to heterogeneity 99.78%



E. Process innovation and skilled-labor demand  
Residual variation due to heterogeneity: 32.37%  
(Innovation decomposition model)



F. Product innovation and mixed-skill labor demand  
Residual variation due to heterogeneity: 98.26%  
(Innovation decomposition model)

**Figure 2.** Compiled of Table 1

**Note:** Funnel plots of technology adoption and employment Residual variation due to heterogeneity is obtained from random-effect meta-regression proposed by Harbord and Higgins (2008), who suggest that residual variation above 75% reflects high levels of heterogeneity.

However, we cannot generalize at this level the economic conclusions related to the impact of technological innovation on employment. In order to take into consideration, the publication selection bias we will move on to the second phase of our approach, which consists of applying the PET/FAT tests (*Precision-effect testing/Funnel-asymmetry testing*) and estimating the bivariate PEESE (*The precision-effect estimate with standard error*), model that takes into account the relation of the nonlinear effect size calculated by the partial correlation coefficient and their standard errors.

**Table 2.** Test FAT/PET/PEESE

	Process/Skilled, FE1, B/Strap	Process/Unskilled, FE B/Strap	Product, Mixed FE, B/Strap	Full sample FE	Process/Skilled, OLS, B/Strap	Product/Mixed OLS, B/Strap	Full sample B/Strap
<b>Dependent variable:</b>	PET/FAT	PEESE					
<b><i>t-value</i></b>							
Precision PCC	0.11 (0.012)***	0.18 (0.27)	0.94 (0.38)***	1.31 (0.151)***	0.076 (0.018)***	0.995 (0.005)***	0.998 (0.0018)***
Constant (Bias)	-2.61 (0.711)***	-0.62 (1.06)	-2.07 (1.31)	-3.86 (0.516)***			
Standard Error of PCC					-515 (273.22)*	-52.3 (24.47)***	-70.16 (98.73)
Number of observations	63	48	306	504	63	306	504
Number of studies	7	7	16	19	7	16	19
AIC	277.87	128.61	1323.065	1705.10	285.07	2959.79	5758.12
BIC	282.16	130.48	1330.512	1709.37	289.36	2967.24	5766.67

**Source:** Compiled by the authors.

**Note:** Estimator choice is based on minimum AIC and BIC values, as indicated in the methodology. \*\*\*, \*\*, \* indicate significance at 1%, 5%, and 10%, respectively.

**Table 3.** Multivariate Meta-Regression

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Precision of PCC	1.22 (0.19)***	1.22 (0.086)***	1.03(0.15)***	1.08 (0.15)***	1.28(0.06)***
Journal Article	4.21 (0.66)***	4.21 (0.36)***	2.61 (1.32)***	2.61 (1.32)***	3.63 (1.57)***
Farm Data	0.9 (1.17)	0.9 (0.24)	-0.05 (0.73)	-0.05 (0.73)	0.22 (0.96)
Product innovation	1.48 (0.49)***	1.48 (0.17)***	1.2(0.13)***	1.2 (1.39)***	1.16(0.14)***
Unskilled labor	-0.006 (0.52)	-0.006 (0.19)	0.23 (0.16)	0.23 (0.16)	0.29 (1.16)**
Middle-income country	2.57 (0.812)***	2.57 (0.34)***	1.22 (0.5)***	1.22 (0.5)***	1.42 (0.48)***
IV estimator	-0.48 (0.28)*	-0.48 (0.14)***	-0.42 (0.2)***	-0.43(0.2)***	-0.40 (0.2)***
Constant	-11.15(1.29)	-11.15 (0.64)	-7.91 (1.69)	-7.76 (1.72)	-9.84 (1.61)
Number of observation	504	504	504	504	504
Number of studies	19	19	19	19	19
AIC	2060.99	2062.993	1726.2	1726.2	1721.76
BIC	2090.87	2097.146	1768.892	1768.892	1764.45
VIF	1.31	1.31	1.31	1.31	1.31
Residual heterogeneity	98%	98%	98%	98%	98%

**Source:** Compiled by the authors

**Note:** \*\*\*, \*\*, \* indicate significance at 1%, 5%, and 10%, respectively.

<sup>1</sup>. According to Stanley and Doucouliagos (2014) the fixed effects estimator is the most technically appropriate in the context of meta-analysis because it gives unbiased results and it considers the size of the effect to be fixed and homogeneous in all studies in the sample.

In addition, to identify the sources of heterogeneity and the factors likely to vary the results, we conducted a multi meta-regression that includes several moderating factors in order to draw economic conclusions. To do this we were based on a hierarchical estimation, in particular, we conducted: estimation based on the method of ordinary least squares (OLS) taking into account a fixed-effects and hierarchical model that consider the dependence between studies. Table (3) displays the results of this estimation. The preferred estimate the one whose AIC and BIC criteria are the smallest (model 5). We note that the introduction of the moderating factors did not reduce the variation of the heterogeneity of the residuals since it displays a value of 98%, this value is not far from that recorded for the group (D) in the funnel graph, and hence confirms the level of heterogeneity recorded. Multicollinearity is irrelevant in the sense of VIF (variance inflation factor) it recorded 1.42, lower than the maximum value of 10 required in econometric work.

In addition, table 4 allow us to draw several conclusions, the first is that in general innovation impacts employment, with a broader level of impact when it comes to product innovation, it corroborates the results of bivariate estimation discussed earlier and confirmed by Cirera and Sabetti (2019) for 15000 firms in developing countries. Similarly, the impact of innovation on less qualified employment remains very low which goes with the results obtained in the work of Ugur and Mitra (2017) that confirms, among other things, the validity of the hypothesis of skilled-biased technological change in developing countries. This perspective also suggests that an increase in the supply of skills can lead to an acceleration in the demand for skills in low- and middle-income countries as suggested by (Acemoglu, 1998).

Another conclusion related to the multi meta-regression is that technology is not totally exogenous because of the simultaneity in the innovation and employment relation. This is explained by problems related to measurement errors and specification model as evidenced by the small coefficient of the effect size obtained from the instrumental variables estimates that takes into account endogeneity. It gives us also an attractive interpretation, since the shortage of qualified workers is able to drive new technologies may slow down its implementation, as the introduction of new technologies likely requires the availability of skill workers, in other words, technology is more skill-biased as a result of an exogenous increase in the supply of highly skilled labor and this was demonstrated by Acemoglu's framework in our literature.

Similarly, we do not have strong evidence that confirms the impact in the agricultural sector is greater than the industrial sector. This can be explained by the limited number of studies relating to this sector in our work.

The effect-size estimates related to middle income countries are relatively larger than those related to employment effect in lower income countries. However, journal articles tend to report larger effect-size estimates compared to working papers and reports. Considering the few studies on the agricultural sector, the impact is not statically significant which lead us to uncertain employment effect at that sector.

## **5. Conclusion**

This study reviewed the main articles on the impact of technological innovation on employment in developing countries it provides an articulation between theoretical analysis and meta-analysis.

The vast majority of researches use three reference models. Derived labor demand model (DDM) developed by Van Reenen (1997) where technological progress is expressed by an innovation variable such as (R&D expenditure, stock of patent, hours worked, etc.), the skill share model (SSM) that differentiate skilled from unskilled workers created by Machin and Van Reenen (1998) and developed by Acemoglu (1998) to demonstrate the endogeneity of innovation and the most recent innovation decomposition model (IDM) that distinguished between process innovation and product innovation presented by Harisson et al. (2014).

We found that a considerably number of studies gives support to the positive effect of technological innovation on job creation. Innovation has diverse materializations in the organizational context several studies analyse its impact on employment according to the type of innovation: product innovation and process innovation and also according to the type of qualifications: skilled workers, unskilled workers. We verified the implications of these two types of innovation whether they have the same effect on the two types of qualifications or not. With the process innovation the implementation of a new or improved production method has a positive effect only on skilled workers it goes with the skill biased hypothesis While the creation of a new good or service or the introduction of an improved version of a previous product to the market has a positive effect on both skilled and unskilled workers.

Despite the fact that the effect of product innovation is larger than process innovation and can be qualified as the main source of job creation we can note

generalize this result that should be taken under the reservation of the presence of high heterogeneity.

Our exercise points out some limitations related to the availability of data especially for the middle-income countries' context, the data bases need to be extended to more exhaustive surveys on technological innovation which is a first and foremost a necessity to increase efficiency of the study, moreover technological innovation may have different effects that needs to be measured including the aspects of displacement and compensation.

Under the routine-biased technological change literature the debate turns more around skill polarization instead of skill shares, focused in replacing routine tasks this hypothesis needs to be verified and developed in future studies for developing countries. The role and quality of institutions should be included in the relationship between employment and technological innovation in order to have a transversal vision about effect on employment in low and middle income. We noticed that the articles analyzing the relation between technological innovation and employment in developing countries are not in line with the current technological changes. None of the articles included the impact of the latest technological advances that have already changed the way we live and work and we can expect for example that artificial intelligence will be integrated further into assisting or even replacing people at work. The analysis cannot be sufficiently relevant with high added value if it remains based on limited data, studies need to be deepened and extended to the effect of these latest advances and be also interested with the potential effect of this continuous process of technological change.

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## Appendix

**Table A1.** Collected of the Empirical Studies

Study	Data Period	Reported estimates	Country	Data	Estimation Method	Model	Type of Technological Innovation	Skill Type	Sector	Median PCC	Median t-value
Almeida (2010)	2003-2005	29	East Asia	Survey Data	OLS	SSM	Process	Skilled	Manufacturing	0.1003	7.3684
Benavente and Lauterbach (2008)	1998-2001	4	Chili	Survey Data	OLS, IV	IDM	Product	Mixed	Manufacturing	0.0243	0.5497
Cirera and Sabetti (2019)	2013-2015	39	Developing Country	World Bank Enterprise Survey	OLS, IV	IDM	Process/Product	Skilled Unskilled	Manufacturing	0.0204	1.1
Conte and Vivarelli (2011)	1980-1991	9	Developing Country	Survey Data	GMM	DDM	Process	Mixed	Manufacturing	0.0408	2.407
Crespi et al. (2019)	1995-2009	52	Argentina, Chili	Survey Data	OLS, IV	IDM	Product	Mixed	Manufacturing non-Manufacturing	0.04902	1.170
Lundin and Fredirik (2007)	1998-2004	8	China	Survey Data	OLS, IV, FE	DDM	Process	Mixed	Manufacturing	-0.01746	-2.1663
Mitra (2019)	1998-2010	44	India	Survey Data	OLS, FE, RE	DDM	Process/Product	Mixed	Manufacturing	0.9872	36.4499
Mitra and Jha (2015)	1998-2010	33	India	Survey Data	OLS, FE, RE	DDM	Process/Product	Mixed	Manufacturing	0.1698	1.61157
Oberaj and Iftikhar (1981)	1977	8	India	Survey Data	OLS	DDM	Process/Product	Mixed	Agricole	0.0503	1.4933
Otsuka et al. (1994)	1966-1990	13	Philippines	Survey Data	Maximum Likelihood Method	DDM	Process/Product	Mixed	Agricole	0.0095	0.1306
Raju (1976)	1968-1971	72	India	Survey Data	OLS	DDM	Process/Product	Mixed	Agricole	0.5386	2.1769
Saafi (2014)	1997-2006	13	Tunisia	Survey Data	GMM, FE	DDM	Process/Product	Mixed	Manufacturing	0.0013	0.0173
Medase and Wyrwich (2021)	2005-2010	14	Nigeria	Survey Data	OLS, Quantile Regression	IDM	Process/Product	Mixed	Manufacturing and services	0.0925	2.230
Okumu et al. (2019)	2011-2015	22	Africa (27 Country)	Survey Data	OLS, IV	IDM	Process/Product	Mixed	Manufacturing	0.022	1.6138
Avenyo et al. (2019)	2013	9	Africa Sub Saharian: DRC (Democratic Republic of Congo), Ghana, Tanzania, Uganda, Zambia	Survey Data	Model Dose-Response and IV	IDM	Process/Product	Mixed	Manufacturing	0.0009	0.0320
Sithole and Buchana (2020)	2010-2012	37	South Africa	Survey Data	OLS, IV	IDM	Process/Product	Mixed	Manufacturing	0.003	0.099
Meriküll (2010)	2001-2006	12	Estonia	Survey Data	GMM, OLS	DDM	Process/Product	Mixed	Manufacturing	0.022	1.853
Aboal et al. (2015)	1998-2009	28	Urguay	Survey Data	OLS, IV	IDM	Process/Product	Mixed	Manufacturing	0.139	2.989
Elejalde (2015)	1998-2001	45	Argentina	Survey Data	OLS, IV	IDM	Process/Product	Mixed	Manufacturing	0.0735	1.665

**Source:** Research finding, followed by PRISMA 2020 guidelines.

**Table A2.** Test FAT/PET/PEESE (Innovation Decomposition Model only)

	Process/Skilled, FE, B/Strap	Process/Unskilled, FE B/Strap	Product, Mixed FE, B/Strap	Process/ Skilled, OLS, B/Strap	Product/Mixed OLS, B/Strap
<i>Dependent variable: t-value</i>		PET/FAT			PEESE
<i>Precision du PCC</i>	0.024 (0.566)***	-0.075 (0.317)	1.5 (0.109)***	0.020 (0.293)***	0.121 (0.048)***
<i>Constant (Biases)</i>	-0.171 (13.34)	-0.046 (1.16)	-5.17 (0.394)***	-23.6 (22.801)	
<i>Standard Error of PCC</i>					-364.96 (288.2)
<i>Number of observation</i>	22	41	121	22	121
<i>Number of studies</i>	5	7	10	5	7
<i>AIC</i>	75.09	138.736	392.454	73.426	832.171
<i>BIC</i>	77.28	142.163	395.249	75.6	837.763

**Source:** Compiled by the authors.

**Note:** Estimator choice is based on minimum AIC and BIC values, as indicated in the methodology.

\*\*\*, \*\*, \* indicate significance at 1%, 5%, and 10%, respectively.

### Meta-regression Tools

Formally, the calculation of the effect size in our study is based on the calculation of the partial correlation coefficient (PCC) given by:

$$PCC_i = t_i / \sqrt{t_i^2 + df_i} \text{ and } PCC_i = t_i / \sqrt{t_i^2 + df_i}$$

where  $i$  represent reported estimates from the primary studies (the estimates resulting from the association of economic variables).  $t_i$  is the associated t-statistic,  $df_i$  the degree of freedom and  $SE_{PCC_i}$  represents the variance of the error associated with the partial correlation coefficient.

Furthermore, the size of the effect in our study estimated by a meta-regression model proposed by (Egger et al. 1997, Card and Krueger, 1995; Ashenfelter et al., 1999; Gorg and Strobl, 2001):

$$PCC_i = \beta + \alpha SE_{PCC_i} + u_i \quad (1)$$

By definition this model is heteroscedastic, because the effect size has different standard errors, so to remedy this phenomenon, we adopted the weighted least squares estimator where the precision  $\frac{1}{SE_{PCC_i}^2}$  is used as a weight. We then divide both sides of equation (1) by the standard error associated with the partial correlation coefficients  $SE_{CCP}$  which give:

$$t_i = \alpha + \beta \left( \frac{1}{SE_{PCC_i}} \right) + \vartheta_i \quad (2)$$

$t_i = PCC_i / SE_{CCP_i}$  is the t-value of the partial correlation coefficient.

However, to deal with the non-linearity between the standard errors and the collected estimates Stanley and Doucouliagos (2014) provide a quadratic model if the PET test (precision test of the size effect) rejects the null hypothesis:

$$PCC_i = \gamma + \delta SE_{PCC_i}^2 + \omega_i \quad (3)$$

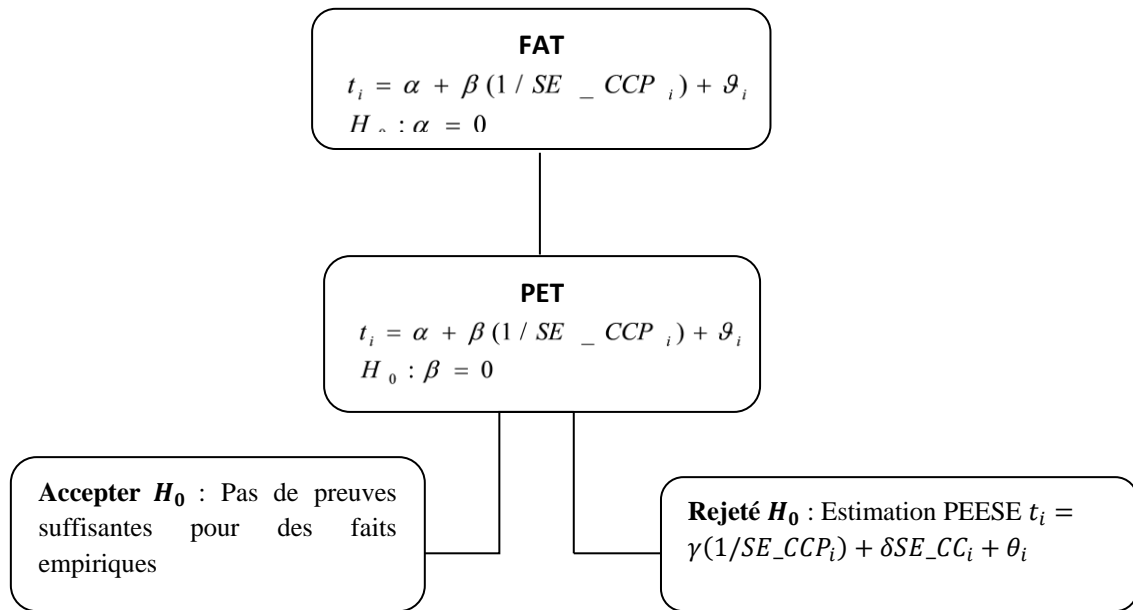
The weighting of model (3) gives:

$$t_i = \gamma \left( \frac{1}{SE_{CCP_i}} \right) + \delta SE_{PCC_i} + \theta_i \quad (4)$$

The estimation of the multivariate meta-regression model is based on the following reformulation:

$$t_i = \delta_0 + \delta_1 (1 / SE_{PCC_i}) + \sum_2^k \delta_k (Z_{ki} / SE_{PCC_i}) + \epsilon_i \quad (5)$$

where  $1 / SE_{PCC_i}$  is the precision,  $Z_{ki}$  is a vector of moderating factors. The moderating factors are represented by dichotomous (binary) variables:



**Figure A1.** Schema for Investigating and Correcting Publication Bias

**Source:** Stanley and Doucouliagos (2012).

**Journal Article:** Variable that takes the value of 1 if the estimated effect size appears in a scientific journal; and the value of 0 if reported estimates are based on a thesis or report.

**Farm Data:** Variable that takes the value of 1 if the effect size concerns the agricultural sector and the value of 0 if it concerns the industrial sector.

**Product Innovation:** Variable that takes the value of 1 if the effect size relates to product innovation and the value of 0 if it relates to process innovation.

**Unskilled labor:** Variable that takes the value of 1 if the effect size relates to unskilled employment and the value of 0 if it relates to skilled employment.

**Middle-income country:** Variable that takes the value of 1 if the effect size concerns middle-income countries and the value of 0 if the country is in the rank of low-income countries.

**IV estimator:** Variable that takes the value of 1 if the estimated effect size relates to the instrumental variables' method and the value of 0 if it relates to another method (GMM, double least squares, etc.)

### Heterogeneity

The heterogeneity is based on the procedure of Hunter and Smith (1990) based on a Chi-square statistic, such as Cochran's  $Q_T$ , given by:

$$\chi_{k-1}^2 = \frac{N}{(1 - r^2)^2} S_r^2$$

while  $S_r^2 = \frac{\sum_{i=1}^k N_i (r_i - \bar{r})^2}{\sum_{i=1}^k N_i}$  is the observed variance calculated by the sum of the squared differences between each effect size and the estimated effect size in the population and weighted by the sample sizes of each study, it is compared to a Chi-square with  $k-1$  degree of freedom, with  $k$  the number of studies. Furthermore, Harbord and Higgins (2008) suggest that a level of heterogeneity above 75% reflects high heterogeneity.



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## **Income Inequality and Aggregate Demand: An Empirical Evidence from Nigeria Digitalized Economy**

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### **Abstract**

Income inequality has been so much evident in the last four decades as the rich are accumulating more wealth than the poor leading to changes in output, consumption, and employment. However, the concern in recent times of digitalized economies has been its effects on macroeconomic activities through the aggregate demand channel. This study examines the impact of income inequality on aggregate demand in Nigeria, the study data were gathered from the World Bank from 1985 to 2020. The study incorporates infant mortality rate and life expectancy as control variables while the Dynamic Ordinary Least Square (DOLS) was adopted as the method of estimation. The study's descriptive analysis shows that the variables are integrated at  $I(0)$  and  $I(1)$  while the DOLS result shows that income inequality, inflation, and life expectancy have a negative impact and significant relationship on aggregate demand. The study results also show a long-run relationship among the variables and it was thus concluded that increasing income inequality in Nigeria is detrimental to aggregate demand. The study recommends that government should increase its spending on social services, ensure direct transfer services to the poor and target fiscal and monetary policies that are inequality reduction driven.

**Keywords:** Aggregate Demand, Dynamic Ordinary Least Square (DOLS), Income Inequality, Infant Mortality, Life Expectancy.

**JEL Classification:** E24, O11, O15.

### **1. Introduction**

One of the ancient discussions in economics is the relationship between income and the level of aggregate economic activity. The basic idea put forward has been that higher-income inequality will reduce aggregate demand, consumption, and employment level (Auclert and Rognlie, 2018). The long subject of the discourse

is cogent that it can be traced to the work of David Ricardo's political-economic fundamental goal and Karl Marx (Robert, 2017). However, in this era of digitalization in which high-technological equipment and internet facilities have taken hold of economic activities and consequentially promote globalization, the world economies have been able to fight poverty to a minimal level, especially among the developed countries but income inequality on the other hand has been rising throughout the digitalized world. Even advanced countries such as the United States and emerging countries like China experienced a significant increase in income inequality in recent decades (Kohlscheen et al., 2021). This scenario does not exempt the developing countries, especially in Africa and Asia where poverty is very predominant. As a result, academic effort has shown that the general shift in income inequality is influenced by skilled-based technical dynamics and globalization, which are outcome of digitalized economy (Atkinson & Bourguignon, 2015). The rising income inequality implications concern has been on its short-term effects on macroeconomic parameters aside from its social and political effects in the long run.

Aggregate demand remains a basic function in economic growth composition and for decades, the functional distribution of income in relation to economic growth has been a major argument to the post-Keynesian economists (see Kaldor, 1955; Pasinetti, 1962; Kalecki, 1971; Steindl, 1976). The post-Keynesian however argued that economic growth nature can either be wage-led or profit-led with the view that wage-led economic growth increases wage share leading to a win-win situation of higher growth and lower inequality while the reverse is the case in the profit-led scenario (Ederen and Rehm, 2019). However, in the literature, the nature of the relationship between economic growth in general to poverty, and income inequality has led to several ideological submissions. To some school of thought, an increase in aggregate demand and economic growth leads to an increase in income which in turn reduce the level of poverty and inequality (Aghion et al., 1999); whereas, Ravallion (2001) argued that income inequality and rising poverty could sometimes be caused by economic growth. Furthermore, from these perspectives, another view surfaced that high-income inequality leads to economic expansion (Galor and Zeira, 1993; Persson and Tabellini, 1994 and Alesina and Rodrik, 1994).

In Nigeria, the problem of income inequality can be seen in the daily struggles of a large percentage of the populace whereas wealth is accumulated by a few groups of people (Igwegbu and Metu, 2021). Presently, about 100 million people in Nigeria are living in poverty and the richest man on the African

continent whose wealth can alleviate the poverty of the majority of people in this category is a Nigerian. It was estimated that lifting Nigerians above the extreme poverty line of \$1.90 will cost about \$24 billion; invariably this means, the total wealth of Nigeria's top four richest men will bring these people out of poverty (Oxfam, 2017).

The paradox of growth in Nigeria negates the common metaphor 'A rising sea lifts all boats' due to the inherent income inequality in the economy. The distribution of resources is seriously skewed by income inequality in Nigeria such that as the country gets richer, only a few benefit, and the majority wallow in low aggregate demand, deprivation and poverty due to the menace of inequality. This *status quo* has been promoted by weak economic empowerment of women in the country. They are mostly regimented to the rural areas with weak economic resources to engage in farming activities. For instance, about 54 million of Nigeria's estimated 78 million women who live in rural areas are off the land to practice agriculture, the largest economic platform for women. It is mostly subsistence farming with hoes and cutlasses the women are disadvantaged at rely upon the use of the farming implements (Oxfam, 2017).

Besides, taxation is the basis of the social contract between governments and citizens is expected to be progressive. Such taxation is at the core of a fair redistribution of public resources. However, in Nigeria, the tax system is largely regressive: the burden of taxation mostly falls on poorer households and teething firms, while the big multinational corporations receive questionable tax waivers and tax holidays, and utilize loopholes in tax-laws to shift huge profits generated in the country to low tax jurisdictions. Moreover, due to pressures from the federal government to meet its revenue generation targets, the state and local governments often impose aggressive tax on the informal sector as well as the participants of the Micro, Small and Medium Enterprises (MSMEs).

As a global commitment toward development, the United Nations Sustainable Development Goal (UNSDG) which is built on the principle of leaving no one behind through its assembly included reduction of poverty and inequality to its goals. However, on the empirical ground, much has not been done to examine the nexus of income inequality and aggregate demand in Nigeria. Available literature focused on the determinants of income inequality, inequality and growth, inequality and poverty (see Akinbobola & Saibu, 2004; Okafor, 2011; Bakare, 2012; Ayinde et al., 2012; Ademola, 2019; Ewubare & Nnamdi, 2020; Enoma, 2020; Igwegbe & Metu, 2021). It is in this regard that this study formally examines the impact and relationship between income

inequality and aggregate demand in Nigeria digitalized economy. The study is then sectionalized into five sections; following this is a brief review of relevant literature; the methodology; empirical results and discussion; conclusion, and policy recommendation.

## **2. Literature Review**

Theoretically, the Kuznets hypothesis presented around 1950 and 1960 has been fundamental for the explanation of income inequality, and following the extant discussion of this theory is the “Poverty-Inequality-Growth” hypothesis propounded by Bourguignon, which try to explain the relationship between poverty, income growth, and income inequality. However, there has not been a clear consensus about the relationship among inequality, poverty, and growth among development and welfare economists. In this regard, the possible connection between income and aggregate demand remains an issue of contention as income play a prominent role in affecting the demand for goods and services by individuals and individual households which invariably constitute aggregate demand. On the empirical ground, there has been diverse attention from scholars on income inequality; for example, Akinbobola and Saibu (2004) looked at the trend and relationship among income inequality, unemployment, and poverty in Nigeria using the vector autoregressive approach. The vector model revealed a reduction in the unemployment rate during the period of analysis improves human development which consequently reduces the poverty rate. Also, the study found increasing government capital spending to be the solution to unemployment and human development index enhancer. Ewubare and Nnamdi (2020) also assessed the relationship between unemployment and income inequality in Nigeria; the assessment conclusion showed that rising unemployment in Nigeria fuels income inequality among the populace.

Enoma (2020) verified whether government macroeconomic policies are capable of reducing poverty and income inequality in Nigeria using the ordinary least square; the study found that macroeconomic policies (monetary and fiscal) put in place by the government were consistent in reducing poverty and inequality in Nigeria over the years. In a similar study by Akinyemi et al. (2019) the nexus of inequality and poverty was examined in Nigeria and they found poverty to be decreasing as the government spend more to standardize healthcare services while inequality keeps rising on the other hand. Growth impacts of income inequality in Nigeria were studied by Ademola (2019) with the conclusion that income inequality hurts persistent economic expansion of Nigeria

as an increase in income inequality has an adverse effect on investment, overall enrolment ratio, and property protection. Bakare (2012) measures income inequality in the Nigerian economy and found a wide disparity among people in terms of income. Not far from this, a study by Igwegbu and Metu (2021) examined the factors responsible for income inequality experienced in Nigeria using the fully modified ordinary least square estimation technique. Their study analyses informed that level of development, technology adoption, globalization, fiscal policy, financial accessibility, and rural-urban migration are major determinants of income inequality in Nigeria. Furthermore, the examination of aggregate demand and national unemployment in Nigeria by Okpe and Sule (2020) using the vector error correction model showed that in both the short and long-run aggregate demand exerts a positive influence on unemployment reduction in Nigeria. Yameogo and Dauda (2022) made a comparative analysis of the effect of income inequality and economic growth on the environmental quality of Nigeria and Burkina Faso adopting the autoregressive distributed lag model. The result showed that income inequality improves environmental quality by reducing the emission of carbon dioxide in Nigeria and has adverse effects on the environmental quality of Burkina Faso.

However, on the global scale, mixed and diverse empirical results have been submitted by scholars on the relationship between income inequality and economic factors. For example, Galor and Zeira, 1989; 1993; Alesina and Rodrik, 1994; Persson and Tabellini, 1994; Birdsall et al., 1995; Perotti, 1994; 1996; Alesina and Perotti, 1993; 1996; Deininger and Squire, 1996; 1998; Knell, 1999; Mo, 2000; Barro, 2000; Rehme, 2002; De La Croix and Doepke, 2003; Banerjee and Duflo, 2003; Knowles, 2005; Easterly, 2007; Sukiassyan, 2007; Noh and Yoo, 2008; Lin et al., 2009; Castelló-Climent, 2010; Chambers and Krause, 2010; Shin, 2012; Herzer and Vollmer, 2012; Wahiba and El Weriemmi, 2013; Fawaz et al., 2014; Cingano, 2014; Darma and Ali, 2014; Bagchi and Svejnar, 2015; Njindan Iyke and Ho, 2017; and Lahouij, 2017 submitted that inequality negatively impacts growth process of nations which conform to the modern perspective expositions.

On the other hand, several studies (such as Partridge, 1997; Li and Zou, 1998; Tanninen, 1999; Deininger and Olinto, 1999; Forbes, 2000; Balisacan and Fuwa, 2003; De Dominicis et al., 2008; Halter et al., 2014; Naguib, 2017; Jauro, 2017; Joshi, 2018, etc.) underscored the impacts of inequality of income distribution for economic growth. however, several other studies (see Barro; 2000; Chang and Ram, 2000; Thornton, 2001; Panizza, 2002; Huang, 2004; Lin

and Weng, 2006; Jalil, 2009; Chambers and Dhongde, 2011; Cheema and Rehman, 2014; Vo et al., 2019) submitted that income inequality has no significance in understanding growth process. Still, a large number of studies (for instance, Furman and Stiglitz, 1998; Wan et al., 2006) found no clear relationship, different relationships at different time horizons (Partridge, 1997; Halter et al., 2014; Malinen, 2013), or different relationships at different parts of the income distribution (Voitchovsky, 2005; Fallah and Partridge, 2007; Lin and Yeh, 2009; Assa, 2012; Tiwari et al., 2013; Delbianco et al., 2014; Chen, 2018). Conclusively, under these empirical discrepancies and little empirics on the relationship between income inequality and aggregate demand in Nigeria, there is a clear cut that more research has to be devoted to this relationship. As such, this study fills the gap by providing empirical evidence of the nexus between income inequality and aggregate demand in Nigeria.

### 3. Data and Methodology

To empirically examine the nexus between income inequality and aggregate demand, the study formulated a model based on theoretical explanations. Income inequality was measured by Gini coefficient while aggregate demand was proxy by gross domestic product (GDP). The GDP though has been argued by Keynesian economists to be equal aggregate in the long run, nevertheless it remains the best measure of aggregate demand as both are quantitatively measured in the same manner. Aggregate demand entails consumption spending on goods, investment, government spending and net exports. The study model is thus formulated based on the linear relationship established by theory to be between income and components of aggregate demand;

$$AD = IE, LE, IMR, SAV, INF \quad (1)$$

AD = aggregate demand, IE = income inequality, LE = life expectancy, IMR = infant mortality rate, SAV = savings, and INF = inflation. LE, and IMR are included in the above model specification being the major immediate effects of the prevalence of income inequality on the social economy while SAV and INF are included being some of the major factors that influence demand for goods and services by households. The data for this study are sourced from the World Bank ranging from 1985 to 2020. Categorically, the individual data identity are presented in Table 1 below:

**Table 1.** Description of Variables

Variables	Proxy
Aggregate demand	GDP
Income inequality	Gini Coefficient
Life expectancy	Life expectancy
Mortality rate	Infant Mortality Rate
Savings	Gross Savings (% GDP)
Inflation	Consumer Price Index

**Source:** World Bank: WDI.

To estimate the study model, the Dynamic Ordinary Least Square (DOLS) by Stock and Watson (1993) was adopted. This method was chosen based on its supremacy over the conventional ordinary least square that does not consider the emergence of autocorrelation between the error term and regressors of a model i.e.,  $COV(e, X) = 0$  which in most cases is not true and leads to biasedness of result coefficients. To solve the biasedness problem of endogeneity in the case when the error term is correlated with the regressors, approaches such as the use of instrumental variables and dynamic least square were suggested. However, the use of instrumental variable requires a large sample size and it's in most cases difficult to find appropriate variables. Given these limitations, this study thus adopted the Dynamic Ordinary Least Square which solves the problem of endogeneity for both small and large sample sizes.

In any time-series analysis, there is need for preliminary diagnostics such as the descriptive and unit root test to confirm the order of integration. Another supremacy of the Dynamic Ordinary Least Square is its applicability to variables of a model that are integrated of order one  $I(1)$  and those of mixed order of integration i.e.,  $I(0)$  and  $I(1)$ .

#### 4. Results and Discussions

Table 2 below shows the descriptive statistics of the variables employed in the study model using the mean, median, standard deviation, skewness, kurtosis and the Jarque-Bera statistics. It was observed from the table that the mean and median of each of the variables are not equal to each other which imply the distribution of each variable is asymmetric and skewed. The greater values of Gini coefficient, life expectancy, savings, and inflation mean over the median imply the variables are positively skewed which can also be confirmed from the skewness values of 0.9231, 0.6791, 0.2575, and 1.7422 while the greater value of infant mortality rate median value over the mean implies the variable is negatively skewed and can also be confirmed from the skewness value of -0.0842

and finally using the mean and median values of aggregate demand, the result fluctuates as a result of negative values that are present in the dataset. However, going by the skewness value, aggregate demand is positively skewed. It can also be deduced from the table that the standard deviation of all variables is less than their mean. This implies all the variables are normally distributed. The result further shows that all the variables have positive kurtosis values and the Jarque-Bera informed that all variables are normally distributed except inflation.

**Table 2.** Descriptive Analysis

	<b>AD</b>	<b>GINI</b>	<b>IMR</b>	<b>LE</b>	<b>SAV</b>	<b>INF</b>
Mean	4.250666	42.25000	101.7694	48.72758	36.22236	19.17818
Median	4.430627	40.10000	102.3000	47.03850	33.66436	12.38637
Std. Dev.	3.914905	5.326564	19.27192	3.221771	13.27443	17.68451
Skewness	0.440571	0.923177	-0.084249	0.679060	0.257530	1.742216
Kurtosis	3.302194	2.562953	1.382320	1.909221	1.982249	4.695105
Jarque-Bera	1.301600	5.400045	3.967922	4.551429	1.951655	22.52197
Probability	0.521628	0.067204	0.137523	0.102723	0.376880	0.000013

**Source:** Research finding.

Table 3 shows the correlation between the variables under study. In this case, focus is on the relationship between the dependent variable (aggregate demand) and other independent variables. It is shown in the table that Gini coefficient has a weak positive correlation with aggregate demand while infant mortality rate, life expectancy, savings, and inflation have weak negative correlation with aggregate demand over the period under study.

**Table 3.** Correlation Matrix

	<b>AD</b>	<b>GINI</b>	<b>IMR</b>	<b>LE</b>	<b>SAV</b>	<b>INF</b>
<b>AD</b>	1.000000	0.070452	-0.063753	-0.119725	-0.069031	-0.321499
<b>GINI</b>		1.000000	0.411966	-0.543385	0.161684	0.107887
<b>IMR</b>			1.000000	-0.946804	0.852203	0.466353
<b>LE</b>				1.000000	-0.792928	-0.372274
<b>SAV</b>					1.000000	0.307553
<b>INF</b>						1.000000

**Source:** Research finding.

The Augmented Dickey Fuller test result was used to confirm the stationarity and order of integration of each variable. The result show that all the variables are stationary; categorically, aggregate demand, infant mortality rate

and life expectancy are stationary at levels while the Gini coefficient and inflation are stationary after the first difference. The result of the unit root test conforms to the provision for the adoption of the Dynamic Ordinary Least Square for variables that are of combine order of I(0) and I(1).

**Table 4.** Unit Root Test

Variables	Test Equation	ADF Stat.	5% Crit. Value	Prob.	I(0)/I(1)	Inference
AD	Trend and Intercept	-3.6688	-3.5442	0.0382	I(0)	Stationary
GINI	Trend and Intercept	-5.8418	-3.5485	0.0002	I(1)	Stationary
IMR	Trend and Intercept	-8.7707	-3.5485	0.0000	I(0)	Stationary
LE	Trend and Intercept	-5.1052	-3.5578	0.0013	I(0)	Stationary
SAV	Trend and Intercept	-4.2899	-3.5443	0.0089	I(0)	Stationary
INF	Trend and Intercept	-4.2477	-3.5950	0.0127	I(1)	Stationary

**Source:** Research finding.

**Table 5.** Dynamics Ordinary Least Square

Variables	Coefficients	Std. Errors	t-statistics	Prob.
GINI	-1.6134	0.3534	-4.5650	0.0008
IMR	-1.2730	1.0072	-1.2638	0.2324
LE	-11.3121	4.5510	-2.4856	0.0303
SAV	0.1642	0.1844	0.8908	0.3921
INF	-0.1196	0.0554	-2.1569	0.0540
C	732.6564	326.5383	2.2406	0.0466
@TREND	1.3460	0.7421	1.8140	0.0970
	R <sup>2</sup>	0.8673	Adjusted R <sup>2</sup>	0.6140

**Source:** Research finding.

**Note:** Dependent Variable: AD; Fixed leads and lags specification (lead=1, lag=1).

Results from the Dynamic Ordinary Least Square (DOLS) analysis showed that there exist negative and significant relationships between aggregate demand and all regressors of the study model except savings. The implication of these results means a unit increase in income inequality, infant mortality, life expectancy, and inflation rate decrease aggregate demand in Nigeria economy over the period of analysis while a positive change in savings increases aggregate demand. These results conform to the correlation matrix results that show that there is a negative correlation between aggregate demand and infant mortality, life expectancy, and inflation. The significance of Gini coefficient, life expectancy, and inflation at 5% critical level shows they were significant factors

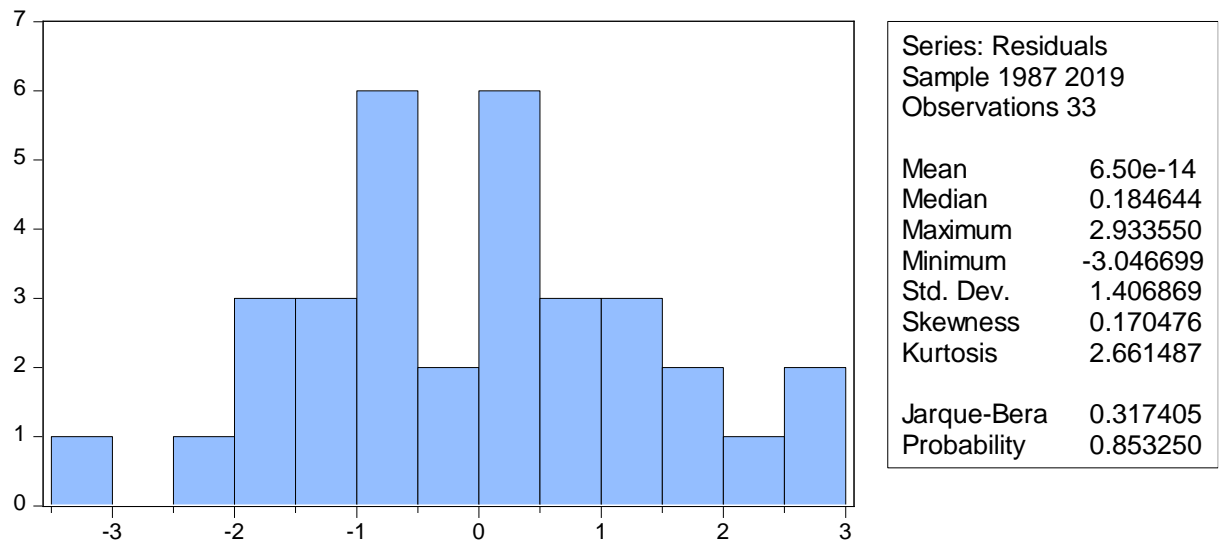
influencing changes in volume of aggregate demand in Nigeria from 1985 to 2020. Furthermore, the R-squared and adjusted R-squared which measure the model goodness of fit show that the explanatory variables of the model explain about 61 percent variation in the explained variables, that is, income inequality, infant mortality, life expectancy, savings, and inflation account for about 61 percent of changes in aggregate demand. The result of the DOLS of negative significant relationship between income inequality and aggregate demand conforms to literature that widespread of income inequality increase poverty rate and affects aggregate demand aside other side effects on output, consumption, savings and employment.

The result of the Enger-Granger cointegration post estimation test for the existence of long-run relationship among the variables show that there exists a long-run relationship among aggregate demand, income inequality, infant mortality rate, life expectancy, savings, and inflation in Nigeria. Using the Jarque-Bera statistics value and probability results from Figure 1 below which presents the normality test result, indicates that the study model residuals are normally distributed for Jarque-Bera probability is 0.853.

**Table 6.** Enger-Granger Cointegration

Specification: AD GINI IMR LE SAV INFC @TREND		
Cointegrating equation deterministics: C @TREND		
Null hypothesis: Series are not cointegrated		
Automatic lag specification (lag=2 based on Akaike Info Criterion, maxlag=7)		
	Value	Prob.*
Engle-Granger tau-statistic	-4.963257	0.1429
Engle-Granger z-statistic	-164.0175	0.0000

**Source:** Research finding.



**Figure 1.** Normality Test  
**Source:** Research finding.

## 5. Conclusion and Recommendations

Over the years, income has become widely unequally distributed among the poor and the rich across developed and developing countries of the world. This disparity in income distribution pronounced so much in developing countries made this study to examine the impact and relationship between income inequality and aggregate demand in Nigeria from 1985 to 2020. Aggregate demand which is the totality of domestic demand for goods and services remains an economic variable that depends on income; the study incorporated infant mortality rate, life expectancy, savings, and inflation as control variables while it adopted the Dynamic Ordinary Least Square (DOLS) as estimation technique for its provision for solution to endogeneity problem that may arise. The DOLS result shows that there are a negative and statistically significant relationships between aggregate demand and income inequality as well as between aggregate demand and some control variables (i.e. life expectancy and inflation).

The study thus concludes based on its findings that increasing income inequality in Nigeria is detrimental to aggregate demand through its social and economic effects. The implication of the study findings is that if policies are not adequately put in place, income inequality will in the long run reduce aggregate demand and as well increase the prevalence of poverty within the economy. This study recommends based on its findings that the government should increase its

spending on social services, ensure direct transfer services to poor households and ensure fiscal and monetary policies that are inequality reduction driven. This can be manifested in a strengthened progressive tax system, promotion of employment and civic inclusion through encouragement of citizens in Micro Small and Medium Enterprises (MSME), as well as the need to strengthen policies and laws that promote gender equality in Nigeria.

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## Tunisians' Dependence on International Remittances during the COVID-19 Pandemic

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### Abstract

In this study, we assess the degree of Tunisian households' dependence on migratory remittances during the first wave of the COVID-19 crisis and how much this dependence intersects with economic vulnerability in Tunisia. For this objective, we identify three variables needed for our analysis that reflect remittance dependency, economic vulnerability, and infrastructure inadequacy. Using data from wave eight of the Afro-barometer Household Survey, conducted in 2020, we estimated a multinomial logistic model. The findings show that a significant probability of the most economically vulnerable Tunisians is considered highly dependent on international remittances. Also, we are finding a likelihood of increased receipt of funds through official channels during the lockdown. However, Tunisians dependent on remittances face more economic shortages which are further exacerbated when they intersect with the infrastructure deficit and fewer digital resources. These households will therefore be less able to adapt to a restriction on in-person remittance services during a lockdown to contain the COVID-19 virus. As a result, the paradigm shift from cash to digital money is necessary.

**Keywords:** COVID-19, Economic Vulnerability, Infrastructure Inefficiency, Multinomial Logistics Model, Remittances.

**JEL Classification:** F22, F24, I10, O15, R2.

### 1. Introduction

Household exposure to the different crises that hit the economy remains an important reason behind social and economic vulnerability in developing countries (Nguyen et al., 2020; Edelbloude et al., 2017; Yang, 2008). One of the economic shock experienced by households around the world was SARS-CoV-2, or severe acute respiratory syndrome coronavirus 2 which was discovered in December 2019 in Wuhan City in China (Singhal, 2020). In March 2020, the World Health Organization (WHO) officially named the virus-related disease "Coronavirus

Disease 2019, COVID-19” (Cucinotta and Vanelli 2020). To manage the burden of the COVID-19 pandemic and to mitigate its negative impact on society and the economy, many governments have imposed restrictions on mobility. They have locked down a large part of their society due to strict social distancing measures and workplace closures put in place to limit the spread of the virus during the first wave (Martin et al., 2020). This will have serious repercussions on the world economic outlook (Béland et al., 2020; Mckibbin and Fernando, 2020; Nicola et al., 2020; Ozili, 2020). Indeed, this shock is not equally borne by society as a whole, particularly low-income households already suffering from declining income and poverty. In the literature, several studies have revealed many job losses that have affected income, in particular for low-income and vulnerable groups (ILO, 2020; Krafft et al., 2021).

Migration remittances are one of the major concerns of the sustainable development agenda, adopted by the United Nations in 2015. In order to achieve the target 7 of the objective 10 of this program which suggests to reduce, by 2030, the cost of migrant remittances to less than 3% (UNDP, 2015), remittances are identified as an automatic stabilizer in response to shocks in the origin countries (Habib, 2022; Bettin et al., 2014; Barajas et al., 2009). However, these international remittances, which are part of the globalization cycle, have also been affected by the health pandemic. The potentially significant impact of the COVID-19 crisis on the flow of remittances is due to the loss of employment of migrant workers and mobility restrictions that prevent individuals from meeting remittance service providers in countries of origin and host (Krafft et al., 2021; Asare et al., 2020; Bisong et al., 2020; Gagnon, 2020). Fasani and Mazza (2021), for example, find that COVID-19 is exposing around nine million migrant workers to involuntary unemployment in Europe. In this context, the World Bank’s 2020 report announces that migratory remittances are expected to decline an unprecedented rate in recent history as a result of the spread of COVID-19, from \$716 billion in 2019 to \$665 billion in 2020, a decrease of 7%. This collapse is worth about \$50 billion. In low- and middle-income countries, the projected decline is \$554 billion to \$508 billion, a decrease of 7.1%. Since 2000, the 5% decline in remittances has occurred during the global financial crisis of 2008-2009. Indeed, removing a major source of additional income for many households strongly affects their ability to cope with and emerge from the crisis.

Tunisia is among the countries in the MENA region that received significant remittance amounts of around \$2050 million in 2019. This improvement has started to bear fruit in terms of the country's development. According to World Bank data in 2020, Tunisia recorded a share of remittances in GDP of 5.7%. However, as in many countries around the world, this progress will certainly be interrupted by border closures, social distancing and lockdowns. In this context, Tunisia, recorded a significant decline in remittances of -14.8% in 2020 compared to the previous year, going from \$2050 million in 2019 to \$1747 million in 2020. This loss is the result of the total lockdown imposed in the country during the first wave to contain the pandemic. These flows into Tunisia come from different countries of origin, mainly Europe (Habib, 2022). A more diversified flow of remittances in terms of countries of origin may be better protected against the effects of the pandemic as it has not affected all countries to the same degree simultaneously. Indeed, the decline in remittances is considered among the main exogenous impacts of exposure to the COVID-19 shock on beneficiary households. Declines of this magnitude will affect some populations differently than others. Accordingly, the greatest impact of the health crisis can be expected on households that are most dependent on remittances, and where this dependence, in addition to the infrastructure deficit, intersects with economic difficulties to adapt to the crisis.

During the first wave of the COVID-19 pandemic, the majority of studies focus on estimating economic impacts on global economic indicators including poverty, growth, employment, etc. (ILO, 2020; Nicola et al., 2020; World Bank, 2020). Despite the idea has importance in the contemporary political paradigm, these models have failed to assess the consequences of the pandemic and the associated lockdown policies on household well-being and their degree of dependence on international remittances. Indeed, severe social measures to limit the spread of the virus, including workplace closures have been accompanied by job losses and income volatility (Aggarwal et al., 2022; Krafft et al., 2021). Consequently, this may have affected the well-being of low-income households by reducing their ability to meet basic needs (Torero, 2020).

For Tunisia, studies about these issues are limited. Therefore, the contribution of this paper is twofold. First, there are few empirical studies on the effects of COVID-19 on household well-being. To the best of our knowledge, this study is among the first studies to examine its implications in Tunisia, where the

standard of living of many households depends on the support of a migrant abroad. Second, we used the Afrobarometer survey<sup>1</sup> where it offers a new perspective, which allows us to examine the characteristics of households' dependent on remittances that could potentially make them more or less vulnerable to the COVID-19 crisis. In our analysis, we do not examine all possible dimensions of a population's vulnerability, but rather focus on those aspects that are relevant to households' dependent on remittances and are covered by the survey, including the labor market situation and liquidity problems. Indeed, this survey aims to produce reliable data on the experiences and assessments of households relating to democracy, governance and life quality. Therefore, this study contributes to understanding the potential economic implications of the COVID-19 crisis by focusing on its potential implications lent to remittances using Tunisian households as a case study and examining the problem from two angles, the gain in well-being and the risk of dependence.

The objective of this study is to explore the impact of the COVID-19 lockdown on the dependence of Tunisian households most economically vulnerable on remittances and the importance of the availability of financial and digital infrastructure. First, we constructed variables needed for our analysis that reflect remittance dependency, economic vulnerability, and infrastructure inadequacy within the limits of the availability of the survey data used. Second, we used a multinomial logistic model to examine the degree of dependence of Tunisians on international remittances. This model is considered flexible because the dependent variable is not limited to two categories. Also, this empirical analysis contributes to the emerging literature and complements existing knowledge to inform and guide policymakers to examine the characteristics of households' dependent on remittances and to better design coping mechanisms during the COVID-19 pandemic at the local level.

For the purposes of our analysis, we seek to analyse the following hypotheses: if households are dependent on remittances, we assume that they are the most likely to see their economic situation negatively affected by a sudden drop in remittances due to an exposure to the COVID-19 shock. Also, we assume that households without jobs and with liquidity problems can be considered the most vulnerable because they lose a safety net to solve these problems. Indeed, if

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<sup>1</sup>. The dataset used in this study is from wave eight of the 2020 Afrobarometer survey, which was released in 2021. It is available at <https://dial.ird.fr/enquetes-statistiques/enquetes-afrobarometre>

households' dependent on remittance and with limited access to digital infrastructure, we assume that these households will have less opportunities to receive remittances in the event of a mobility blockage in their country.

The results show that: First, households characterized by the still experiencing shortages of cash and jobless are highly dependent on remittances. These households are considered the most economically vulnerable to the shock induced by the pandemic. Second, a high probability of Tunisian households that have access to a bank are highly dependent on remittances. This may be explained by the increased receipt of funds through official channels during the lockdown. However, those households that are dependent on remittances have less digital resources and face more economic shortages. Furthermore, these results suggest important policy implications. The country's decision-makers can facilitate the circulation of migration funds. This requires reducing the cost of remittances to help mitigate the COVID-19 crisis. Also, digital remittance services are often cheaper and less likely to spread the virus than in-person services which are feared as a potential pathway of contagion.

The rest of this paper is structured into five sections. The second presents a literature review. The third section focuses on a detailed description of our methodology. The fourth section is a summary of the results obtained. The last section concludes and proposes the implications of economic policies.

## **2. Literature Review**

Contrary to the Neoclassical Economics, the New Economics of Labor Migration (NELM), founded by Stark and Bloom (1985), shows that migration is a collective strategy and not an individual decision in order to remedy the situations harmful to development that characterize developing countries (income inequality, poverty, unemployment, low growth) and to improve the standard of living of resident households in the origin countries through remittances (Acosta et al., 2008; Barham and Boucher, 1998). In this context, emigration constitute, at the individual and family levels, a strategy for diversifying sources of income given the situation of ambient uncertainty which requires vulnerable households to seek additional income (Maharjan et al., 2020; Singh and Basu, 2019). Thus, migrants' remittances are the main bridge linking migrants to their families in countries of origin (Gubert, 2017).

Remittances are among the main factors of economic growth and poverty reduction in several developing countries (Majeed, 2015; Barajas et al., 2009; Acosta et al., 2008; Lucas and Stark, 1988). Most studies highlight the altruistic motivation of migrants to send funds to their origin countries (Agarwal and Horowitz, 2002; Elbadawi and Rocha, 1992). Following this assumption, remittances can be an important lifeline for development supporting adaptation to political, economic, natural and health crises. (Gagnon, 2020; World Bank, 2020; Akhter and Islam, 2019; Mawejje, 2019; Edelbloude et al., 2017; Bettin et al., 2014; Radha, 2005).

Several previous studies examine the hypothesis that remittances counter-cyclically respond to an economic shock (Mouhoud, 2016; Ebeke, 2010; Neagu and Schiff, 2009 Radha, 2005). They increase during periods of economic downturn or after a natural disaster, helping beneficiary households to maintain their level of well-being. Indeed, the support provided to the family budget by migrants' remittances constitutes a form of insurance against the precarious living conditions of the beneficiary households. But, the regularity of remittances allows households to settle in a situation of dependence. This dependence on foreign remittances is similar to what economists call the "liquidity trap" (Daffé, 2008). This is explained by the certainty that households receive regular remittances. So, any additional flow of remittances is quickly lost through misuse when they are no longer limited to smoothing the necessary expenses. As several studies have shown, regular remittance flows can lead beneficiary households to reduce their work effort and increase their leisure time, which contributes to reinforcing the dependence between the migrant and his family in the origin country (Habib, 2022; Murakami et al., 2021; Chami et al., 2018).

In the context of the COVID-19 pandemic, the term of Contra-cyclicity of remittances loses its meaning. The World Bank (2020) predicts a significant reduction in this global flow. Thus, Orozco (2020) estimates that around 35% of migrants to send less than 5% of their previous remittance volumes during COVID-19. This decline in remittances is mainly due to the loss of employment of migrant workers and the risks of being stuck in vulnerable situations (Fasani and Mazza, 2021; Callaham, 2020; Gagnon, 2020; Hubbard, 2020) and the impact of containment and lockdown measures on households' ability to access the remittance service (Mora and Rutkowski, 2020; Orcozo et al., 2020). Thus, an exogenous shock has had various socio-economic and political consequences in all

countries (Béland et al., 2020; Ozili, 2020). In addition, these mobility bans in most countries around the world lead to a reduction in international migration, which reduces the number of migrants sending funds to their origin countries (Clemens, 2020).

The containment policies taken due to the COVID-19 pandemic will jeopardize the level of consumption and savings of low-income households' dependent on labor income through the reduction of the number of working hours (Baldwin and Weder di Mauro, 2020; Arendt et al., 2020). Kansime et al. (2021) report that low-income Kenyan and Ugandan families who depend on labor income are more vulnerable to income shock during the COVID-19 pandemic. In the same context, Habib's study (2020) on Tunisian and Moroccan households shows a certain degree of dependence of the most vulnerable families on the amounts sent by their resident members abroad during the COVID-19 crisis. This dependence has devastating consequences, in particular the increase in unemployment and the economic shortage of households in the event of lockdown measures in response to the COVID-19 health crisis. Furthermore, Bisong et al. (2020) examine the effects of a decrease in the consumption of remittance-dependent households during the lockdown period due to a work stoppage in the receiving countries of migrants. In a comparative study between a set of African countries, Kalantaryan and McMahon (2021) showed that a drop in remittances contributes to worsening the economic situation for households who report being dependent on these foreign incomes during the pandemic. The authors also show that the containment measures adopted by countries are likely to limit people's ability to send and receive funds in person. However, the economic implications of COVID-19 could be further compounded when they intersect with the exclusion of financial and digital infrastructure to adapt to the crisis. Closures of banks and offices of Western Union and other transfer operators have been reported in many countries around the world (Win and Barkawi, 2020; Zaatari, 2020; Miles, 2020). By contrast, Afford (2020) shows that in the UK, remittance operators have been recognized as an "essential business" that can remain open during the crisis. Also, Bossone (2020) highlights how the payment system can be further improved to facilitate the circulation of remittance flows.

This decline in the remittance flows due to the current global health crisis will have different implications on the recipient households most dependent on these foreign incomes. So, these remittances can be a gain in the face of the

beneficiaries' precarious living conditions and the instability of the macroeconomic environment, as they can be a loss due to the risk of dependency.

### **3. Data and Methodology**

#### **3.1 Sample Selection and Data Collection**

To study the impact of Tunisian households' dependence on remittances on economic vulnerability and to assess the policy responses in a rapidly changing context, reliable data are imperative. In this regard, we analyse micro-data from the Afrobarometer survey, a pan-african research network capturing attitudes towards social, political and economic issues. It collects detailed information on a wide range of topics, including household demographics, education, markets, governance, quality of life, and other aspects of development. Thus, seven rounds of surveys were conducted in 38 countries between 1999-2018. In particular, we use data from round eight, conducted in Tunisia during the period 2019-2020. Afrobarometer conducts face-to-face interviews in the language chosen by the respondent at the national level.

The Afrobarometer survey in Tunisia is led by the national partner, "One to One for Research and Polling". It interviewed a random and nationally representative sample that includes 1200 Tunisian households aged 18 and over, which is stratified by the main subnational unit of government (province, region) and by urban or rural location. A randomly selected sample of  $n=1,200$ , gives results at the country level with a margin of error of  $\pm 3$  percentage points at a 95% confidence level. The survey base was created on the basis of the final results of the last census carried out in Tunisia in 2014 by the National Institute of Statistics (INS).

Based on the availability of the survey data used, to analyse the interest variable, the dependence on remittances, we use an Afrobarometer survey item that indicates whether respondents received or not remittances. The question asked is: "Considering all the activities you engage in to secure a livelihood, how much, if at all, do you depend on receiving remittances from relatives or friends living in other countries?" Responses were divided into four categories based on how frequently respondents received remittances: (1) Not at all i.e. there are no remittances, (2) A little dependent, (3) somewhat dependent, and (4) lot dependent.

To analyse economic vulnerability, we use two items from the Afrobarometer survey relating to labor market status and the liquidity problems

they report facing. The question asked about the employment situation is: “Do you have a job that pays a cash income?” The possible answers are: (1) employed, part-time and full-time and (2) unemployed. And, the question of the lack of liquidity is the following: “Over the past year, how often, if ever, have you or anyone in your family: Gone without a cash income?” The possible answers are: (1) Never lack liquidity, (2) Sometimes, (3) Several times and (4) Always, lack liquidity.

Finally, to analyse the level of inadequacy of the digital and financial infrastructure, we use three questions from the Afrobarometer survey relating to the availability of a bank in the residential area, the availability of a bank account and the availability of internet access. So, the questions asked are: “Are the following infrastructures available in or within walking distance of this sampling unit/enumeration area? Banks.” The possible answers are: (1) Yes, with access to a bank and (2) No, without access to a bank. “Which of these things do you personally own: Bank account?” The possible answers are: (1) Yes, has a bank account and (2) No, no one in the household has a bank account. And the last question: “Which of these things do you personally own: Mobile phone? [If “Yes”] Does your phone has access to the internet?” The possible answers are: (1) Yes, with internet access and (2) No, without internet access.

### **3.2 Methodology**

#### **3.2.1 Variables of Interest**

Following the methodology adopted by Kalantaryan and McMahon (2021), we identify the following three variables in order to analyse the degree of dependence of the Tunisian households’ dependence on remittances sent by their members abroad. Also, we analyse the economic vulnerability which could be further exacerbated by the unavailability of the financial and digital infrastructures necessary to adapt to the COVID-19 crisis.

#### *1-Remittance Dependency*

Some beneficiary households consider migration remittances as an essential lifeline when there is a lack of money problems (Mouhoud, 2016; Radha, 2005). However, the durability of remittances can contribute to reinforcing the dependence on these remittances between the migrant and their family of origin and to decreasing labour market participation (Habib, 2022; Chami et al., 2018). Households’ dependent on remittances are the respondents to the question, if they receive remittances, to what extent they depend on them. These households may

respond “A little”, “Somewhat” and “A lot” dependent on migration remittances. The sum of these three responses indicates the proportion of the population that depends on remittances in Tunisia. Thus, we propose the hypothesis that these households are the most likely to see their economic situation negatively affected by a sudden drop in remittances due to the COVID-19 crisis.

### *2-Economic Vulnerability*

In general, the concept of vulnerability is a tool to describe the states of insecurity of physical and social systems and to guide the normative analysis of actions to improve well-being through risk reduction (Hoddinott and Quisumbing, 2003). This concept has been adopted in several disciplines. For example, in the field of economics, this risk has been often the proportion to suffer from a significant well-being shock which can itself limit the resilience capacities of individuals (Alwang et al., 2001; Chambers, 1989). Several studies insist on the relationship between risks and coping capacity. Indeed, the differential vulnerability of individuals and groups increases when the risks increase and vice versa. This notion is widely used in studies of vulnerability to natural shocks and climate change and their impacts on society (Schilling et al., 2020; Afriyie et al., 2018; Bettin et al., 2014; Adger and Kelly, 1999; Liverman, 2013). In theory, economic vulnerability is the amalgamation of several factors. In our study, it is de facto assimilated to exposure to the COVID-19 shock, through the degree of household dependence on remittances. Notably, economic vulnerability is not only the share of families’ dependent on remittances that face cash flow problems, but also the share of those families that they are unemployed. Indeed, in the context of the COVID-19, many jobs are at risk. Based on data from a survey by the Economic Research Forum (ERF), Krafft et al. (2021) show that around 16% of salaried workers in Tunisia lost their jobs in October 2020.

Survey data indicate that households that report being dependent on remittances are the most or least economically vulnerable. This can be taken according to their labor market situations (with or without employment) and the lack of liquidity (lack of money) that may be faced. Thus, in a context of confinement where remittances are interrupted, we propose the hypothesis that households without jobs and with cash flow problems can be considered the most vulnerable because they lose a safety net to solve these problems.

### 3-Insufficient Infrastructure

The economic effects of COVID-19 are worsening with the problems of inadequate infrastructure in the countries. Indeed, closures of banks and money transfer operators have been reported in several countries around the world during the crisis (Miles, 2020; Zaatari, 2020). These measures have an influence on the amounts of remittances as they can affect individuals to meet with the intermediaries of remittances and service providers. Bisong et al. (2020) indicate the transition to digital remittances is needed as a solution to this challenge. This type of remittances does not require individuals to physically visit an office and responds to lockdown and social distancing measures. Also, according to the World Bank, digital remittances are often around 50% less expensive than traditional remittance channels. Indeed, the availability of the digital infrastructure for sending and receiving funds depends on a bank account and an internet connectivity.

The survey data focuses on households receiving remittances who reside in areas without a bank, do not have a bank account, and do not have access to the Internet. These indices give an idea of the level of inadequacy of the digital and financial infrastructure. Thus, we propose the hypothesis that households' dependent on remittance and with limited access to digital infrastructure, will have less opportunities to receive remittances in the event of a mobility blockage in their country.

**Table 1.** Construction of Variables

Variables	Modalities
<b>Remittance Dependency (RD)</b>	DR1: Share of the population dependent "A little" on remittances.
	DR2: Share of the population "Somewhat" dependent on remittances.
	DR3: Share of the population dependent "A lot" on remittances.
<b>Economic vulnerability (EV)</b>	<i>Lack of cash (LC)</i>
	EV1: Share of the population dependent on remittances, facing cash problems "Sometimes" per year.
	EV2: Share of the population dependent on remittances, facing cash problems "Several times" per year.
	EV3: Share of the population dependent on remittances, facing cash problems "Always"

	<i>Unemployed (U)</i> EV4: Share of the population dependent on remittances and unemployed.
	<i>Access to a Bank (B)</i> III: Share of the population dependent on remittances, resides in areas without a bank.
<b>Insufficient infrastructure (II)</b>	<i>Has a bank account (BA)</i> II2: Share of the population dependent on remittances, without a bank account.
	<i>Internet access (I)</i> II3: Share of the population dependent on remittances, without access to the Internet by mobile phone.

**Source:** Research finding, based on the Afrobarometer survey.

### 3.2.2 Empirical Method

The qualitative data was analysed using a multinomial logistic model which was used to highlight the likelihood if the expected decrease in remittances creates a significant impact on the households that are the most dependent on it, and those who have cash shortages. Long and Freese (2001), Heck et al. (2014) and Field (2018) have shown that the use of a multinomial logistic regression is to predict the probability of several independent variables to belong to a category of a dependent variable. As in a binary logistic regression, multinomial logistic regression uses the maximum likelihood estimation to assess the probability of categorical membership. Then, this type of model allows for determine the decision probability of a respondent in a particular discrete multinomial choice, conditioned by the values of the independent variables. Nevertheless, this type of model does not allow for directly reading the model's coefficient estimation results. Indeed, it is necessary first to calculate the relative risk ratio (RRR) in order to be able to interpret the results.

In our study, we will use the multinomial logit model where the dependent variable, dependent remittances ( $RD_i$ ), can take more than two categories ( $m > 2$ ) (Heck et al., 2014). We assume that the number of categories ( $m_i = 0, 1, 2, \dots, M_i$  with  $M_i = 3$ ) of a qualitative dependent variable  $RD_i$ , observed for the  $i^{\text{th}}$  individual ( $i = 1, \dots, N$  with  $N = 1200$ ). We will limit ourselves to the simpler case where this number is assumed to be fixed for the entire sample. Equation (1) expresses which of the independent variables ( $X_i$ ) significantly predict(s) whether a household chooses the categories "A little dependent" (coded 1), "Somewhat dependent"

(coded 2) or “A lot dependent” (coded 3) against the reference category “No dependency” (coded 0).

$$Prob\left(RD_i = m - X_i = X_1, X_2, \dots, X_N\right) = Prob\left(RD_i = m - N\right); \quad (1)$$

$m = 0, 1 \dots M$

The aim is to find the  $m$  probabilities ( $Prob(RD_i = 1), Prob(RD_i = 2), \dots, Prob(RD_i = m)$ ) car  $Prob(RD_i = 0) = 1 - \sum_{m=1}^M P(RD_i = m)$ . Each of these probabilities is written as a function of the independent variables  $X_i$  and a vector of parameters  $\beta$ . The response probability of the individual who chooses the modalities ( $m = 1, \dots, M$ ) is defined by the following equation:

$$Prob(RD_i = m / X_i) = \frac{\exp(X_i \beta_m)}{1 + \sum_{h=1}^M (X_i \beta_h)} = Prob_m(X_i, \beta); m = 1, \dots, M \quad (2)$$

Thus, Equation (3) defines the probability of the reference category ( $m = 0$ ):

$$Prob(RD_i = 0 / X_i) = \frac{1}{1 + \sum_{h=1}^M (X_i \beta_h)} = Prob_0(X_i, \beta) \quad (3)$$

We used the maximum likelihood estimator (MLE) to estimate the model's parameters ( $\beta$ ) which are expressed by the relative-risk ratios (RRR). This method is expressed by Equation (4) as follows:

$$L(\beta) = \sum_{i=1}^n \sum_{m=0}^M 1[RD_i = m] \log[Prob_m(X_i, \beta)] \quad (4)$$

The maximum likelihood estimator ( $\tilde{\beta}$ ) is convergent and asymptotically distributed according to a logistic law on the real value of the model's parameters ( $\beta$ ).

### 3.2.3 Empirical Model Specification

We follow the methodology adopted from McFadden (1972), estimating the following model:

$$RD_i = \alpha_i + \beta_0 EV_i + \beta_1 II_i + \beta_2 X_i + \varepsilon_i \quad (5)$$

The following equation details the components of each variable in our model as follows:

$$RD_i = \alpha_i + \beta_0 LC_i + \beta_1 U_i + \beta_2 B_i + \beta_3 CB_i + \beta_4 I_i + \beta_5 X_i + \varepsilon_{it} \quad (6)$$

The independent variables are:  $EVi$  et  $Ii$  respectively denote economic vulnerability under the two categories, Lack of cash ( $LC_i$ ) and unemployed ( $U_i$ ) and the inadequacy of the infrastructure which consists of the three variables, access to a bank in the area who resides ( $B_i$ ), has a bank account ( $CB_i$ ) and access to the internet ( $I_i$ ).

For the purposes of this study, we include other control variables conceptualized in a vector denoted  $X_i$  (gender, age category, geographical location, region, number of adults in the household, level of education).  $\alpha_i$  is the fixed effects that capture the unobserved heterogeneity, in other words, the characteristics specific to each individual. And,  $\varepsilon_{it}$  is the error term.

## 4. Results and Discussion

### 4.1 Descriptive Analysis

Table 2 shows the statistics of socio-demographic characteristics which show that Tunisian respondents share similar proportions in terms of gender, male (50.13%) and female (49.87%). Age categories record about half of respondents aged 26-45 (45.2%), followed by respondents aged 46-59 (25.27). In addition, the survey considered that a large part of the respondents had a primary education level of 38.62% followed by respondents with a secondary education level (35.36%). In addition, the large percentage of respondents is for households with a maximum of two members (46.12%). Also, households with three to four members recorded a significant proportion of respondents (37.28%). On the location side, about two-thirds of respondents live in urban areas (67.97%).

Since the Afrobarometer does not ask respondents how much they receive, we grouped together all those who receive remittances, regardless of the frequency (a little, somewhat, and lot dependent). Grouping remittance recipients in this way, the descriptive statistics of the survey data used show that more than 16% of respondents in Tunisia reported some degree of dependency on remittances. These households are the most likely to encounter a vulnerable economic situation and be negatively affected by a sudden drop in remittances sent from abroad following a country closure in response to the COVID-19 pandemic.

Also, one of the main results described that the current economic reality of Tunisia is fair or bad. Indeed, the lack of liquidity and employment are among the most important problems identified by the sample. In the same way, we have

grouped together all those who declare that they are in a situation of liquidity shortage, whatever the frequency (Sometimes, Several times and Always). The data shows around half of the respondents say they are dependent on remittance and that they are in a situation of lack of cash, i.e. 48.2% and around 38.6% of households' dependent on remittances, report they do not have a job. This highlights how migration remittances are a vital currency source for these households as they are less able to solve their difficulties without this additional income which can be like a safety net in some situations.

On the other hand, the statistics of the responses show that the financial infrastructure in Tunisia is insufficient to meet the needs of the population in a context of closure and social distancing measures. More than half of Tunisian households that receive remittances report that they do not have access to a bank in the enumeration area, i.e. 50.6% and about 32.8% of respondents did not have a bank account. Also, statistics show that digital connectivity is not widely available, about 62.2% of remittance-dependent households do not have access to the internet through a mobile phone. This does not allow households to adapt the way they receive remittances to the restrictions imposed during a lockdown due to the COVID-19. So, the infrastructure challenges indicate that Tunisia's preparedness and the authorities' responses to handling the COVID-19 crisis were uncertain.

**Table 2.** A Summary of Respondent Responses

Questions	Variables	Modality	N	%
<b>Residence area = PSU/EA</b>	Location	Rural	384	32.03
		Urban	815	67.97
<b>Gender</b>	Gender	Female	601	50.13
		Male	598	49.87
<b>Total number of adult citizens in the household?</b>	Adult	1-2	553	46.12
		3-4	447	37.28
		≥5	199	16.60
<b>How old are you?</b>	Age	18-25	182	15.18
		26-45	542	45.20
		46-59	303	25.27
		60+	172	14.35
<b>What is your highest level of education?</b>	Education level	Without level	97	8.09
		Primary	463	38.62
		Secondary	424	35.36

		University	215	17.93
<b>How much, if at all, do you depend on receiving remittances from relatives or friends living in other countries?</b>	Dependence on Remittances (DR)	No dependency		
		A little	1.006	83.90
		Somewhat	119	9.92
		A lot	44	3.67
			30	2.50
<b>In the past 12 months, how often have you (or a member of your family) had to deal with lack of money?</b>	Lack of Cash (LC)	Never	621	51.79
		Sometimes	359	29.94
		Several times	205	17.10
		Always	14	1.17
<b>Do you do salaried work?</b>	Unemployment (U)	With employment	736	61.38
		Without employment	463	38.62
<b>Are the following infrastructures available in or within walking distance of this sampling unit/enumeration area? Banks.</b>	Access to a Bank (B)	With access to a bank		
		Without access to a bank	592	49.37
			507	50.63
<b>Which of these assets do you own? [If no]: Does another member of your household own one Bank account?</b>	Has a bank account (BA)	With a bank account		
		Without a bank account	805	67.14
			394	32.86
<b>Does your phone has access to the internet?</b>	internet access (I)	With internet access	453	37.78
		Without internet access	746	62.22

**Source:** Research finding, based on the Afrobarometer survey.

#### 4.2 Remittance Dependency

Table 3 highlights the results of estimating a multinomial logit model of the determinants if the degree of household dependence on remittances affects their economic vulnerability during the COVID-19 pandemic and if exclusion of digital and financial infrastructure intersects with this vulnerability. Indeed, the relative risk ratio (RRR) represents the predicted multiplicative change in the relative risk of belonging to a comparison class of degree of dependence on remittances (a little, somewhat or a lot) by compared to the reference class where respondents are included in the basket no dependency (i.e. no remittances).

Individuals identified as female are 0.4462 times more likely than male respondents to be in the “no dependency” on remittances basket and a lower

probability of being in the “a lot dependent” on remittances class. This is partly due to the fact that men are the main beneficiaries of the additional income. Therefore, they are the most likely to see their economic situation negatively affected by a sudden drop in remittances due to the COVID-19 crisis. Since the “age” variable was treated as a categorical, each older category is compared to a younger category (18-25 years, coded 0). We find that the odds of individuals aged 46-59 and +64 are respectively 0.1141 times and 0.0415 times more likely to be included in the baseline “no dependency” on remittances than those aged between 18-25 year who are in a basket of major dependence on international funds. The RRR of the education level variable indicates that respondents with basic and secondary education levels are respectively 0.1245 and 0.4051 times more likely to be in the “no dependency” on flows of foreign funds class than individuals with lower basic education level who are more likely to be in a situation of major dependence on foreign remittances. The “Adults” variable, which refers to the size of adults in the household, indicates that households with more than three members have significant probabilities of 1.3927 times and 1.3169 times to belong to the comparison modality where there is a major dependence on remittances compared to households with only one or two members.

In terms of geographical location, our results suggest that households living in cities have a significant probability of 1.6634 times to be in the “a lot dependent” on remittances class than those living in rural households. We also find that the South East region of Tunisia has a significant probability of 2.5234 times more likely to be included in the major remittance dependency class. This is explained by the fact that historically this region has traditionally been a departure zone for foreign countries. Indeed, the North-East and Center-East regions have significant probabilities of 0.1225 times and 0.4697 times respectively of being included in the “somewhat” dependent on remittances modality compared to the basic modality “no dependency”.

In addition, the economic vulnerability of households is measured in our model by the two variables, liquidity shortage and the jobless situation on the Tunisian labor market. Indeed, the RRR of the “lack of cash” variable indicates that respondent households who sometimes lack cash have a significant probability of 1.8624 times more likely to be in the basket “little dependent” on remittances compared to respondents who report that they do not have cash flow problems and who are more likely to be in the basket “no dependency” on remittances. In

addition, the results indicate that respondents with always a shortage of cash have a highly significant probability of 6.3681 times that they have failed to exit the basket of major dependence on foreign money. Regarding the devastating consequences of COVID-19 on employment status and income, salaried individuals may encounter difficulties in accessing markets and have lost their jobs, mainly in the case of the restriction measures adopted by the Tunisian authorities (Krafft et al., 2021). Then, the “lack of employment” variable indicates that unemployed Tunisian households have a significant probability of 1.8393 times to belong to the comparison modality where there is a major dependence on remittances compared to respondents who declare never having a lack of employment. Thus, households in a situation always with liquidity problems and unemployed, have a major dependence on remittances. However, the disruption of remittances to dependent households due to COVID-19 lockdowns removes a safety net to address these issues. So these households can be considered as the most economically vulnerable.

The efficiency of Tunisia's financial and digital infrastructure is analysed through the availability of a bank, a bank account and internet connectivity. Indeed, the results of our study highlight that respondents with access to a bank in the area they reside have a significant expected probability of 0.3954 times to be included in the basket of a major dependency on remittances. These results are consistent with the findings of several studies where we find that geographic mobility restrictions due to COVID-19 blockages have made it more difficult to transport cash across borders. As a result, one of the positives of this pandemic has been the increase in electronic (official) remittances, which has become the only option for many migrants to support their low-income households. However, this increase recorded during the pandemic could be due to a shift from informal to formal channels (Kpodar et al., 2021; Cattan and Gayol, 2020). In the same context, Bossone (2020) highlights the importance of improving the payment system to facilitate the circulation of remittance flows. Households that report not having a bank account are 2.1598 times more likely to belong to a basket “somewhat dependent” on foreign funds than respondents with a bank account. Also, respondents who do not have internet connectivity are little dependent on foreign funds with a significant probability of 1.5209 times to be in this dependency basket. So these households have a high probability of finding some degree of remittance dependency. In a context of lockdown and social distancing to surround the spread

of the virus, they will have fewer digital tools to continue to receive remittances without leaving their homes.

**Table 3.** Multinomial Logistic Regression of the model

Basic Modality : No dependency	Comparison Modality #		
	Dependent 'A little'	Dependent 'Somewhat'	Dependent 'A lot'
<b><u>Socio-Demographic Characteristics</u></b>			
<b>Gender</b>			
Female	0.8165	0.9382	0.4462*
<b>Age</b>			
18-25 (basic)			
26-45	0.4667***	0.6230	0.4886
46-59	0.4044***	0.1901**	0.1141***
+60	0.3775***	0.6774	0.0415***
<b>Education</b>			
Less than basic (basic)			
Basic	1.5890	0.7799	0.1245***
Secondary	1.5008	0.9963	0.4051*
Higher education	2.2354	2.5462	0.3831
<b>Adult</b>			
1-2 (basic)			
3-4	0.9264	0.6633	1.3927**
≥ 5	1.0009	0.9777	1.3169*
<b>Location</b>			
Urban	0.9408	1.0746	1.6634*
<b>Region</b>			
Great Tunis (basic)			
North East	1.0794	0.1225**	1.2167
North West	0.2685**	1.6514	1.7746
Center East	1.0050	0.4697*	1.3267
Center West	0.9091	1.2883	0.8986
South East	1.6074	0.4546	2.5234*
South West	1.0537	0.3319	2.3214
<b><u>Economic vulnerability</u></b>			
<b>Lack of cash</b>			
Never (basic)			
Sometimes	1.8624***	0.8928	0.6392
Several times	0.6570	0.8668	0.9962
Always	2.4292	4.21e-06	6.3681*
<b>Lack of employment</b>			
With job (basic)			
Unemployed	1.0371	0.9055	1.8393*

<b>Infrastructure</b>			
<b>Access to a bank</b>			
With access to a bank (basic)			
Without access to a bank	1.1594	1.1010	0.3954*
<b>Has a bank account</b>			
With a bank account (basic)			
Without a bank account	1.0697	2.1598*	0.5888
<b>Internet access</b>			
With Internet access (basic)			
Without internet access	1.5209*	1.6823	0.7988
<b>Observations</b>		1200	
<b>LR chi2(72)</b>		144.87	
<b>Prob &gt; chi2</b>		0000	
<b>Log Maximum Likelihood</b>		-635.09	

**Source:** Research finding, based on the Afrobarometer survey.

**Note:** Robust standard errors, \*\*\*=p<0.01, \*\*=p<0.05, \*=p <0.1.

# The comparison modalities of remittance dependency are 1=A little, 2= Somewhat, 3=A lot, against a reference modality 0=No dependency.

## 5. Conclusion and Policy Recommendation

The COVID-19 pandemic and the lockdown to contain it reveal the social vulnerability of migrant workers and their families. In a context of broader economic decline as governments seek to contain the virus, a decline in international remittances (World Bank, 2020), will remove a safety net for many poor and vulnerable families in developing countries. Thus, this decline can register a major impact on individuals and households, even in countries that do not receive particularly large remittance inflows at the macroeconomic level.

In order to reflect on the potential socio-economic implications of the COVID-19 crisis on migrant remittances, we rely on microeconomic data from the Afrobarometer survey conducted in Tunisia in 2020. Using a multinomial logistic model, we described the extent to which Tunisians are more or less dependent on remittances, and how these households are potentially economically vulnerable in a context of “staying at home” in the country.

The results show: first, households in a situation still with liquidity problems and unemployed have a major dependency on remittances. Thus, the disruption of these remittances due to COVID-19 containment measures removes a safety net to address these issues. These households can be considered the most economically vulnerable. Second, households with access to a bank in the area where they reside have a major dependence on remittances. We explain this result by the increase in

official remittances at the expense of informal remittances, which have become the only option for migrants during the border closures. Third, Tunisians who do not have a bank account and internet connectivity have some degree of dependency on remittances. So, in a context of lockdown and social distancing to surround the spread of the virus, these households will have fewer digital tools to continue to receive remittances without leaving their homes. Thus, the lack of digital infrastructure increases the economic vulnerability of Tunisian households' dependent on remittances to adapt to the crisis.

In addition, the Tunisian government needs to address a clear set of clear policies and guidelines to respond to the new normal emerging in the cross-border movement of workers affected by COVID-19. Therefore, it is necessary to identify some economic and political implications that may be relevant to mitigate in particular the impact of dependence on international remittances on economic vulnerability. First, the frequency with which Tunisian households find themselves without cash and jobs and experience the cessation of remittances underlines the need for social protection measures to protect these families against the shocks induced by the national lockdown. Also, the Tunisian government should extend social protection coverage to returning migrants who are pushed into transitory poverty due to the devastating consequences of the COVID-19 pandemic. Second, despite fears of a major collapse, remittance flows to developing countries resisted during COVID-19. This increase may have reflected a shift from informal to formal channels. However, the rise in official remittances during the pandemic is increasing remittance costs. Given that these flows are a lifeline for many poor and vulnerable households, it will be important on the one hand, to consider remittance services as essential and not be subject to mandatory closure in the country like many countries in the world, on the other hand, to facilitate the circulation of these international funds. The latter policy requires reducing the cost of money transfer to help mitigate this crisis, in line with the Sustainable Development Goals (SDGs), in particular Goal 10, which aims to reduce the transaction costs of migrants' remittances to less than 3%. Third, to adapt to the requirements of public authorities to fight the pandemic, technology plays a crucial role in helping households to receive money by supporting remittance through digital channels. So the Tunisian government can encourage and support digital remittance service providers. This requires promoting financial and digital literacy among beneficiary households and improving internet connectivity in the country. Fourth, the

coronavirus is a global disease and we do not know how long it will continue to threaten individuals. In this scenario, the concepts of resilience and sustainability are fundamental to the development of future social actions. Indeed, it is necessary to employ adaptation and mitigation strategies based on sustainable investment. This can mitigate the income shock and build resilience to future disruptions.

These measures would reduce the harm of additional income loss that is essential for many households and help support a sustainable and resilient economic recovery. Indeed, among the lessons learned from the COVID-19 pandemic is that we need to ensure that the resources we use to rebuild are sustainable and that the solutions are long-term.

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## Revealing the Lives of Poor Female Heads of Households: What Can Be Done?

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### Abstract

Women who are heads of households are often trapped in poverty and are in quite vulnerable conditions. They have to carry out a dual role: taking care of the household and at the same time earning a living for their family. Uncovering and understanding their life can help find the best way to improve their life. This study uses a descriptive-qualitative analysis approach by combining secondary and primary data analysis. All research activities focus on the conditions and situations faced by poor female heads of households in Gorontalo Province, Indonesia. This study found that the combination of old age, uneducated, unskilled, and unemployed is the main factor causing poverty in poor female heads of households. Basic public services and economic resources, which are unable to reach all poor households, have contributed to exacerbating poverty conditions. Therefore, to improve the standard of living of women headed poor households, interventions are needed that combine social assistance and protection (such as provision of cash, food assistance, health insurance, etc.), provision of skills, equipment assistance, business capital assistance (especially for trading businesses), access to micro-credit, and assistance, while improving their housing conditions, especially housing, sanitation, and clean water.

**Keywords:** Female, Livelihood, Multidimensional, Poverty, Poor Households.

**JEL Classification:** B54, P36, R2.

### 1. Introduction

The problem of poverty remains an important issue and the main challenge for the current development of Gorontalo Province. Even though the poverty rate has shown a downward trend in the last decade, the number of poor people as of March 2022 is as high as 185.440 people or 15,42 percent of the total population, is still

relatively high and needs to be pressed to a lower level. Rural areas seem to be pockets of poverty, where nine out of 10 poor people in Gorontalo Province live in rural areas. The poverty rate in rural areas reaches 24,42 percent, which means that for every five residents who live in rural areas, one of them is categorized as poor (BPS Gorontalo, 2022).

However, the condition of poverty in Gorontalo Province looks interesting because the number and percentage of poor households with female heads of households is relatively high. Based on the Gorontalo Province Unified Database, there are at least 11.15 percent of poor households where the head of the family is a woman. This means that for every nine poor households in Gorontalo Province, one of them is a woman as the head of the family. The highest number of poor female heads of households is found in Kabupaten Gorontalo. The phenomenon of female heads of households is quite a concern, considering that they have a dual role, in the midst of quite difficult conditions, being a support for the family's economic resilience and being the head of the household in providing for family members (Brown and Van de Walle, 2021).

The link between women and poverty has been shown by several previous studies. It was stated that patriarchal culture has indirectly provided boundaries for women, and injustice and inequality have contributed to the closeness of women's identity to poverty (Orkoh et al., 2022). Women's and men's experiences of poverty are different, and compared to men, women are far behind in accessing economic resources as a door to eliminating various injustices in society. The impact of lagging behind women also implies that reducing poverty must be able to encourage increased participation and welfare of women (Tekgüç and Akbulut, 2022). If women are not used as the target for poverty alleviation, and gender analysis is not used to look at the root causes of poverty, then poverty alleviation programs will not be able to reach most women who have limited access to public space (Mdluli-Maziya et al., 2022; Sen, 2014; Sharaunga and Mudhara, 2021).

**Table 1.** Number of Poor Female Heads of Households by Regency/City in Gorontalo Province

No.	Regency/City	Number of Women Head of Poor Household	Percentage
1.	Gorontalo City	2.096	17.10
2.	Bualemo Regency	1.493	12.18
3.	Pohuwatu Regency	950	7.75
4.	Gorontalo Regency	5.073	41.40
5.	North Gorontalo Regency	928	7.57
6.	Bone Bolango Regency	1.714	13.99
	Gorontalo Province	12.254	100.00

**Source:** Gorontalo Province Integrated Database, 2022.

Cumulatively, various conditions affect women, which make them trapped in poverty, namely a weak bargaining position in society, a repressive culture, poverty due to disasters and conflicts, discrimination in the public and domestic spheres, and the state's indifference in issuing policies useful policies to lift women out of poverty (Klasen et al., 2015). According to Admasu et al., (2021) confirmed that the livelihoods of women heads of poor households are actually in conditions of more multidimensional poverty, even more, difficult than those of poor male heads of households. This is in line with the idea expressed by Mosse (2002) that, there is a linear correlation between the poverty of women and women's heads of households. That is, when a woman lives in poverty and is in a position as the head of the family, she will play an increasingly important role in supporting her family or making a living for her family members. Jayasinghe and Smith (2021) outlines that a woman who heads a household is a woman who has the sole responsibility for supporting her family, so she is the main breadwinner and also has to meet all the necessities of life for her family members.

The results of a field survey conducted by the Pekka Foundation (Empowerment of Female Heads of Family) show the fact that women who are the heads of these families, among others, are widows whose husbands have died, divorced widows, women who have been left by their husbands for a long time and are not given a living, single women from underprivileged families, and women whose husbands are sick or disabled (Zulminarni, 2009). In this situation, women carry a double burden in the household, namely taking care of the household and at the same time earning a living.

Understanding their poverty condition is the first step to helping them get out of the poverty trap. Moreover, so far there has not been much research that

specifically focuses on the condition of poor female heads of households. In addition, the analysis of the relationship between the sex of the head of the household and the condition of poverty, is faced with the problem of limited statistical data and there is debate about the definition of a poor female head of household which is heavily influenced by factors cultural factors. The novelty of this poverty study is that it focuses on analyzing the lives of poor female heads of households, where this research has never been done before in that area. In addition, the results of this research can serve as guidelines and solutions as well as provide practical implications for the government, to help poor female heads of households get out of poverty and improve their standard of living in the future.

Mosse (2002) gives an interesting term for the female head of the household by saying women headed or women maintained (which is looked after by women) namely women who bear the sole responsibility for supporting their family. This understanding is linear with the notion of the head of the family himself, namely a person who has both economic and social responsibilities towards his family.

Departing from the above understanding, if in reality a family is supported by a woman or a wife then of course conceptually, the woman is the head of the family. Based on the results of a field survey conducted by the PEKKA Foundation, in real terms, the women who are the heads of these families include widows whose husbands have died, divorced widows, women who have been left by their husbands for a long time and are not given a living, single women from poor families and women whose husbands are sick or disabled (Zulminarni, 2009). Meanwhile, other data that was found was that women whose husbands were unemployed, either because they were laid off, lazy to work, or had difficulty finding work, also bear the sole responsibility for their families. On average, the female heads of poor households come from poor families and have low education. The jobs they do are jobs in the informal sector, such as housemaids, farm laborers, small traders, and other jobs that do not require skills. In areas of poverty pockets, poor women experience miserable things, whereas he is the one who suffers the most from the poverty of his family (Bersisa and Heshmati, 2021).

From the results of research conducted by the World Health Organization (WHO) team, it was noted that the number of poor female heads of households tends to increase every year. In the Caribbean, the number of poor female heads of households is 35%, Latin America is 21%, Sub-Saharan Africa is 20%, Central Asia is 17%, North Africa, West Asia, and South Asia is 12%-13%, India is 11.7%, even in In Central America, 90% of refugee families are supported by women.

Based on these data, it seems that the female head of a poor household is a

reality that cannot be avoided in both developed and poor countries. In developed countries, they are usually independent women, especially from an economic point of view, or career women who are highly educated. On the other hand, in poor countries, women heads of poor households are those with low education and low economic status. This is in line with the theory that states that, there is a linear correlation between women's poverty and poor female heads of households (Mosse, 2002).

That is, when a woman lives in poverty, she will play an increasingly important role in supporting her family or making a living for her family members. In Indonesia, one out of 10 heads of poor families is a female head of household, which is estimated to number 1.2-1.5 million people and the average educated person has not graduated from elementary school. This is confirmed by data from the Central Statistics Agency (BPS) which states that 13.2% of households in Indonesia are headed by women (Subhan, 2008). Meanwhile, according to data from the PEKKA Foundation, it was stated that the number of female heads of households is poor in Indonesia every year it increases by 13% -17% (Zulminarni, 2009). According to World Bank metadata, the percentage of poor female heads of households in Indonesia in 2017 has reached 14.8%.

The increasing number of poor female heads of households, especially in developing countries poverty is caused among others by (1) Migration. Migration has a real effect on women who are left behind. For village women, when their husbands leave, they have sole responsibility for the fields, there are no male workers and they have a low source of income for farming, causing very low productivity. As a result, women do part-time jobs outside of work as farmers who have economic value; (2) the Husband dies, divorces, the husband leaves home (works outside the city, outside the region, or abroad) and the husband is sick. This factor is experienced by many poor female heads of households in Indonesia. In addition to these factors, the increase in the number of poor female heads of households is also caused by the desire and awareness of women to free themselves from aspects more repressive in non-biased cultures (Momsen, 2002).

According to Danquah et al. (2021) found the fact that poor women suffer more than poor men and suffer more than fellow women who come from better economic classes. Some of the common conditions that poor people have to face include food shortages, minimal income, untreated diseases due to costs and access to health facilities, malnutrition, unhealthy housing, a bad environment, and difficulty in supplying clean water. This condition forces the poor to spend their time and energy to meet their basic needs to survive. Low education or even

illiteracy further limits access to information (Hubeis and Mulyandari, 2010).

This is in line with what was found by Birdsall (1983) which states the fact that the burden on poor women is greater because of their dual roles, namely as a housekeeper as well as a breadwinner for the family. Women are responsible for taking care of children, preparing food, fetching water and firewood, washing clothes, cleaning the house, and managing household finances, which absorb most of their time. However, this work is often not considered "work", so it is also not counted in the "production" of a household. This is exacerbated by the assumption that a woman's income is only "additional or complementary" to her husband's income.

There is a connection between women and conditions of poverty, where patriarchal culture has indirectly provided limitations for women, and injustice and inequality have contributed to the closeness of women's identities to poverty. Women's and men's experiences of poverty differ, and women compared to men are far more behind in accessing economic resources as a door to eliminating various injustices in society (Azumah et al., 2023). Reducing the poverty rate must be able to encourage increased participation and welfare of women. If women are not made the target of poverty alleviation and gender analysis is not used to look at the root causes of poverty, then poverty alleviation programs will not be able to reach most women who have limited access to public (Appiah-Kubi, 2021).

Several analyzes of the poverty condition of households headed by women have come to different conclusions. Analysis based on BPS data shows that the poverty rate (percentage of households living below the poverty line) in female-headed households is lower when compared to male-headed households, but the annual rate of poverty reduction during 2008–2012 in households headed by women (an average of 7.16% per year) is slightly slower than the rate of decline in households headed by men (average 7.77% per year).

However, the results of Yusrina and Akhmadi (2013) analysis, which disaggregates households into households with complete spouses and households with single parents (male or female) show that, although they are not poorer than households with complete partners, single-parent households headed by women are poorer than single-parent households headed by men. This analysis, which is based on data from the 2012 Indonesia socioeconomic survey, also shows that, when viewed from the aspects of age, educational background, type of work, and workload, the condition of the female head of household is the most vulnerable.

Analysis based on data from the 2011 social protection program data collection also shows the high vulnerability of households headed by women. From

the data covering households with the lowest three deciles (30%) consumption levels, there are 15% of households headed by women. This percentage is slightly higher than the proportion of households headed by women in general in 2011 which was around 14%. Compared to male heads of households, female heads of poor households are relatively older, more are disabled or suffer from chronic illnesses, have a lower average level of education, and more often do not have ID cards or driving (Lockley et al., 2013).

In some literature, the role of women is often divided into three lines, namely: first, the productive role, namely the role of a woman who has an additional role as an additional breadwinner for her family. A productive role is a role that is rewarded with money or goods that generate money or services related to economic activities (Yilmaz and Ledwith, 2017). This role is identified as the role of women in the public sector, for example, farmers, tailors, laborers, teachers, and entrepreneurs. Second, the domestic role, namely the role that focuses more on the biological nature of women cannot be valued in terms of money/goods. This role is related to human survival, for example, the role of the mother when conceiving, giving birth, and breastfeeding children is the nature of a mother (Gulland, 2019). This role is ultimately followed by carrying out the obligation to do homework. *Third*, social roles, namely roles that are a need for housewives to actualize themselves in society and participate in their social environment (Tadesse and Huang, 2022).

## **2. Data Description**

The data used in this study are secondary data and primary data. Secondary data in the form of the number and distribution of poor female heads of households were obtained from the integrated database system of the Gorontalo Provincial government. Meanwhile, primary data was obtained from interviews with poor female heads of households. By using a questionnaire, primary data is obtained such as the profile of a poor female head of household; type of work, income, and assets owned by the poor female head of household; the role of family members on household income; poor household expenditure; access of poor female heads of households to basic public resources and services; environment and social participation of women heads of poor households; as well as the challenges and opportunities faced by poor female heads of households. This data collection was carried out in 2022.

### **3. Methodology**

This study uses a descriptive-qualitative analysis approach by combining secondary and primary data analysis. The purpose of the descriptive-qualitative analysis approach is finding facts with the right interpretation and making systematic, factual, and accurate explanations about the facts and characteristics of the population. Secondary data in the form of the number and distribution of poor female heads of households were obtained from the integrated database system of the Gorontalo Provincial government. Meanwhile, primary data was obtained from interviews with poor female heads of households. By using a questionnaire, primary data is obtained such as the profile of a poor female head of household; type of work, income, and assets owned by the poor female head of household; the role of family members on household income; poor household expenditure; access of poor female heads of households to basic public resources and services; environment and social participation of women heads of poor households; as well as the challenges and opportunities faced by poor female heads of households. To complement the information obtained from female heads of poor households, in-depth interviews were conducted with a number of key informants from government agencies, such as regional development planning agencies, community empowerment agencies, women's empowerment agencies, sub-district and village/kelurahan governments, and non-governmental organizations. From the results of this analysis, various efforts can be made to help poor female heads of households get out of poverty.

The research location is the entire area of Gorontalo Province. Considering that the number of poor female heads of households is relatively large, it is necessary to explain the population and sample. The population is all poor female heads of households scattered throughout the province of Gorontalo. Meanwhile, the sample selection was carried out in stages as follows: (i) determining/selecting one sub-district for each district/city which shows the relatively largest proportion of poor female heads of households; (ii) determine one village/kelurahan for each selected sub-district which shows the relatively largest proportion of poor female heads of households; and (iii) determine/choose female heads of poor households randomly. The number of samples selected in each kelurahan/village was determined proportionally according to the population of poor female heads of households.

**Table 2.** Locations of Data Collection and Number of Samples at Each Location

No.	Regency/City	District	Sub-district/Village	Total Population Poor Female Heads of Households*	Total Sample Poor Female Heads of Households
1	Gorontalo City	Kota Timur	Ipilo	44	27
2	Boalemo Regency	Paguyaman	Saripi	35	18
3	Pohuwatu Regency	Paguat	Soginti	18	13
4	Gorontalo Regency	Limboto Barat	Hutabohu	73	37
5	North Gorontalo Regency	Kwandang	Bulalo	26	13
6	BoneBolango Regency	Tilongkabila	Bongoime	15	15

**Source:** Gorontalo Province Integrated Database, 2022.

Effectively, this research was carried out within seven months.

### 3. Results

#### 3.1 Profile of Poor Female Heads of Households

In general, the status of the female head of a poor household occurs due to divorce, either through divorce or divorce. This is in line with findings Liu et al. (2017) in Latin America that women who change their status to become heads of poor households are triggered by divorce so they become single parents and live alone, to survive. Cases of divorce are more common in Bone Bolango Regency and North Gorontalo Regency, around 20 percent above other districts/cities. Those who are divorced are generally of productive age (under 50 years of age). Although the proportion is relatively small, there are female heads of poor households who have never married. They generally live alone.

In general, the living conditions of poor female heads of households are inadequate. They occupy a semi-permanent building with cement floors, walls and roof, and a building area of less than 45 M2. However, some of them have buildings with better conditions, especially those who have relatively higher incomes. Relatively larger income, tend to have permanent residence buildings and relatively wider. More than 30 percent of poor female heads of households in

Gorontalo, Pohuwato and Bone Bolango districts live in permanent buildings with an area of 45 M2, more than poor households in other districts/cities.

Supporting facilities for the residence of the female head of poor households are relatively adequate for most households. More than 90 percent of residential buildings have access to state electricity company and clean water sources from local water company. About 60 percent have used gas fuel for cooking. More than 80 percent have used toilet facilities, both public and private, as a means of defecating. However, some poor households tend to pay less attention to environmental health aspects in defecation habits. They tend to use the river as a means of defecating because of limited toilet facilities. Especially in Boalemo Regency, for example the majority of poor households (reaching 61.1%) still defecate on the banks of the river.

### **3.2 Type of Work, Income, and Assets**

Most of the female heads of poor households work as traders, farmers, laborers and casual workers. Some of the clients work as craftsmen, selling services/labor such as traditional birth attendants and household assistants. This type of work provides remuneration below the poverty line. They have been in this type of work for a relatively long time, on average more than 10 years. Even though they provide relatively little remuneration, they still stay in this type of work because it is difficult to get a more decent job. There are also a number of poor female heads of households who have not worked (unemployed) for quite a long time, namely more than five years.

For those who have side jobs, their income is relatively higher compared to other household heads. However, those in this category are relatively small, namely only around 8.9 percent. Gorontalo District shows a relatively higher number compared to other districts/cities. Poor female heads of households in Gorontalo District have 50 percent higher income than other districts/cities.

The amount of income received by female heads of poor households seems to be associated with the amount of time devoted to work. Those with relatively higher incomes devote more time to work. On average, the time devoted to work is only 21 hours per week. This time allocation is found in the types of work of traders and laborers. In very small numbers, there are poor female heads of households who work up to 7-8 hours per day. Interestingly, the relatively large working hours are experienced by women aged 60 years and over. This fact can be seen in Gorontalo City, Gorontalo District, Pohuwato and North Gorontalo. Meanwhile, in Boalemo and Bone Bolango Regencies, the largest allocation of

working time was experienced by those in the age range of 40 to 55 years. As might be expected, all poor households with working household members tend to have relatively larger household incomes. Nearly half of poor households have household members who work and earn income. The average total income of household members is IDR 580,000 per month. If the income of the head of household is added to the income of the household members, the average income for a poor household is IDR 990,000 per month. There are a small number of household members, especially in Kota Gorontalo and Kabupaten Gorontalo, who have a relatively higher income compared to other districts/cities.

The picture of asset ownership by poor female heads of households in Gorontalo Province is only seen in half of the households, especially those with relatively large incomes. The types of assets they have include residential buildings, savings, livestock, furniture, vehicles, electronic equipment, land and gold. Most (approximately 65.9 percent) of poor female heads of households live in residential buildings with self-ownership status. Meanwhile, ownership of savings (in the form of cash) only occurs in 5.7 percent of poor female heads of households. If measured in monetary terms, some of the assets owned by the heads of poor households apart from building and land assets, if accumulated, only average around Rp. 2.5 million.

Ownership of household assets tends to be very dominant as can be seen in the heads of poor female households who are elderly and have relatively low levels of education. This fact is seen equally among female household heads in all districts/cities in Gorontalo Province. Based on employment status, asset ownership tends to be seen in female household heads who work as farmers, traders, laborers, and service providers. This is in line with the findings Altamirano and Teixeira (2017) which illustrates the limited asset ownership for poor female heads of households in Nicaragua so that these conditions exacerbate more multidimensional poverty for women.

### **3.3 Household Expenditure**

The largest proportion of the total income of poor female heads of households is spent on spending on food needs. The proportion of spending on food needs reached 78.25 percent, while the remaining 21.75 percent was spent on non-food needs. Even in Pohuwato and Gorontalo Regencies, the proportion of expenditure on food reaches 90 percent, which is the highest figure of all districts/cities in Gorontalo Province. In contrast, in Bone Bolango and Boalemo Regencies, the proportion of expenditure on non-food items was relatively larger, reaching 30

percent of total expenditure.

In absolute terms, the largest total expenditure for both components (food/non-food) is found in poor households in Gorontalo City with an average expenditure of IDR 1.080.000 per month or about 70 percent higher than Pohuwatu District which recorded the lowest number of IDR 635.000). In general, the income of poor households in Gorontalo Province is above their expenditure. In other words, poor households experience a surplus of income. The difference between income and expenditure of poor households seems insignificant. Even so, there are still a number of poor households that experience an income deficit, which is caused by the presence of household members who do not work/have no income who are the responsibility of the head of the household.

Even though in general there is a surplus of income for poor households, it is not sufficient enough to increase the ability of poor households to own assets. In general, almost all poor households in all districts/cities do not have adequate assets. The surplus income is only kept as cash savings for precautionary motives in the event of a decrease in income. That is why the surplus income cannot be accumulated into assets.

The largest proportion of food expenditure is still to meet the needs of staple foods. Of all food expenditure, around 62.5 percent is allocated to purchase staple foods (rice, corn and tubers) and side dishes, especially fish. Meanwhile, spending on foodstuffs that can meet the nutritional needs of poor household members, such as meat and milk, receives a very small allocation, and even tends to be unfulfilled in most poor households. Like meat consumption, for example, the majority of poor households can only eat it once a year. However, an interesting fact can be seen in the consumption pattern of several poor households in North Gorontalo, Boalemo, and Bone Bolango Regencies, where poverty does not influence them not to consume tobacco and cigarettes. This is in line with the findings Addai et al., (2022) that women heads of poor households in Ghana experience difficulties in meeting food needs, most of them have limited sources of consumption material that are ideal for fulfilling nutrition. This condition exacerbates food poverty.

The non-food consumption pattern of poor households in the past year has slightly differed between districts/cities. Poor households in Gorontalo, Pohuwato, and Gorontalo Districts seem to be very dominant in allocating their expenditures for household needs such as home repairs, electricity bills, water, and telecommunications. Meanwhile, poor households in Boalemo and North Gorontalo Regencies allocate budgets for spending on various goods and services. The largest composition of non-food expenditure for parties, festivities and

traditional ceremonies is specifically seen in poor households in Bone Bolango Regency.

#### **4. Access to Public Services and Resources**

The majority of poor households in Gorontalo Province have good access to several public services and economic resources. Several components of public resources and services have almost reached all poor households, such as access to the electricity and health services (health insurance). This is in line with the findings of Mussa et al., (2022) that government assistance in Ethiopia in the form of health services for poor female heads of households contributes to increased accessibility and public services.

However, access to education services for some poor households is relatively low. Some school-age household members have had to stop going to school on the grounds that they do not have the funds and that they have to work to help their parents. A small number of household members who attend school feel that the distance to school is quite far, even more than 5 km.

On average, population administration documents have not been fulfilled for more than 25 percent of poor household members in Gorontalo province. Some documents that have not been fulfilled are birth certificates and Resident Identity Cards for household members over 17 years old. The city of Gorontalo, which is relatively the closest in terms of access to administrative services for the population, apparently has a fairly large percentage of poor household members who do not have residence documents compared to several districts.

The majority of poor female heads of households who have had access to capital assistance are working as traders. On average, the capital assistance obtained is used for the purposes of starting and developing a business. So far, the access of female heads of household to capital assistance has been more dominant from financial institutions and the government. However, the proportion of poor female heads of households who have received capital assistance is only 18.7 percent.

Most of the poor female heads of households have received assistance from various parties, especially the government. Even so, there are still around 7.5 percent of poor female heads of households who have never been touched by various assistance schemes. They actually have an average low income and are only able to meet their basic food needs twice a day.

The majority of assistance programs that have been received by poor female heads of households have come from government assistance. On average, each

poor household receives more than one type of assistance program from the government. The composition of the government assistance program provided to poor households is in the form of rice, health services, education services, direct cash assistance, home repairs, electricity, livestock, and other assistance. However, some women heads of poor households who receive assistance still experience obstacles and problems in receiving assistance. Several obstacles were felt in the form of assistance that often arrived late, assistance that was not as it should have been, complicated procedures, and other obstacles.

Empowerment assistance such as skills training has been received by a small number of poor female heads of households in Gorontalo Province. However, it is considered that almost half of the female heads of poor households have not felt the positive impact or benefits of the training assistance, especially in Kota Gorontalo and Kabupaten Gorontalo. In general, training that is expected by female heads of poor households can have a direct and significant impact on improving the household economy. The majority of poor female heads of households really hope that skills training is followed by capital assistance so they can immediately start a business.

## **5. Environment and Social Participation**

The low role and level of social participation of women heads of poor households are indicated by their low involvement in social organizations and other social activities. The number of household heads who to be involved in social activities in their surroundings does not reach 10 percent. Even in Bone Bolango Regency and North Gorontalo Regency, almost all poor female heads of households are not involved in social organizations. In various social activities, the number of poor female heads of households involved in these two districts is relatively smaller compared to other districts.

Age and education level do not appear to be a barrier for female heads of poor households to be involved in social activities. This can be seen in several poor female heads of households who are over 60 years old with an elementary school education level and who tend to be involved active in social activities. They are involved in social organizations such as farmer groups, head of household group, and other social organizations. Household heads who are not involved in social organizations still show social participation in their surroundings by being involved in cooperation, recitation, social gathering, and other activities, but with a relatively small number of household heads. This is in line with the findings of Wondimu et al. (2022) that the low level of education and income of poor female

heads of households makes them looked down upon in society so that their social participation becomes increasingly limited.

In reality, the concern for the social environment for poor female heads of households still comes from neighbors. So far, most of the poor female heads of households in Gorontalo Province have experienced a lot of material and non-material assistance provided by their closest neighbors. As a form of concern, the neighbors provided various types of assistance such as food assistance, financial loans, and labor assistance. However, there are still a small number of poor female heads of households who feel the opposite, where their neighbors don't care about their situation and often get unpleasant treatment when they ask for help.

## **6. Challenges and Opportunities Faced**

The combination of old age, uneducated, unskilled and unemployed is the biggest challenge to poverty alleviation efforts for poor female heads of households in Gorontalo Province. Poor female heads of households are generally over 50 years old (reaching 74%), and they are relatively uneducated and tend to be unemployed. This condition can be seen in all districts/cities in Gorontalo Province. This is in line with the findings of Bairagi et al., (2022) that one of the reasons for the high number of poor female heads of households in Vietnam is due to the low level of education. This is the root of poverty for women. They were generally only able to complete elementary school education, and some did not even finish elementary school or had never attended school. If accumulated, the figure reaches about 80 percent.

Poor female heads of households in Gorontalo Province generally do not have skills. The figure reached 69.5 percent. For those who claim to have skills (about 30,5 percent), the types of skills possessed are sewing, carpentry, crafts, food processing, and traditional birth attendants. They acquire these skills through experience and are self-taught. On average, more than 75 percent of those who have skills are employed, but the field of work they are involved in does not fully correspond to the skills they have.

More than 70 percent of poor female heads of households still wish to own a business when they receive capital assistance, even though they are already old. This type of trading business is the most dominant activity desired by poor female heads of households. The reason is because trading is easier to do, does not require special skills, does not require a lot of energy, and can be done at home. Approximately 14 percent of poor female heads of households had previously had business activities but then failed. Factors causing the breakdown of their business

due to lack of capital and weak ability to compete. Lekobane (2022) also emphasizes that government intervention for poor female heads of households needs to begin with mapping the number of beneficiaries who are in conditions of multidimensional poverty and poor income, so that government assistance is far more effective, efficient, productive and able to reduce the number of female heads of households' poor.

## **7. Conclusion**

Based on the analysis conducted on the condition of poor female heads of households in Gorontalo Province, the following conclusions can be drawn: (1). The combination of old age, uneducated, unskilled, and unemployed is the main causal factor to women heads of poor households, (2). Household members who work are a support for the income of poor households. Those of productive age, are relatively more educated, and have a job, contribute quite significantly to household income, (3). The largest proportion of poor household expenditure is allocated to buying food, (4). Basic public services and economic resources do not seem to be able to reach all poor households. Access to basic public services, such as education, health, clean water, sanitation, and population, is relatively better than access to economic resources, such as microcredit and capital assistance, (5). Field facts show that there are still some poor female heads of households who escape government assistance, (6). The involvement of poor female heads of households, both in social organizations and social-community activities, appears to be very minimal, (7). Even though most of the female heads of poor households are elderly, they still think that they can still be involved in productive business activities. Trading activities are considered the most feasible business option, apart from not requiring special skills, they are also considered easy to work on. In addition, the living environment is also considered quite possible to carry out a trading business, (8). Still found inclusion error, several female heads of household are identified (recorded) as poor households, but have income and expenditure far above the poverty line with adequate living conditions.

The policy implications of this research include; (1) Efforts that can be made so that old age, uneducated and unemployed do not become obstacles to poverty alleviation efforts, they must rely on the provision of social security and protection, such as the provision of cash (cash transfer), food aid, public health insurance. Apart from that, it is also necessary to deliver various forms of public services to them, such as clean water services, sanitation, etc., (2). Capability and capacity building should be directed, not solely to the head of the household, but to

household members who are of productive age. Providing access to education services, health services, skills training, equipment, and capital assistance, and involving them in labor-intensive jobs, are several forms of intervention that can be provided, (3). Controlling food prices is an important policy to protect and maintain the purchasing power of the poor. At the same time, food assistance, especially rice assistance, must still be able to reach all poor households, (4). To improve the quality of human resources and increase the standard of living of the poor, the government needs to ensure that various forms of basic public services can truly reach all poor households, and at the same time, facilitate poor households to gain access to economic resources, (5). The activity of collecting data on poor households and improving the mechanism for distributing aid are two important things to do in the future so that it can be ensured that all women heads of poor households get the assistance they should receive, (6). Women heads of poor households need to be continuously encouraged to be involved in social activities. This is important, especially to build stronger social relations so that poor female heads of households can get support and help from their social environment when they need help, (7). Associated with productive business activities, capital injections are the most needed type of assistance to realize their desires.

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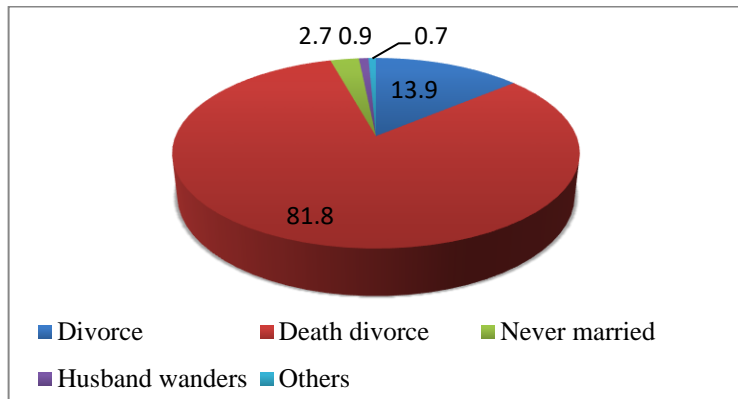
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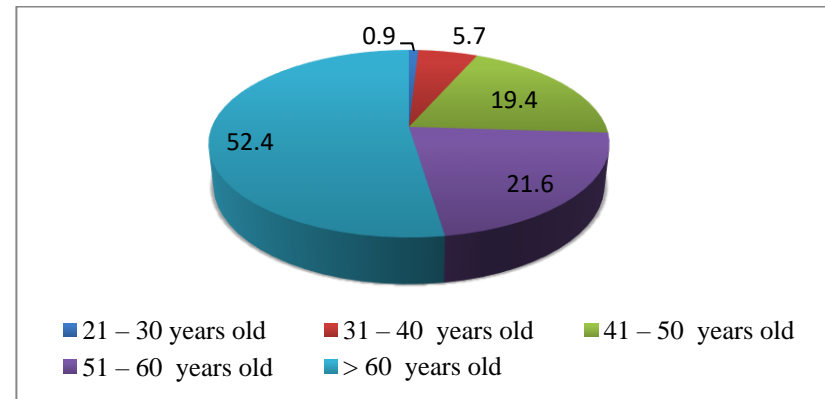
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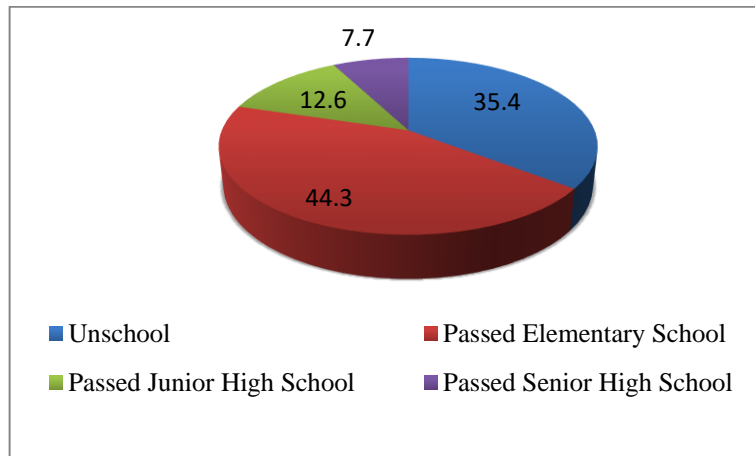
## Appendix



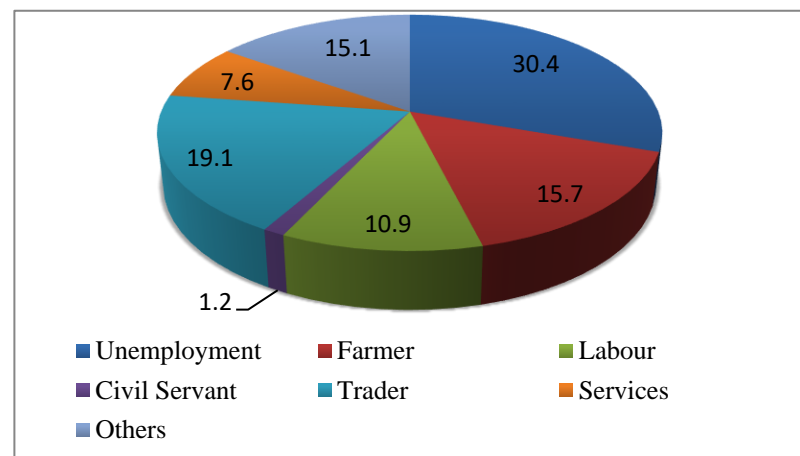
Poor Female Heads of Households by Status  
**Source:** Research finding, using in-depth interview, 2022.



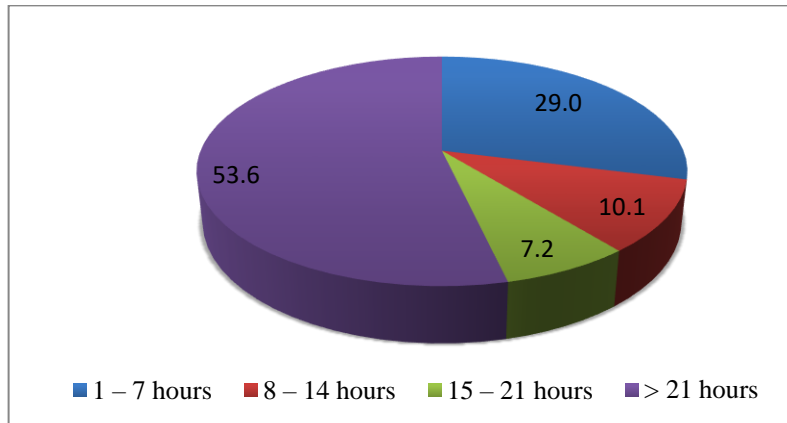
Poor Female Heads of Household Based on Age  
**Source:** Research finding, using in-depth interview, 2022.



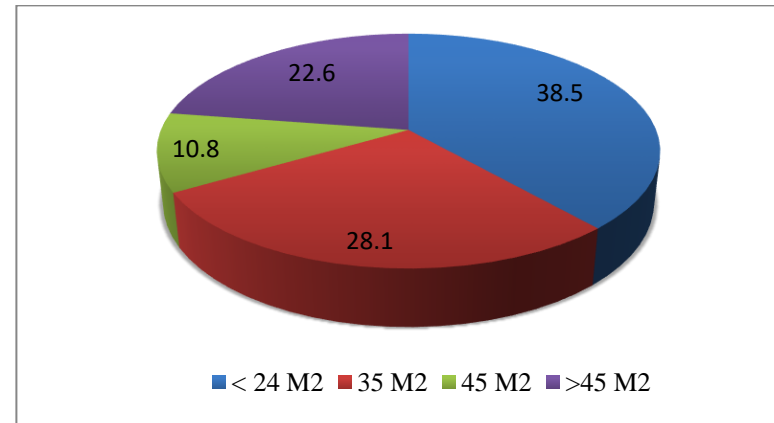
Poor Female Head of Household Based on Education  
**Source:** Research finding, using in-depth interview, 2022.



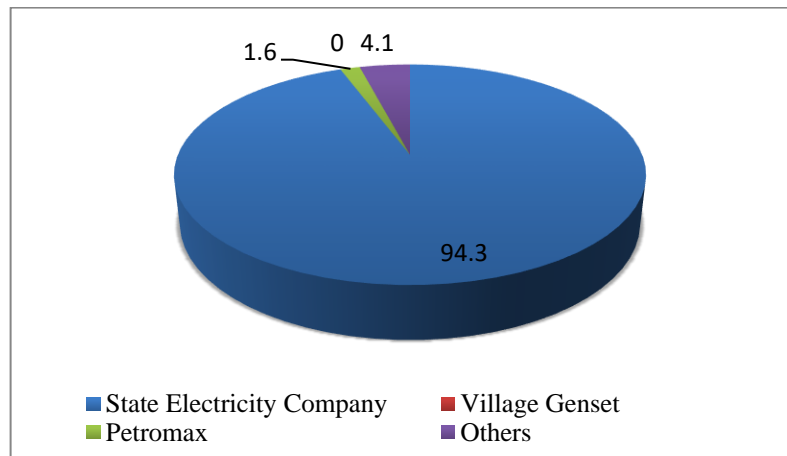
Poor Female Head of Household Based on Main Occupation  
**Source:** Research finding, using in-depth interview, 2022.



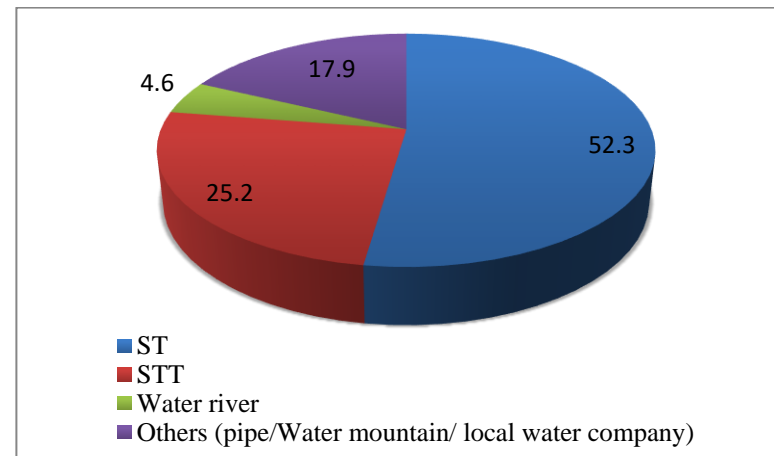
Poor Female Head of Household based on allocation of Working Time  
**Source:** Research finding, using in-depth interview, 2022.



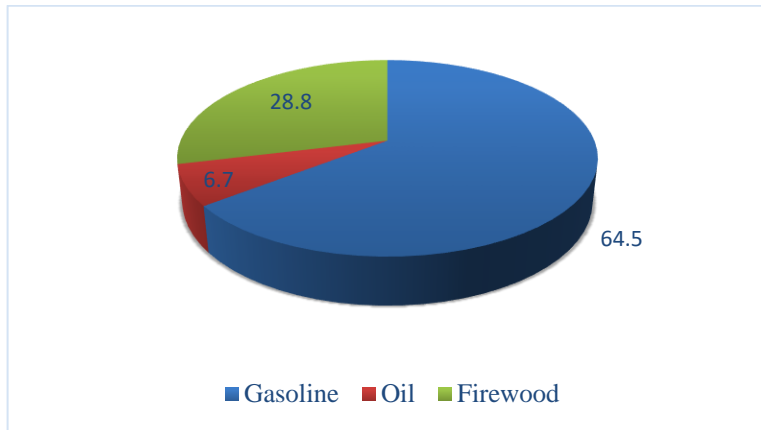
Poor Female Heads of Household Based in Residential Building Areas  
**Source:** Research finding, using in-depth interview, 2022.



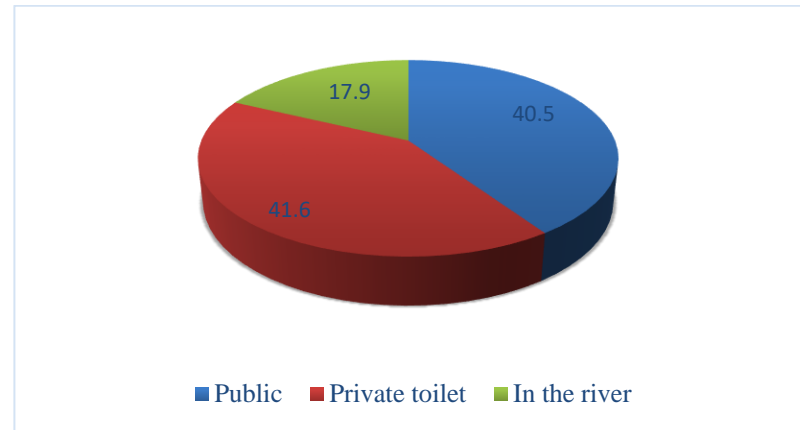
Poor Female Heads of Household Based on Access to Electricity  
**Source:** Research finding, using in-depth interview, 2022.



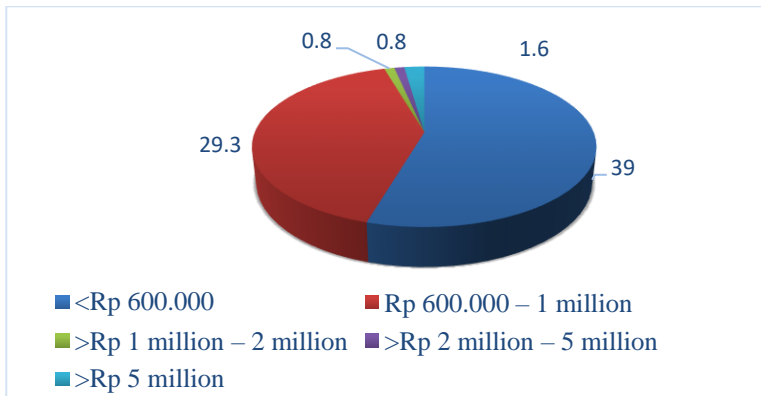
Poor Female Heads of Household Based on Access to Drinking Water  
**Source:** Research finding, using in-depth interview, 2022.



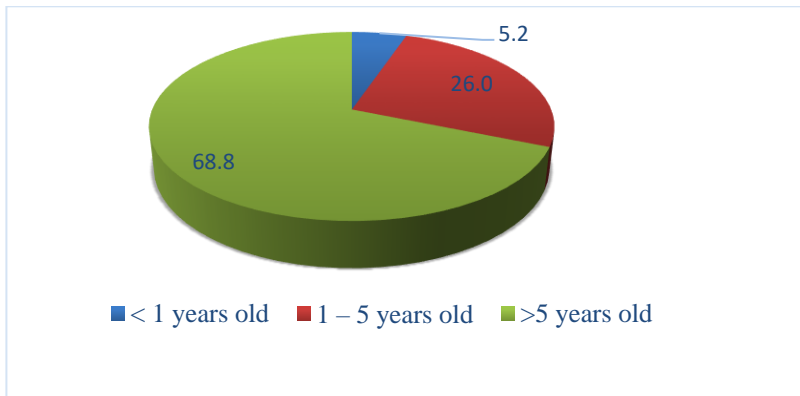
Poor Female Heads of Household Based on Access to Cooking Fuel  
**Source:** Research finding, using in-depth interview, 2022.



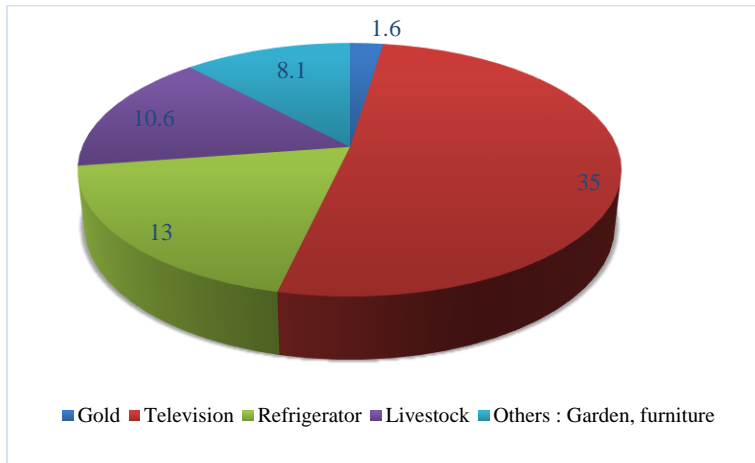
Poor Female Head of Household Based on Access to Toilet Facilities  
**Source:** Research finding, using in-depth interview, 2022.



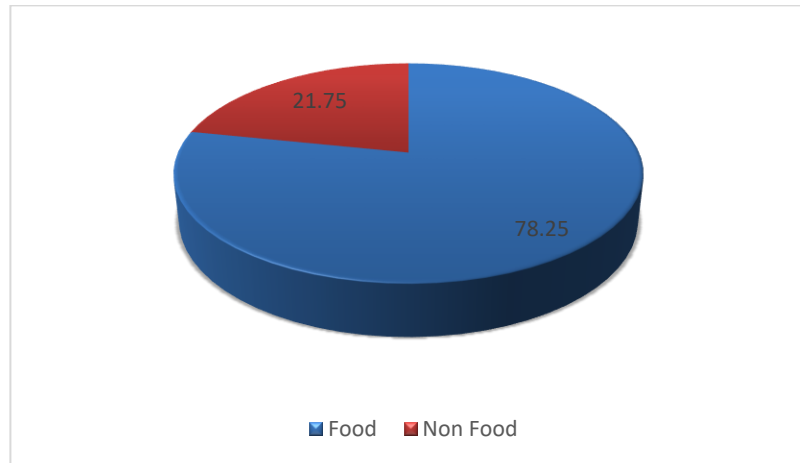
Poor Female Head of Household Based on Income  
**Source:** Research finding, using in-depth interview, 2022.



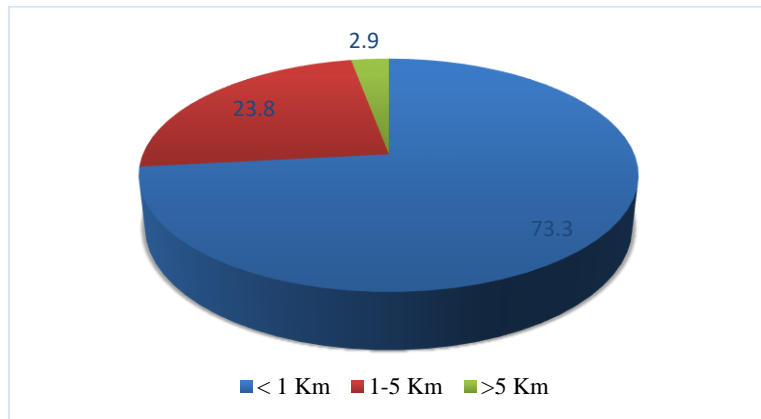
Poor Female Heads of Household Based on Length of Work  
**Source:** Research finding, using in-depth interview, 2022.



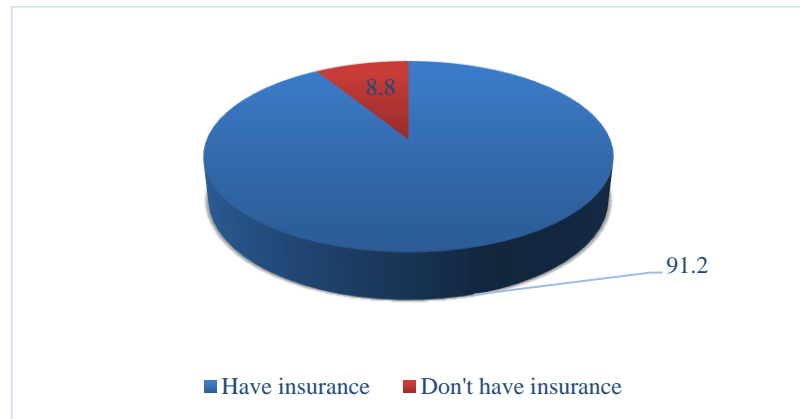
Poor Female Heads of Household Based on Assets Owned  
**Source:** Research finding, using in-depth interview, 2022.



Poor Female Heads of Household Based on Type of Spending  
**Source:** Research finding, using in-depth interview, 2022.



Home to School Distance  
**Source:** Research finding, using in-depth interview, 2022.



Poor Female Heads of Household Based on Health Insurance Ownership  
**Source:** Research finding, using in-depth interview, 2022.

**Tabel A1.** A Comparison Income and Expenditure /Month Poor Female Heads of Household in Gorontalo Province

No	Comparison income and expenditure /month	District/City												Total	
		Gorontalo City		Gorontalo Regency		Pohuwatu Regency		Boalemo Regency		North Gorontalo Regency		Bone Bolango Regency		Rata-rata	
		Rp	%	Rp	%	Rp	%	Rp	%	Rp	%	Rp	%	Rp	%
1	Poor Household Income	1.402.59	100	1.177.839	100	641,818	100	936,644	100	1.069.444	100	801,482	100	992924	100
2	Spending of Poor Household	881,814	62,9	392,47	33,3	602,513	93,9	570,642	60,9	819,222	76,6	769,053	96	849842	85,5898337
	<b>Difference (1-2)</b>	<b>520776</b>	<b>37,1</b>	<b>785,369</b>	<b>66,7</b>	<b>39,305</b>	<b>6,1</b>	<b>336,002</b>	<b>39,1</b>	<b>250,222</b>	<b>23,4</b>	<b>32,429</b>	<b>4</b>	<b>143082</b>	<b>14,4101663</b>

Source: Research finding, using in-depth interview, 2022.

**Tabel A2.** A Composition of Food Expenditure / Month Poor Female Heads of Household in Gorontalo Province

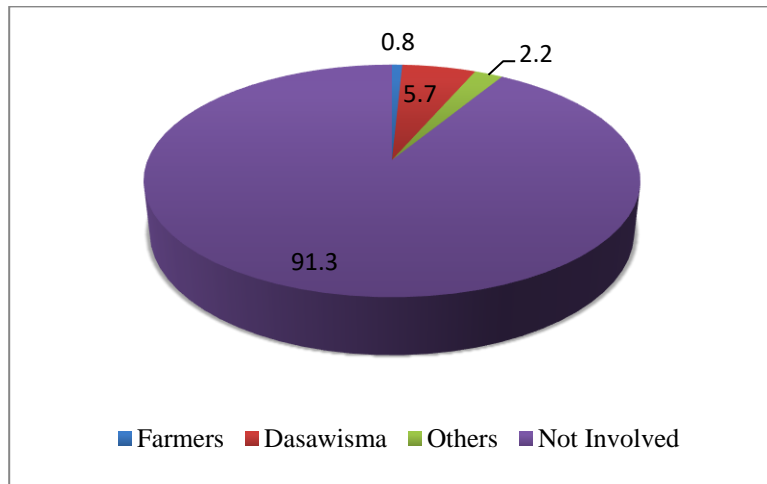
No	Composition of Food Expenditure / Month	Regency / City						Province
		Gorontalo City	Gorontalo Regency	Pohuwato Regency	Boalemo Regency	North Gorontalo Regency	Bone Bolango Regency	
1	Staple Food (rice, corn, tubers)	50,5	36,6	35,2	35,6	31,3	52,8	41,3
2	Side dishes (fish, shrimp, squid, meat)	21,2	18,5	25,5	14,8	33,1	21,4	21,2
3	Protein (eggs, milk)	1,5	2,9	3,6	3,5	1,3	1,7	2,5
4	Vegetables, fruits and nuts	6,8	9,8	11,1	8,3	17,7	6	9,2
5	Condiments/compliment cooking/oil/fat	14,1	19	16,7	22,8	8,4	9,2	15,7
6	Condiments drinks	4,7	9,7	7,7	7,3	3,6	4,2	6,7
7	Other food (crackers, instant noodles)	0,7	2,7	0,1	3,4	1,2	1,2	1,6
8	Fast food (snack, non-alcohol and alcohol drinks)	0,5	0,9	0,1	2,5	0,3	2,8	1,2
9	Tobacco, cigarettes, betel nuts	-	-	0	1,7	3,1	0,8	0,6
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Research finding, using in-depth interview, 2022.

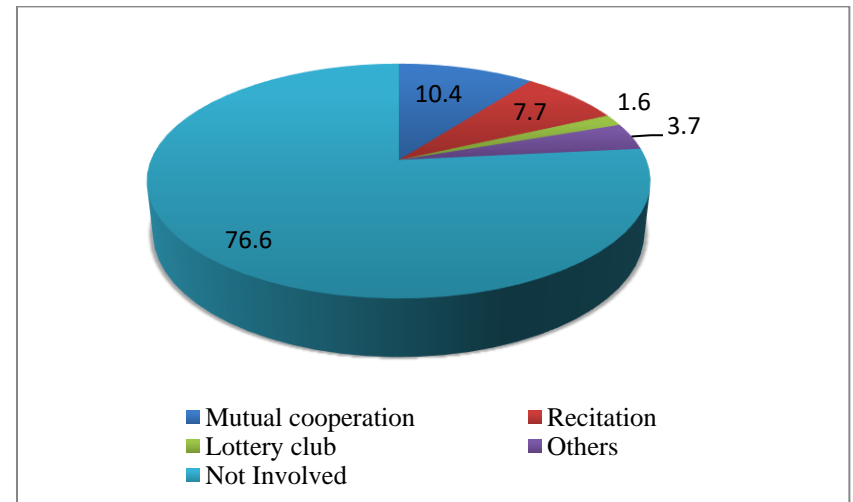
**Tabel A3.** The Access of Poor Female Heads of Households to Population Administration Documents in Gorontalo Province

No	Component	Regency / City (%)														
		Total	Gorontalo City	Total	Gorontalo Regency	Total	Pohuwato Regency	Total	Boalemo Regency	Total	North Gorontalo Regency	Total	Bone Bolango Regency	Total	Province	
1	Household members have a deed born	Yes, have	21	77,7	24	80,6	15	75	10	55,6	5	55,6	10	61,1	85	70,7
		Half only	2	7,9	1	4,5	1	5	2	11,1	3	33,3	2	13,7	11	10,1
		None	4	14,4	5	14,9	4	20	6	33,3	1	11,1	4	25,2	24	19,2
	<b>Total</b>	27	<b>100</b>	30	<b>100</b>	17	<b>85</b>	18	<b>100</b>	9	<b>100</b>	16	<b>100</b>	117	<b>100</b>	
2	17 years old who has ID Card	20	74	25	80,6	13	65	16	88,9	6	66,7	13	72,2	93	75,6	
	<b>Total</b>	20	<b>74</b>	25	<b>80,6</b>	13	<b>65</b>	16	<b>88,9</b>	6	<b>66,7</b>	13	<b>72,2</b>	93	<b>75,6</b>	

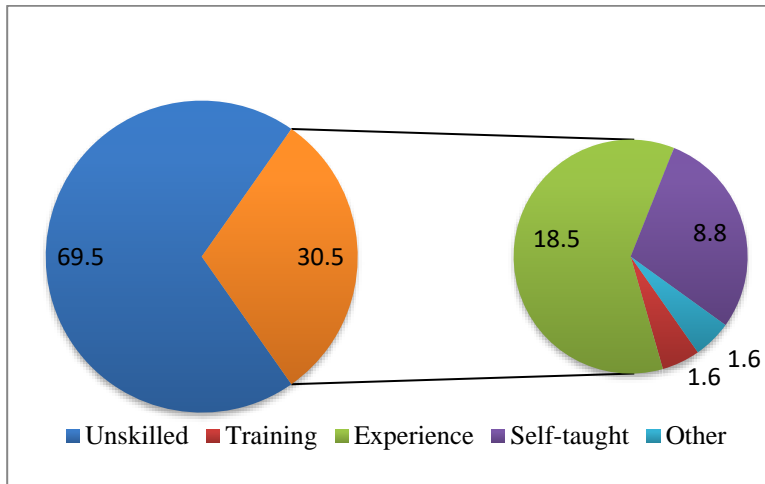
Source: Research finding, using in-depth interview, 2022.



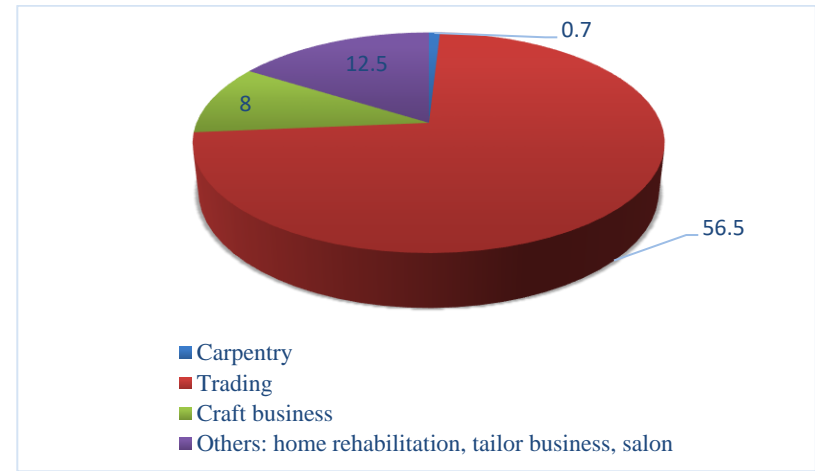
Poor Female Heads of Household Based on Involvement in Social Organization  
Source: Research finding, using in-depth interview, 2022.



Poor Female Heads of Household Based on Involvement in Social Activities  
Source: Research finding, using in-depth interview, 2022.



Poor Female Heads of Household Based on Skills  
**Source:** Research finding, using in-depth interview, 2022.



Types of Business Desired by Poor Female Heads of Households  
**Source:** Research finding, using in-depth interview, 2022.



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## The Potential of Iran's Agricultural Exports: Evidence from a Stochastic Frontier Gravity Model

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### Abstract

The evidence shows that the lack of comprehensive trade policies in Iran's agricultural sector has caused the growth of this sector to be unstable and limited to a few countries. Experts and economists also claim that Iran's capacity to achieve higher export figures and expansion of target markets is higher. Therefore, this paper aims to quantify the export capacity of Iranian agricultural products to trading partners using a stochastic frontier gravity model during 1997-2021. The results indicated that Iran has the export efficiency above 50% with only six countries including Germany, Russia, Vietnam, Spain, India, and the UAE, which represent the high capacity of Iran's export potential in many trading partners in agricultural products. In addition, except for Russia and the UAE, other neighboring countries have a high potential for accepting agricultural products. On the other hand, regarding the estimation of the average export potential and its gap from the actual export based on the estimated stochastic frontier gravity model, the results indicated that the highest potential agricultural exports are related to Turkey, Egypt, Libya, Croatia, and Uzbekistan, respectively. The export gap is negative for all trading partners, which indicates that Iran has agricultural exports less than the maximum possible limit to all trading countries. The results confirmed that economic size and geographical distances have a positive and negative effect on Iran's agricultural exports, respectively.

**Keywords:** Agriculture Exports, Export Potential, Gravity Model, International Trade, Stochastic Frontier Model.

**JEL Classification:** C23, F17, G14, Q17.

### 1. Introduction

International trade is recognized as a tool and a driver for economic development, and classical and neoclassical economists consider foreign trade as the engine of economic growth (Frankel and Romer 1999). International trade is considered as one of the factors for strengthening GDP as a source of foreign exchange, which

increases economic growth, reduces poverty, and increases employment (Mohammadi et al., 2019). In addition, we can benefit from economies of scale with the development of trade (Helpman and Krugman, 1985). Export efficiency is considered as one of the most important concepts of trade which has been less considered. Export efficiency is defined as the ratio of the actual exports of a country to its maximum export potential (Doan and Xing, 2018).

The efficiency and performance of different countries in global markets are not the same, and the heterogeneity of countries in terms of economic development, trade relations, and border policies may be considered as the cause of inefficiency in realizing trade potential. Some of these factors are related to the exporting country (domestic factors) and others are related to the destination countries (foreign factors) (Hajivand et al., 2020). Therefore, focusing on export efficiency and its evaluation in different countries is important since it allows policymakers to identify suitable export markets and minimize or eliminate trade constraints and barriers to achieving full export potentials (Mohammadi et al., 2019).

High fluctuations in oil prices and economic sanctions against Iran have forced politicians and economic planners to free the country from a single-product economy and promote non-oil exports such as agricultural exports. Agriculture is recognized as one of the key sectors of Iran's economy, which accounted for about 12.2% of GDP in 2019, while its share of total labor, non-oil exports, and food supply was 23, 21, and 80%, respectively (Central Bank of Iran, 2019). In the sixth five-year development plan, Iran's agricultural sector is expected to grow by 8% annually. Therefore, this sector as a source of non-oil revenues has a high priority in the five-year national development plans.

The value of Iran's agricultural exports has significantly increased during 1997-2021 from 768 million\$ to 2.64 billion\$ (244% growth) (Chamber of Commerce, Industry, Mines, and Agriculture of Iran, 2021). Despite the significant growth, the instability of the value of Iran's agricultural exports during the mentioned period (Figure 1) and the limited target countries of Iran's exports (Figure 2)<sup>1</sup> are considered as the weaknesses of exports in this sector. The fact is that the lack of comprehensive policies regarding trade in the agricultural sector has caused the growth of this sector to be unstable and limited to a few countries. Experts and economists claim that Iran's capacity to achieve higher export figures

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<sup>1</sup>. The share of trading partners in exporting Iran's agricultural products in 2021, which is obtained by dividing the value of Iran's exports to the target countries by the total value of agricultural exports in Iran, 2021.

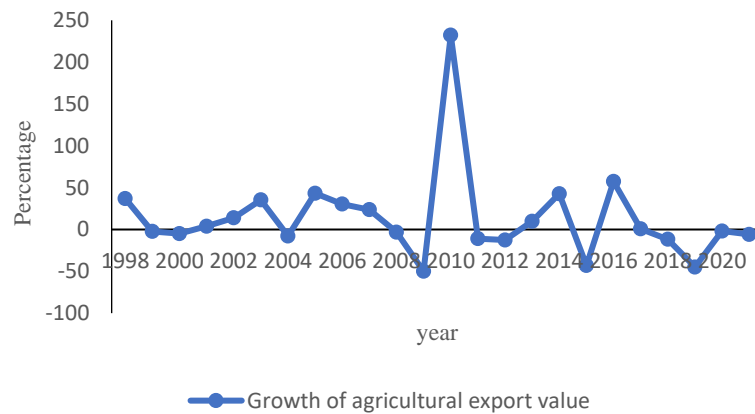
and expansion of target markets is higher (Roosta et al., 2017). Thus, the following questions were raised in this study.

Q1. What is the potential of Iran's agricultural exports?

Q2. Has Iran been able to be effective in exporting agricultural products?

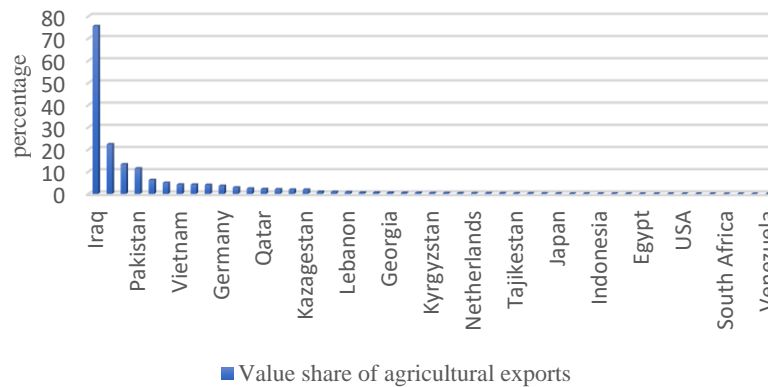
Q3. Which countries have more capacity to export Iranian agricultural products?

The answer to these questions can be a comprehensive guide for policy makers and Iranian businessmen in the development of export markets of agricultural products.



**Figure 1.** Growth of Iran's Agricultural Exports during 1998-2021

**Source:** Research finding.



**Figure 2.** The Share of Trading Partners in Agricultural Exports in Iran

**Source:** Research finding.

## 2. Literature Review

Few researchers have addressed the evaluation of export efficiency. Deluna and Cruz (2013) examined the export performance of Philippine goods in 69 trading partner countries by using a frontier gravity model. The results of the estimated coefficients of the gravity equation indicated that the flow of exporting goods from the Philippines to trading partners is significantly affected by the income and market size of the importing partner.

Tamini et al. (2016) analyzed the export potential versus real trade among trading partners in North Africa during 2001-2012 based on a stochastic frontier gravity model. The results indicated that commercial efficiency for agricultural products is relatively low. In addition, there was a weak and inverse regulatory environment, which highlighted the importance of improving domestic policies to encourage the development of entrepreneurship and business facilities.

Noviyani et al. (2019) analyzed the efficiency of Indonesian exports and their influential factors by applying a stochastic frontier gravity model. The results indicated that the flow of Indonesian exports is significantly affected by gross domestic product (GDP) and population. In addition, the efficiency of average export to 62 trading partners in Indonesia was 51.35 and 49.69% in 2012 and 2016, respectively. The highest and lowest value of export efficiency is related to Singapore and Portugal, respectively.

Atif et al. (2019) assessed the main determinants of Pakistani agricultural exports by using a frontier gravity model during 1995-2014 among 63 countries and the results indicated bilateral exchanges and tariff rates in agricultural exports. In addition, the impact of common borders, common culture, colonial history, and preferential trade agreements was evaluated by considering dummy variables. Further, based on technical efficiency, Pakistan has a great export potential with neighboring countries, the Middle East, and Europe.

Mohammadi et al. (2020) efficiency of Iran's pistachio exports to the target markets in the time period of 2001-2016 have been investigated. For this purpose, they have used the random boundary gravity model. The efficiency results indicated that the efficiency of Iran's pistachio exports in all markets and European markets has decreased. While, this trend is increasing for Asian markets and has reached from 0.412 to 0.567.

In another study, Abdullahi et al. (2021) discussed the determinants of efficiency and export potential of agricultural products from Nigeria to the European Union during 1995-2019 by using a stochastic frontier gravity model and the results indicated that the economic size (GDP) and bilateral distance between Nigeria and the EU countries could positively determine the export of agricultural

products from Nigeria to the EU. In addition, Nigeria has a relatively low score in terms of export efficiency of its agricultural products to EU countries. Nguyen (2022) estimated the factors affecting Vietnam rice and coffee exports by applying a stochastic frontier gravity model. Technical efficiency and potential exports indicated that Vietnam can play a significant role in increasing rice and coffee exports with its main trading partners. The Association of Southeast Asian Nations is still considered as the major market for Vietnamese rice and coffee.

Abdullahi et al. (2022) examine the key determinants and efficiency of China's agricultural exports with its 114 importing countries by applying the Stochastic Frontier Analysis (SFA) on an augmented gravity model for the period of 2000–2019. The results reveal that China's economic size (GDP) and its importing countries, the Belt and Road Initiative (BRI), common border, and the Chinese language positively determine China's agricultural export flows. The results, on the other hand, also reveal that China's agricultural export is adversely influenced by the income (per capita GDP) of China and its trade partners, currency depreciation, distance, and land-locked. Suroso and Tandra (2022) investigate the determinants, efficiency, and potential of Indonesian palm oil downstream exports to the global market using stochastic frontier gravity model (SFGM) during 2012–2020. The determinants show that the gross domestic product (GDP) importer, Indonesia's GDP per capita, the bilateral exchange rate, colonialization, and World Trade Organization (WTO) membership have a positive and significant impact on Indonesia's palm oil downstream exports. Nevertheless, there are negative and significant effects from Indonesia's GDP, geographical distance between Indonesia and trading partners, the importer's GDP per capita, and landlocked countries. Romyen et al. (2023) assessed the trade effects of free trade agreements (FTA) between Thailand and its trading partners using a copula-based stochastic frontier gravity model for important agricultural commodities such as: silk, cassava, fruits, vegetables and medicinal plants from 1998 to 2019. The results showed that China and Japan have the highest export efficiency (0.48), followed by India (0.41), New Zealand (0.39) and Australia (0.33), respectively. Hence, Thailand should pursue more FTA negotiations with the trading partners. Moreover, they should promote miscellaneous behind-the-border barriers to stimulate flows of goods to enhance the country's trade efficiency substantially.

Helian Xu et al. (2023) investigate the determinants of Vietnamese agricultural exports to APEC using a stochastic frontier gravity model and determine the export gap between Vietnam and each APEC trading partner in the period 1998-2018. The empirical results confirm the suitability of the gravity

model for Vietnamese agricultural exports. The new findings suggest that the government should focus on designing a policy framework to encourage export companies to invest more in technology, especially for large and demanding markets such as the United States, Japan, and Korea. On the other hand, research should be conducted to create competitive strategic products that can be exported to potential new markets such as Russia, Australia, and Malaysia.

Based on the above literature, few researchers have addressed the evaluation of export efficiency in agriculture sector, especially in domestic studies. Therefore, this study aims to examine the efficiency and export potential of agricultural sector in Iran during 1997-2021.

### **3. Methodology**

There are many theoretical and empirical studies on the relationship between trade and development. Various aspects of trading have been explored by researchers. But the most interesting question is to find the determinants of trade and future prospected development of a country's trade. Empirically, the gravity model has not only been employed to estimate exports, imports, and bilateral trade but it has also been applied to explain trade factors of production (Atif et al., 2019).

The difference between actual exports (observed) and predictive quantities (appropriate) is usually defined as potential exports. Estimating the potential export or export between two countries using the ordinary least squares (OLS) equation leads to an estimation error due to the estimation of the conditional average of the data and the failure to calculate the high data constraints (Baldwin, 1994). Therefore, it is necessary to make an estimate that shows the high range of data (Kalirajan, 2008). To address this issue, Kalirajan (2008) proposed the concept of the Stochastic Frontier Gravity Model (SFGM) to make the model estimation more meaningful.

### **4. Stochastic Frontier Gravity Model (SFGM)**

Aigner et al. (1977) and Meeusen and Van Den Broeck (1977) individually develop the gravity equation using SFA in production economics. This method suggests that the estimations of the maximum level of output and a production possibility frontier (PPF) can be reached from a given level of inputs. A firm/industry operating below the frontier output is considered a technically inefficient firm, indicating a shortfall between the observed and the maximum possible output levels. In contrast, technically efficient operates on the PPF such that observed and frontier levels of output correspond. Hence, the former refers

to the opportunity for additional expansion of output. Thus, the technically inefficient production function refers to the degree to which actual output falls short of potential output. Similarly, in the case of exports, SFA can be used to define export frontier whereby inefficient export performance refers to the degree to which actual export falls short of the maximal potential export. Kalirajan (2007) introduces the SFA in the gravity equation to explain trade partners' variations in trade. The trade frontiers estimated through this approach give liberty in taking the optimal trade level among the countries in the analysis. These bilateral trade frontiers are influenced by positive or negative error terms formed within the model. This allows the randomly created trade frontier to differ according to the given deterministic part of the gravity model. The observed magnitude of trade afterwards can be matched against the predicted frontier values of trading nation partners to analyze the maximum size of the trade.

Belotti et al. (2013) and Kalirajan (2007) suggest the significance of applying the SFGM in international trade analysis as follows. First, it can offer information on exports' efficiency and potential. Second, it can be applied even if a model has not adequate information about the omitted variables. Third, it separates the analysis from the white noise term, and it estimates the effect of the economic distance term, which may cause non-normality and heteroskedasticity. The inclusion of SFA in the gravity model permits estimation of exports potential at a bilateral level. These export frontier quantities are influenced by a random error that may either be positive or negative and, consequently, permit stochastic frontier exports to fluctuate around the model's deterministic part (Ravishankar and Stack, 2014; Atif et al., 2016). Therefore, the strong theoretical and policy relevance of SFA results provide a decent justification for its use.

At first, Tinbergen (1966) used the gravity model to find the determinants of trade. In this model, trade is directly proportion to the income of trading countries and inversely proportion to the distance between these two. Therefore, the basic form of gravity model can be presented for our agriculture export model as follows:

$$AGXP_{jt} = \frac{GDP_t, GDP_{jt}}{DIST_j} \quad (1)$$

where  $AGXP_{jt}$  is agriculture export flow from Iran to importing country 'j' ( $j=1,2,3, \dots, 63$ ) in period 't' ( $t=1995, 1996, \dots, 2021$ ).  $DIST_j$  is the geographical distance between Iran and importer 'j.' Following the gravity theory, agricultural exports are supposed to be positively influenced by both countries' GDP. Iran's  $GDP_t$  is representing the supply-sided output capacity. On the other hand, the

importer's  $GDP_{jt}$  is a demand-sided phenomenon and is representing the demand capacity of the importer's country for Iranian products. Distance is a proxy for transport cost and it is assumed that it has a negative influence on trade. Equation (1) is non-linear in nature and has estimation problems. Therefore, it is generally estimated by taking log of both sides to make it linear.

$$\ln AGXP_{jt} = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln GDP_{jt} + \beta_3 \ln DIST_j + \varepsilon_{jt} \quad (2)$$

In Equation (2),  $\ln$  is natural log and  $\beta$ s are elasticity parameters to capture the impact of GDP of Iran and importer and distance on exports.

The gravity equation, revealing the significance of geographical dynamics in international trade theory, created a reawakening interest among researchers to establish theoretical foundation of gravity model. For instance, Anderson (1979), first, derived gravity equation through product differentiation model. Bergstrand (1989) investigated the theoretical base of bilateral trade through monopolistic competition models. Helpman and Krugman (1985) justified gravity model by assuming increasing returns to scale and differentiated product market. Deardorff (1995) establishes that gravity model characterizes many models and can be validated through standard trade theories.

Along with the theoretical explanations, gravity model has been enriched by various scholars by introducing different time variant and invariant explanatory variables. For example, Frankel (1992) augments Equation (2) by incorporating the product of GNP and GNP per capita as proxies for economy size and level of development, respectively. Similarly, Wall (1999) introduces trade policy index as a measure to estimate the trade protection level of US with the trading partners. Nguyen (2010) extends gravity model by including lagged volume of trade, regional trade agreements and exchange rate to explain Vietnam's exports flows with ASEAN<sup>1</sup> countries.

The gravity model is widely estimated to project the determinants of trade for the trading nations. However, there is a weakness in the estimation methodology. Exports or imports are generally taken as average of sample instead of optimum feasible values for the trading countries. This may be problematic in estimation gravity model in the presence of highly diverging values in the sample (Ravishankar and Stack, 2014). Therefore, stochastic frontier methodology stands better in estimation of gravity model.

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<sup>1</sup>. The Free Trade Agreement, signed between Malaysia, Indonesia, Singapore, Thailand, Brunei Darussalam, Vietnam, Myanmar, Laos, and Cambodia on January 28, 1992, in Singapore to reduce trade and customs tariffs, was signed by member states.

The stochastic frontier technique was developed by Aigner, Lovell, and Schmidt (1977). Since the conception of this idea, this methodology has widely been used to assess firm performance. Typically, the stochastic frontier model (SFM) postulates a production possibility frontier representing the optimal level of production obtained from fixed available inputs. The efficient firms operate on production possibility boundaries whereas technically inefficient firms operate inside the given frontier level and also it is representing production loss equal to difference between actual and potential output. Hence, it implies that the latter can further expand its output from given level of inputs. Thus, stating in the context, the firm operating below optimal level of production commits technical inefficiency.

Similarly, SFM is a better methodology in dealing with the trade below than optimal level. In this connection we can modify gravity model as follows:

$$\ln AGXP_{jt} = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln GDP_{jt} + \beta_3 \ln DIST_j + \sum_{g=1}^G \gamma_g Z_j + \sum_{k=1}^K \alpha_k X_{jt} + v_{jt} - \mu_{jt} \quad (3)$$

In Equation (3), all the trade determinants are same like Equation (2). However, the error term  $\varepsilon_{jt}$  has been segregated into two parts. That is  $v_{jt}$ , a double-sided error term that assumes  $N(0 \sim \sigma^2 v)$  and it explains statistical noise caused by estimation error. And a single side error term  $u_{jt}$ , that is supposed to be normally distributed,  $N(0 \sim \sigma^2 u)$ , and it stands for a measure of trade performance. The term  $u_{jt}$  represents technical efficiency<sup>1</sup> and can be used to identify the extent to which the actual trade level strays from the maximum possible/potential trade. According to Anderson and Wincoop (2003), these deviations happen due to multilateral trade resistances. These resistances are difficult to quantify and lead to inefficient trade performances in the bilateral and multilateral trade settings.

Following the Aigner, Lovell, and Schmidt (1977) methodology, we are using maximum likelihood estimation technique in Equation (4). In this methodology, SFM is an appropriate methodology if inefficiency is proved as significant. Furthermore, we would test the existence of technical efficiency through single-sided likelihood ratio test. For example,  $H_0: \sigma^2 u = 0$  is null hypothesis against the alternative  $H_1: \sigma^2 u > 0$ . Acceptance of null hypothesis indicates that SFM is reduced to ordinary least square estimates. Following the

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<sup>1</sup>. Technical efficiency is the ability of a firm to produce as much output as possible with a specified level of inputs, given the existing technology. It can also be a situation wherein it is impossible, with current technical knowledge, to increase output from given inputs or produce a given output using less than one input without using more of another input (Erena et al., 2021).

estimation of gravity parameters, the point estimates for technical efficiency can be calculated by following equation suggested by Battese and Coelli (1988):

$$\begin{aligned}
 E[\exp(-\mu_{jt})|v_{jt} + \mu_{jt}] &= \left[ \frac{1 - \phi[\sigma_\alpha + \gamma(v_{jt} + \mu_{jt})/\sigma_\alpha]}{1 - \phi\gamma(v_{jt} + \mu_{jt})/\sigma_\alpha} \right] \\
 &\times \exp\left[\gamma(v_{jt} + \mu_{jt}) + \frac{\sigma_u^2}{2}\right]
 \end{aligned} \tag{4}$$

where  $\phi(0)$  denotes the density function for standard normal random variables. If the value of  $\gamma$  is equal to 0 then it means that there is no deviation due to inefficiency. Whereas, if  $\gamma = 1$  then it indicates that there is no deviation in export-caused variance in 'u'. The technical efficiency can be estimated for each country-pair ranging from 0 to 1. A value equal to 1 indicates that the potential and actual trade coincides whereas value near to 0 implies that the actual trade is below the potential trade and there are possibilities for the further trade.

To analyze the determinants of agricultural exports of Iran, this study uses SFM gravity approach to estimate bilateral trade potential. This technique enables us to get consistent estimates from gravity model what Concretely, Baier and Bergstrand (2009) show that the following model produces similar estimates from those obtained by fixed effect method but without taking into account of dummy variables. Further, we have replaced the  $X_{jt}$  and  $Z_t$  from Equation (3) with tariff, bilateral exchange rate, border, language and preferential trade agreements in Equation (5).

$$\begin{aligned}
 \ln A GXP_{jt} = &\beta_0 + \beta_1 \ln G DP_t + \beta_2 \ln G DP_{jt} + \beta_3 \ln D IST_j + \beta_4 \ln(1 \\
 &+ ATAR_{jt}) + \\
 &\beta_5 \ln B EXR_{jt} + \beta_6 \ln B ORD_j + \beta_7 \ln L ANG_j + \beta_8 \ln P TA_j + \beta_9 Sanction_j \\
 &+ v_{jt} - \mu_{jt}
 \end{aligned} \tag{5}$$

where  $ATAR_{jt}$  = Average tariff imposed by country 'j' on agriculture exports from Iran,  $BEXR_{jt}$  =Bilateral exchange rate between Iran and importer.  $BORD_{ij}$ ,  $LANG_{ij}$ ,  $SANCTION_j$  and  $PTA_{ij}$  = border, language, sanction and preferential trade agreements dummies.

Table 1 shows a summary of the variables used in the model, as well as the expected sign and information sources of the variables.

**Table 1.** Expected Sign and Sources of Data

Variables	expected sign	Previous studies	Data resources	Details
Iran's agricultural export to partners			UN Comtrade Database	Aggregate of HS.01-24
Iran's GDP per capita	+	Koochakzadeh and Karbasi: (+)	World bank	GDP per capita (constant 2015 US\$)
GDP per capita in trading partner	+	Hendizadeh et al.: (+) Toossi et l.: (+)	World bank	GDP per capita (constant 2015 US\$)
Geographical distance	-	Karbasi and Aminizadeh: (-)	Centre d'Etudes Prospective et d'Informations Internationales (CEPII)	Distance between the capital of importing and exporting countries
Tariff rate	-	Atif, Haiyun and Haider Mahmood (-)	World bank	Tariff rate, applied, weighted mean, primary products(%)
Real exchange rate	(+/-)	Atif, Haiyun and Haider Mahmood (+)	World bank	Real effective exchange rate index (2010 = 100)
Trade agreement	+	Dourandish et al.: (+) Aminizadeh et al.: (-) Shepherd and Wilson: (-/+)	Centre d'Etudes Prospective et d'Informations Internationales (CEPII)	Dummy variable value "1" Existence of agreement with business partner and "0" Absence of agreement.
Common border	+	Shepherd and Wilson: (-/+) Toossi et l.: (+)	Centre d'Etudes Prospective et d'Informations Internationales (CEPII)	The dummy variable is a value of "1" for a business partner with a common border and "0" for a non-common border.
Common language	+	Atif, Haiyun and Haider Mahmood (+)	Centre d'Etudes Prospective et d'Informations Internationales (CEPII)	The dummy variable is "1" for a business partner with a common language and "0" for a non-common language.
Economic sanction	(-/+)	Karbasi and Aminizadeh: (-)	Samur (2015)	the dummy variable is "1" for the years 2010 onwards and "0" for the years before 2010.

Source: Research finding.

## 5. Results

As shown in Table 2, the high coefficient of variation (cv) in the value of agricultural exports in Iran (3.57) indicates that Iran's exports are very scattered. Further, the cv of GDP per capita among importing countries indicates the diversity of market size in Iran's target countries. The minimum and maximum range for the import per capita GDP of the importer and bilateral exchange rate is considerably wide, which means that Iran's partners are heterogeneous in many respects.

**Table 2.** A Summary of Statistics in Model Variables

Variables	Mean	Standard deviation	coefficient of variation	Minimum	Maximum
Agriculture exports	63.5	227	3.57	852	2610
Exporter -GDP per capita	4717	609.5	0.13	3703	5664
Importer-GDP per capita	42310	180803	4.27	332.7	1593917
Distance	3461	2623	0.76	540	12916
Tariff rates	5.07	5.39	1.06	0	62
Bilateral exchange rate	5299	13699	2.58	0.11	135921

**Source:** Research finding.

**Note:** \*indicates the variables adjusted for MR term.

Before estimating the gravity model, it is necessary to check the stationary of the variables. The results Fisher and Im-Pesaran-Shin tests showed that all variables are stationary (Table 3).

**Table 3.** Results of Unit Root Test

Variable	Fisher		Im-Pesaran-Shin	
	Statistics	Significance level	Statistics	Significance level
Iran's agricultural export to trading partners	4.71	0.00	-2.16	0.01
Exporter -GDP per capita	9.12	0.00	-4.10	0.00
Importer-GDP per capita	29.93	0.00	-7.21	0.00
Tariff rates	1.51	0.08	-1.59	0.05

Bilateral exchange rate	13.73	0.00	-2.39	0.00
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**Source:** Research finding.

In addition, based on the results in Table 4, no perfect collinearity is observed between the independent variables of the model.

**Table 4.** Results of Covariance Matrix Test

	lex	lgdpci	lgdpcj	latr	lbi	ldist1
lex	1					
lgdpci	0.346	1				
lgdpcj	0.0490	0.0723	1			
latr	-0.0371	-0.312	-0.319	1		
lbi	0.0629	0.220	0.222	-0.175	1	
ldist1	-0.286	-0.0865	0.220	-0.183	-0.218	1

**Source:** Research finding.

Table 5 indicates the results of panel diagnostic tests. The result of Chow's test indicated that the structured data used to estimate the gravity model is in the form of a panel. Further, the result of Hausman test showed that the null hypothesis of the effect of the random effects method is rejected and the fixed effect method has better results.

**Table 5.** Results of Panel Diagnostic Tests

Test	Statistic	p-value
Chow test	29.26	0.00
Hausman test	19.02	0.00

**Source:** Research finding.

Table 6 shows the factors affecting Iran's agricultural exports by using a stochastic frontier gravity model. The coefficients of the explanatory variables are in accordance with the expected economic theories. The model fits well based on the high value of gamma ( $\gamma$ ) which is 0.75. The value ( $\mu$ ) is significant at 1%, which confirms the inefficiency of the model. In addition, the value of  $\sigma^2$  is significant, which measures the average of total changes over time. In fact, the flows of Iran's agricultural export are different over time. However, ( $\eta$ ) is not statistically significant at the level of 10%, which indicates a lack of significant changes in export inefficiency during the study period.

Based on the results, the value of agricultural exports is positively determined by supply capacity (Iran's GDP), as well as partner demand capacity (GDP of importing countries), while geographical distances are considered as the main barriers. The coefficient of domestic supply capacity indicated that a 1% increase in GDP leads to an increase in the value of agricultural exports by 2.38%, while a 1% increase in importer revenue (importer GDP) results in increasing the demand for agricultural exports by 0.29%. Similarly, regarding the negative distance coefficient, a 1% increase in distance prevents from exporting agricultural products by 0.7%. Both predictions theoretically are consistent with the gravity model hypothesis upon which Iran's agricultural exports are positively related to economic volume and inversely related to the distance between trading partners. The results are in line with those of Raimondi and Olper (2008) and Atif et al. (2016) in which agricultural trade has a positive and negative relationship with market size and distance, respectively.

In addition to the base gravity model estimates, the average tariff rate was added as an explicit measure of trade costs. Regarding the negative coefficient of 0.18, the export of agricultural products has a negative relationship with the tariff rate and the export of agricultural products decreases by 0.18% and vice versa by a 1% increase in the tariff rate by the importing country. In addition, a negative relationship between tariff rates and exports of agricultural products was confirmed by Raimondi and Olper (2008) and Ghazalian et al. (2012).

Further, the positive and significant coefficient of the bilateral exchange rate shows that an increase in the bilateral exchange rate (devaluation of the rial based on the definition) results in increasing the income of agricultural exports by 0.13%. Therefore, the demand for exporting Iranian agricultural products is elastic and its devaluation plays a significant effect on the earnings of agricultural exports. The finding is consistent with that of Erdal et al. (2012) which focused on agricultural exports.

Along with other independent variables, four dummy variables were added to examine the effect of a common border, common language, trade agreements, and economic sanctions on Iran's agricultural exports. The common border coefficient for exporting Iranian agricultural products was significant. In other words, the existence of a common border led to an increase in agricultural exports of Iran, which may be related to lower shipping costs and easier access to the market. Common border markets have a more similar food taste due to cultural similarities and tastes, which leads to more exports to the neighboring countries.

Common language (CL) failed to have a significant effect on the value of exports, which is in line with the study of Herath et al. (2014).

Given that Iran has not adopted any trade agreements in the agricultural sector except for Pakistan and Turkey, and these agreements have failed to create any significant change in Iran's agricultural exports to these countries, the trade agreement variable failed to play any significant role on the value of Iran's agricultural exports. Furthermore, the lack of significant effect of economic sanctions on the value of Iran's agricultural exports may be related to the fact that US and EU multilateral sanctions have not had any effect on agricultural products due to food security reasons, and accordingly failed to decrease Iran's exports.

**Table 6.** Maximum Likelihood Estimates of the Stochastic Frontier Gravity Equation for Iran's Agriculture Exports

Variable	Coefficient	Standard error	P-Value
Exporter -GDP per capita	2.38	0.67	0.00
Importer-GDP per capita	0.29	0.13	0.04
Distance	-0.70	0.36	0.05
Tariff rates	-0.18	0.10	0.07
Bilateral exchange rate	0.13	0.06	0.04
Language	0.27	1.21	0.82
Regional trade agreements	1.27	1.80	0.48
Common border	1.28	0.6	0.05
Sanction	-0.20	0.15	0.19
Year	0.01	0.01	0.53
Constant	2.29	7.19	0.76
( $\gamma$ )	0.75	0.06	0.86
( $\eta$ )	0.00	0.01	0.40
( $\mu$ )	2.88	0.47	0.00
$\sigma^2$	3.38	0.85	0.00
Log-likelihood	-919.64	X2	83.16

**Source:** Research finding.

## 6. Technical Efficiency and Export Potential

### 6.1 Export Efficiency

Table 7 indicates the estimation of the average export technical efficiency based on the stochastic frontier gravity model for major trading partners in Iran. Based on the results, none of the countries indicated 100% technical efficiency. In other words, regarding the factors playing a role in the gravity model, Iran has failed to do maximum exports with its trading partners and a lot of potentials are available for increasing the trade with these countries. As shown in Table 7, Iran has had

export efficiency above 50% with only 6 countries including Germany, Russia, Vietnam, Spain, India, and UAE, which represents the high export potential of many trading partners in agricultural products. In addition, except for Russia and the UAE, other neighboring countries have high potentials for accepting agricultural products.

**Table 7.** The Efficiency of Iranian Exporting Target Markets

Partner country	Technical efficiency (%)	Partner country	Technical efficiency (%)
Germany	↑ 76	Yemen	↓ 5
Russia	↑ 64	United Kingdom	↓ 4
Vietnam	↑ 61	Thailand	↓ 4
Spain	↑ 60	Belgium	↓ 3
India	↑ 59	Syria	↓ 3
United Arab Emirates	↑ 57	Indonesia	↓ 3
Afganistan	→ 34	Greece	↓ 3
Italy	↓ 24	Hungary	↓ 3
Kazagestan	↓ 23	Egypt	↓ 3
China	↓ 19	Turkey	↓ 3
Lebanon	↓ 14	Azerbaijan	↓ 3
Uzbekistan	↓ 14	Algeria	↓ 3
Tajikistan	↓ 12	Morocco	↓ 2
Japan	↓ 11	Georgia	↓ 2
Turkmenistan	↓ 10	Armenia	↓ 2
France	↓ 9	Qatar	↓ 2
Pakistan	↓ 8	South Africa	↓ 1
Australia	↓ 6	Jordon	↓ 1
Republic of Korea	↓ 6	USA	↓ 1
Kyrgyzstan	↓ 5	Bahrein	↓ 1
Kuwait	↓ 5	Oman	↓ 1
Iraq	↓ 5	Singapore	↓ 1
Poland	↓ 5	Libya	↓ 0
Netherlands	↓ 5	Croatia	↓ 0

**Source:** Research finding.

### 6.3 Export Potential

Table 8 estimates the average export potential and its gap from actual exports based on estimated stochastic frontier gravity model. The results indicated that there is a significant potential for Iranian agricultural exports with all of the trading partners. The highest potential agricultural exports in Iran, which is about US 32,273 million dollar, belong to Iraq, followed by Turkey, Oman, Qatar and Pakistan. In fact, the highest export potential is related to the neighboring country, common border, large population, and informal Arabic and Turkish language common in most parts of Iraq and Turkey.

**Table 8.** Agriculture Export Gap in Iran: An Average of US Million Dollars (1997-2021)

Partner country	Actual exports	Potential exports	Exports gap	Partner country	Actual exports	Potential exports	Exports gap
Iraq	1584.7	32273.1	-30688.4	Poland	9.9	206.6	-196.6
Turkey	191.0	6938.8	-6747.8	Russia	316.5	496.9	-180.4
Oman	59.0	5929.6	-5870.6	Uzbekistan	28.4	206.4	-177.9
Qatar	68.4	4176.0	-4107.7	United Kingdom	7.5	178.6	-171.1
Pakistan	298.2	3610.5	-3312.4	India	200.9	339.5	-138.7
Azerbaijan	70.9	2761.2	-2690.3	Australia	8.6	143.9	-135.3
Armenia	27.1	1462.9	-1435.7	Morocco	2.8	120.1	-117.4
Kuwait	70.7	1413.3	-1342.5	Italy	37.0	153.2	-116.2
China	285.4	1514.4	-1229.0	Belgium	4.2	120.2	-116.0
Libya	3.6	1178.1	-1174.5	Egypt	3.1	108.6	-105.5
Syria	34.4	1061.1	-1026.7	Lebanon	17.3	121.1	-103.7
Afghanistan	507.9	1505.4	-997.5	France	9.7	106.5	-96.8
Jordan	10.5	999.6	-989.0	USA	1.0	91.8	-90.8
Kyrgyzstan	34.4	642.5	-608.1	Indonesia	2.9	91.5	-88.6
Bahrein	5.4	529.5	-524.2	Greece	2.3	74.3	-72.0
Turkmenistan	58.5	579.9	-521.4	Tajikistan	9.8	79.3	-69.4
Georgia	10.9	511.2	-500.3	Hungary	1.8	60.9	-59.2
Singapore	3.6	418.9	-415.3	South Africa	0.8	56.9	-56.0
Thailand	16.5	409.9	-393.3	Germany	155.4	203.5	-48.1
United Arab Emirates	464.7	808.4	-343.7	Japan	5.4	49.3	-43.9
Croatia	0.5	292.5	-292.0	Vietnam	58.2	94.6	-36.4
Kazakhstan	77.8	343.2	-265.4	Republic of Korea	2.2	38.0	-35.8
Netherlands	11.2	238.3	-227.0	Spain	53.8	89.5	-35.7
Algeria	5.6	224.1	-218.5	Yemen	1.3	29.0	-27.7

**Source:** Research finding.

## 7. Conclusion and Policy Implication

The results indicated a significant growth in the export value of Iran's agricultural products in the studied period, although the lack of stability in the value of Iran's agricultural exports and the limitation of Iran's export target countries during the studied period are considered as the main weaknesses of exports in this sector. It is believed that the capacity of Iran to achieve higher figures is very high. Therefore, in this study, the gravity model was estimated for Iran's agricultural exports to its 48 main trading partners during 1997-2021 by using the stochastic frontier gravity model technique. Further, the factors related to Iran's agricultural

export potential were assessed with its major trading partners. The results confirmed that economic size and geographical distances have a positive and negative effect on Iran's agricultural exports, respectively. Additionally, the real exchange rate (devaluation of the domestic currency) has had a positive and significant effect on the export income of the agricultural sector. However, implementing such a policy successfully necessitates the adoption of correct financial and monetary policies (Karimzadeh et al., 2014). Furthermore, common borders have positive and significant effects on agricultural exports, while common language, trade agreements, and sanctions failed to help us analyze the agricultural exports in Iran.

In addition, the stochastic frontier gravity model technique quantifies the values of export potentials by estimating technical efficiency. The average technical efficiency of agricultural exports in most trading partners was less than 10%. Further, actual agricultural exports have been considerably lower than potential exports. As a result, the export gap was negative for all trading partners. The results of this study for GDP per capita of the exporting country and importing countries, geographical distance, common border, bilateral exchange rate and tariff with the studies of Delona et al. (2014), Atif et al. (2016), Noviani et al. colleagues (2017), Hajivand et al. (2020) is consistent. For Iran's export potential in the agricultural sector, it is consistent with the studies of Hajivand et al. (2020) and Mohammadi et al. (2017). Based on the model findings, the following suggestions are mentioned.

First, the business partners with the highest export potential were Iraq, Turkey, Oman, Qatar and Pakistan. In the meantime, considering the impact of the common border and geographical distance on exports, it is recommended that Iraq, Turkey and Pakistan should be prioritized for Iran's exports due to their short distance. However, this variable has not had a significant effect on improving agricultural exports because of the lack of attention to trade agreements in Iran's agricultural sector, especially with neighboring countries. Second, participation in regional trade agreements can help strengthen the political bond between Iran and its trading partners while developing Iran's bilateral trade. Accordingly, given that geographical distance affects transportation and the volume of bilateral trade, it is recommended that the government plan should expand trade with the neighboring countries which have high economic, cultural, and social similarities with Iran. Finally, considering that the agricultural sector has never been included in the list of sanctions imposed on Iran due to the provision of food to the people and the demonstration of human rights by the sanctions (Faraji et al., 2018), this variable

failed to have a significant effect on the export value of agricultural products. Thus, politicians can compensate a part of the currency shortage by the agricultural sector by boosting agricultural trade.

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## Do Political Institutions Have Similar Effect on Quality of Economic Institution Across Different Sub-regions in Sub-Saharan Africa?

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### Abstract

This paper investigated the impact of four different indicators of political institutions on the quality of economic institutions across the different Sub-regions (Central, East, South and West Africa) in Sub-Sahara Africa (SSA). A panel data of 43 countries in SSA over the period 1996 to 2020 was gathered and analyzed. Im-Pesaran-Smith (IPS) panel unit root test technique is used to evaluate the stationarity property of the variables. Then, three alternative long-run panel cointegration regression techniques, namely; mean group (MG), pooled mean group (PMG) and dynamic fixed effects (DFE) are used to gauge the specified model. The most efficient among them is chosen using Hausman specification test. The findings from the empirical analysis are in three folds: i. political institutions do not have short-run impact on economic institutions in SSA as a whole and across the four sub-regions; ii. political institutions do have long-run influence on the quality of economic institutions, with rule of law having the biggest impact, follow by government effectiveness, political stability and quality of democracy in that order; iii. The impact of political institutions on economic institutions is not similar across the four sub-regions in SSA. Unlike previous studies, this paper identifies specific type of political institutions relevant in improving the quality of economic institution in each sub-region of SSA. The finding establishes inter alia that one size fit not all hypothesis is applicable across the sub-regions in SSA.

**Keywords:** Economic Institutions, Rule of Law, Government Effectiveness, Polity Stability, Sub-Regions.

**JEL Classification:** C33, O43, O55, P16.

### 1. Introduction

It is established in the literature that the quality of institutions is critical to economic performance (see, for example, Hall and Jones, 1999; Acemoglu et al.,

2003; Ferrini, 2008; Luiz, 2009; Boettke and Fink, 2011; Osman et al., 2011; Kilishi et al., 2013; Yildirim and Gokalp, 2016; Mullings, 2018; Uddin et al., 2021). Thus, it is imperative to understand how to improve the quality of institutions, particularly in developing countries. Research on the determinants of institutional quality has attracted attention in the field of institutional economics recently.

The literature on the determinants of the quality of institutions is growing fast. This literature can broadly be grouped into five categories. The first category emphasizes geographical conditions (see, for example, Engerman and Sokoloff, 1997; Gallup et al., 1999; Easterly and Levine, 2003; Lehne et al., 2014), and the second focuses on culture such as ethnic fractionalization (La Porta et al., 1999), the third links quality of institutions with economic factors such as growth (see Chong and Zanforlin, 2000; Islam and Montenegro, 2002; among others), income distribution (see Alesina and Rodrik, 1993; Alesina and Perotti, 1996; Engerman and Sokoloff, 1997), and trade openness (Acemoglu and Robinson, 2008), the fourth group argues that history is responsible for the quality of institutions, for the effect of colonization see Acemoglu et al., 2001; 2002, while the fifth group emphasizes politics and political institutions (see Acemoglu, 2006; Acemoglu and Robinson, 2012; Acemoglu and Robinson, 2016; Congleton and Yoo, 2018; Alhassan and Kilishi 2019; Alonso et al., 2020).

However, Alhassan and Kilishi, (2019) show empirically that political institutions are the fundamental determinants of the quality of economic institutions in Africa. While immutable factors such as culture, history, and geography were not statistically significant. Most studies that found the immutable factors to have a significant effect were cross-sectional studies without accounting for the time dynamics. However, in most panel studies, these variables are not usually statistically significant.

This paper contributes to the literature by investigating whether or not the impact of political institutions varies across the different sub-regions in Sub-Saharan Africa (SSA). The economies in SSA vary greatly in terms of their structure, composition, and level of sophistication. Therefore, it is not expected that the impact of political institutions will be the same across the sub-regions in SSA. Thus, this study is different from previous studies in three ways: first, the study examines the relative impact of four different categories of political institutions on economic institutions; second, the investigation is carried out using the full sample

of countries in SSA and then sub-samples of countries in Central, East, South and West Africa respectively; third, the study employed techniques of dynamic panel data analysis which yield both the short and long-run impacts.

Brief literature review, theoretical argument, model specification, description of the estimation procedure, and the nature and sources of data are presented next to this introductory section. While preliminary results, regression results, conclusion, and policy implications make up the rest of the paper.

## **2. Literature Review**

The literature on the determinants of institutional quality has grown tremendously recently. Lawson et al. (2020) surveyed over 70 empirical papers that studied the determinants of economic institutions measured as economic freedom. Several variables ranging from income, growth, geography, history, natural resource, inequality, foreign aid, education, and fractionalization, to political variables such as civil liberties, political rights, level of democratization, type of government, and level of political competitiveness among others were examined in the literature as potential determinants of economic freedom. While some of the variables show significant positive effects, some show significant negative impacts and some were not statistically significant.

Although few studies find the impact of political institutions to be insignificant, no study shows significant negative effect, while numerous studies show that political institutions have significant positive effects on economic institutions. Among all the various factors examined in the literature, political institutions have the most consistent significant positive effect across several studies (see for example, Vega-Gordillo and Álvarez-Arce, 2003; de Haan and Sturm, 2003; Dawson, 2003; Lundström, 2005; Dreher and Rupprecht, 2007; Pitlik, 2008; Aixalá and Fabro, 2009; Carden and Lawson, 2010). This means that political institutions that allow constitutional protections for speech, religion, assembly, and other civil liberties have the highest impact on economic institutions. The average effect of political institutions as calculated by Lawson et al. (2020) is about 0.23. Earlier, Islam and Montenegro (2002) showed that political institutions that promote checks and balances enhance the quality of economic institutions. Saeed (2022) shows that voice and accountability have the most influence in shaping institutional quality in a sample of developing countries. This implies that the quality of economic institutions improves when political

institutions allow most citizens to participate in selecting their government, while they enjoy freedom of expression, freedom of association, and free media.

Distinct from the effect of political institutions, a number of studies also show that formal democracy has positive significant effect on economic institutions. The standardized size of the effect is calculated to be around 0.217. Among studies that find significant positive relationship between democracy and economic institutions are Pitlik (2008); Rode and Revuelta (2015); Sheehan and Young (2015); Dutta and Williamson (2016); Hall (2016); Krieger and Meierrieks (2016); Kotschy and Sunde (2017); Murphy and Smith (2018); O'Reilly and Murphy (2017); Tarabar and Young (2017). Krieger (2022) on the other hand, presents a simple theoretical model which predicts that a transition from autocracy to democracy would lead to an increase in the quality of economic institutions. However, his model further predicts that this improvement is larger when the level of human capital is high. He supported the theoretical model with empirical analysis of panel data covering 150 countries over the period 1920 to 2019.

Javed (2016) investigates the potential determinants of institutional quality using panel data of IMF member countries over a time period that the number of IMF programs witnessed an increasing trend. Similar to the studies on the effects of democracy, his results show that parliamentary form of government, aggregate governance level, civil liberties, and trade openness enhance institutional quality. While economic growth is conducive to enhancing economic institutional quality. On the other hand, military power negatively impacts on institutional quality.

### **3. Theoretical Design**

There is no standardized generally accepted theory of institutional change. However, there are a number of attempts to theorize the evolution of institutional trajectories across different societies. However, this study is based specifically on the political economy theory of institutional changes. This approach is promoted by studies like Acemoglu, Johnson, and Robinson (2005), Acemoglu (2006), Acemoglu and Robinson (2008), Acemoglu and Robinson (2012), and more recently Krieger (2022) among others. In the context of the theory, economic institutions are the formal and informal rules that determine the incentives of and constraints on economic actors as well as shape economic outcomes. As such, institutions are social decisions, chosen for their consequences. Meanwhile, different economic institutions affect different individuals and groups of

individuals differently. Hence, different individuals and groups will prefer different institutional settings. Consequently, there is a conflict of interest among various social groups and individuals over the choice of economic institutions. It is interesting to ask; “if different social groups prefer different institutional settings, which of the group’s preferred institutions will prevail”? It is the interest of the group with more political power that will prevail. That is, the allocation of political power determines the equilibrium of economic institutions. This makes issues of political economy of distribution of political power important.

The distribution of political power in a society is in turn determined by political institutions. Weak and exclusive political institutions make political power concentrated in the hands of few individuals. While strong and inclusive political institutions ensure that political power is not concentrated in the hands of a few individuals or a narrow group of people, rather political power is open to a broad set of people. That is, inclusive political institutions create a level playing political ground. Inclusive political institutions will also allow citizens to hold politicians accountable and will ensure politicians do not use their political power to promote narrow interests. If political institutions are inclusive, the citizens influence how political power can be used in the best interest of the majority, such as creating inclusive economic institutions and using national resources to provide infrastructure for the benefit of the generality of the people.

The key theoretical propositions of the political economy theory of institutional change are that: first, in a political system where few individuals or narrow groups control political power such as the case in an autocracy, the government only gives attention to the preferences of the elite who control political power. Thus, the members of the elite use this influence and indicate the institutional quality that maximizes their utility. Hence, weak, exclusive and extractive institutions are likely to exist in such a system. Second, as societies transit from authoritarian regimes to democratic regimes, the control of political power becomes broader and the influence of people on government increases, thus, the preferences of the people will be accommodated in government policy decisions. Therefore, better, strong and inclusive economic institutions are likely to emerge. Meanwhile, partial democratization with political institutions that do not allow wide participation of people is not necessarily associated with increasing institutional quality, because the elite would still control political power, hence, they will prevent changes in the quality of the economic institutions.

This theory provides a good explanation for why weak institutions still exist in many African countries despite the wind of democratization that blew across the continent. Political institutions are still weak in the majority of the countries. In most countries, the same elites that controlled power during the non-democratic eras emerged as national political leaders after the transition to democracy. In cases where they do not contest or win elections, they control the majority party.

Another dimension of the argument as provided by Acemoglu and Robinson (2008; 2012), Iwayemi and Kilishi (2016), and Krieger (2022) is that if political institutions are weak, there will be little or no restraint on the actions of the political elite. Consequently, political power will attract rents. Thus, political elites would be desperate for political power, and as such, there would be serious infighting among various groups over the control of political power. Political elites are therefore likely to provide weak and exclusive economic institutions to limit the ability of citizens to take over government and policymaking from them. Overall, weak political institutions are more likely to produce weak economic institutions. Iwayemi and Kilishi (2016) also argue that if the utility of the political elite is a function of natural resource rent rather than tax revenue, there is no incentive for the elite to create strong and effective economic institutions that would promote economic activities. Hence, resource-rich countries with weak political institutions are likely to have weak economic institutions.

#### 4. The Model

Drawing from the extant literature in the area of determinant of institutional quality and in line with the objective of this study, the model specification is hereby presented as follows;

$$EI_{it} = \alpha_i + \beta_j PI_{it}^j + \gamma_k EF_{it}^k + \delta_l GF_{it}^l + \theta_m SF_{it}^m + \varepsilon_{it} \quad (1)$$

where  $EI$  represents economic institutions,  $PI$  epitomizes different indicators of political institutions,  $EF$  stands for the economic factors,  $GF$  denotes geographical factors,  $SF$  represents social factors,  $\varepsilon$  is the Gauss Markov error term,  $i$  stands for an individual country,  $t$  stands for time in years and the superscripts indicate specific variable in each category of factors.

Four political institutional variables are introduced successively, these are Quality of Democracy measure by Polity II, Rule of Law, Government Effectiveness, and Political Stability. The economic factors considered in this paper are per capita income measured by GDP per Capita (GDPPC) and trade openness

(TOP). It has been argued that countries with higher per capita income would pursue better institutions because the people would demand it, and as countries interact with the external world in trade, they tend to strengthen their institutions so as to be able to compete favourably. The emphasis in this paper is more on variables that can be influenced by policymakers rather than predetermined factors such as geography and culture. Nevertheless, two geographically related variables are controlled for, viz log of land area (LnLand) and natural resource rent (NatRes). The natural resource rent is introduced to test the resource curse hypothesis. Similarly, two variables are used to stand for social institutions, these are education (Educ) and employment (Emp).

Thus, the extended model is given as:

$$EI_{it} = \alpha_i + \beta_j PI_{it}^j + \gamma_1 GDP_{it} + \gamma_2 TOP_{it} + \delta_1 LnLand_{it} + \delta_2 NatRes_{it} + \theta_1 Educ_{it} + \theta_2 Emp_{it} + \varepsilon_{it} \quad (2)$$

The dynamic specification following from equation 2 is:

$$EI_{it} = \beta_0 + \sum_{j=1}^p \alpha EI_{it-j} + \sum_{j=0}^{q_1} \beta_j PI_{it-j} + \sum_{j=0}^{q_2} \gamma_{1j} GDP_{it-j} + \sum_{j=0}^{q_3} \gamma_{2j} TOP_{it-j} + \sum_{j=0}^{q_4} \delta_{1j} LnLand_{it-j} + \sum_{j=0}^{q_5} \delta_{2j} NatRes_{it-j} + \sum_{j=0}^{q_6} \theta_{1j} Educ_{it-j} + \sum_{j=0}^{q_7} \theta_{2j} Emp_{it-j} + \varepsilon_{it} \quad (3)$$

The specification in equation 3 can be re-parameterized to obtain both the long run and short run estimates within a dynamic panel framework. This is given as:

$$\begin{aligned}
\Delta EI_{it} = & \beta_0 + \delta_i EI_{it-1} + \pi_{1i} PI_{it-1} + \pi_{2i} GDPPC_{it-1} + \pi_{3i} TOP_{it-1} \\
& + \pi_{4i} LnLand_{it-1} + \pi_{5i} NatRes_{it-1} + \pi_{6i} Educ_{it-1} \\
& + \pi_{7i} Emp_{it-1} \\
& + \sum_{j=1}^{p-1} \alpha_{ij} \Delta EI_{it-j} + \sum_{j=1}^{q_1-1} \varphi_{1ij} \Delta PI_{it-j} \\
& + \sum_{j=1}^{q_2-1} \varphi_{2ij} \Delta GDPPC_{it-j} + \dots + \sum_{j=0}^{q_7-1} \varphi_{7ij} \Delta Emp_{it-j} + \mu_i \\
& + \varepsilon_{it}
\end{aligned} \tag{4}$$

From Equation 4, the short run impact for each of the predictors is captured by  $\varphi_j$  and  $\alpha$ , while the long run impact is measured for each of the explanatory variables by the  $\pi_s$ . The error correction version of the specification in equation 4 is equivalent to:

$$\begin{aligned}
\Delta EI_{it} = & \omega_i ECT_{it-1} \\
& + \sum_{j=1}^{p-1} \alpha_{ij} \Delta EI_{it-j} + \sum_{j=1}^{q_1-1} \varphi_{1ij} \Delta PI_{it-j} \\
& + \sum_{j=1}^{q_2-1} \varphi_{2ij} \Delta GDPPC_{it-j} + \dots + \sum_{j=0}^{q_7-1} \varphi_{7ij} \Delta Emp_{it-j} + \mu_i \\
& + \varepsilon_{it}
\end{aligned} \tag{5}$$

The  $ECT_{it-1}$  in Equation 5 is the error correction term and  $\Delta$  is the difference operator, where  $ECT_{it-1} = \Delta EI_{it} - \varphi_{1ij} \Delta PI_{it-j} - \varphi_{2ij} \Delta GDPPC_{it-j} - \dots - \varphi_{7ij} \Delta Emp_{it-j}$ .

## 5. Estimation Procedure

The estimation procedure begins with unit root tests using Im-Pesaran-Smith (IPS) panel unit root technique. The results of the test show a combination of I(1) and I(0) series. Given this outcome and the fact that both N (43) and T (1996 to 2020) are relatively large, the autoregressive distributed lag (ARDL) modelling procedure is employed to gauge the models. Three alternative long-run panel cointegration techniques are used in the study, namely; mean group (MG), pool mean group (PMG), and dynamic fixed effects (DFE). According to Pesaran and Smith (1995) and Pesaran, Shin, and Smith (1997, 1999), the three techniques are

consistent when both  $T$  and  $N$  are large. Even though they are based on different assumptions, all three techniques employ the ARDL framework where the series are a combination of  $I(0)$  and  $I(1)$ . The MG and DFE are extreme opposite, while PMG is intermediate. MG assumes a heterogeneous slope and intercept coefficient, and thus derives long-run parameters by averaging the long-run parameters of the ARDL for individual units. DFE imposes the homogenous slope coefficients but allows constant intercepts to vary across units. PMG imposes the assumption of short-run heterogeneous slope coefficients and long-run homogenous slope coefficients. The most efficient of the alternatives is determined using the popular Hausman specification test.

## **6. Nature and Sources of Data**

Data is collected over a period of 1996 to 2020 across 43 countries in Sub-Sahara Africa (SSA). The Heritage Foundation's Index of Economic Freedom is used as a measure for economic institutions. The index describes economic freedom as "the fundamental right of every human to control his or her own labor and property". The index is scaled from 0 to 100, the closer to 0, the weaker institutions are, and closer to 100 means strong institutions.

Polity II, which is from the Polity IV dataset measures the degree of democratization as against autocracy. Its value ranges from +10 (strongly democratic) to -10 (strongly autocratic). Data on the other three political institutional variables viz government effectiveness, rule of law, and political stability are gathered from World Bank Governance Indicators. Government Effectiveness measures perceptions of the people on the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Rule of Law measures the perceptions of people on the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Political Stability captures the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism. The estimate for each of these three variables ranges from -2.5 to 2.5.

The control variables, land area, GDP per capita, Natural resource rent, and trade openness data are collected from World Development Indicators (WDI) database.

While, education is an index obtained from Oxford Poverty and Human Development Initiative (OPHI) database.

### **7. Preliminary Results**

This section presents the summary statistics for the key variables which are economic institutions, polity II, rule of law, political stability, and government effectiveness. Also, presented in the section are the results of the unit root tests. While the summary statistics are presented in Table 1, the unit root test results are presented in Table 2.

The mean, standard deviation, minimum and maximum values for the full sample and sub-regional samples across Central Africa, East Africa, South Africa, and West Africa respectively are presented in Table 1. The average economic institutions index in SSA is 53.79, the average value in West (57.39), East (54.38), and South (54.20) are slightly above the SSA average, while the average in Central Africa (48.61) is lower. Paradoxically, the lowest minimum and highest maximum values across the sub-regions are found in East Africa. The standard deviation is highest in West Africa and lowest in Southern Africa, implying that the disparity in economic institutions across countries is highest and lowest in West Africa and South Africa respectively.

The average values of the political variables indicate that political institutions are weak in SSA. The average quality of democracy measured by polity II is 1.92, while the average values for rule of law, political stability, and government effectiveness are  $-0.68$ ,  $-0.51$ , and  $-0.73$  respectively. It is pertinent to note that the average value of these three governance indicators in SSA is negative. Across the four sub-regions, West Africa has the highest average value (3.20) in polity II, while Central Africa has the lowest ( $-1.85$ ). The average values for the three governance indicators are negative for all the sub-regions.

From the unit root test results presented in Table 2, it is clear that political stability, government effectiveness, GDP per capita, education, and natural resource rent are stationary at level. Implying that they are integrated of order zero  $I(0)$ . The remaining variables, including economic institutions, polity II, rule of law, trade openness, employment, and land are all stationary after first difference, hence, they are integrated of order one  $I(1)$ . It is therefore certain that no variable is integrated of order two.

**Table 1.** Summary Statistics of Key Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
<b>Sub-Sahara African Countries (Full Sample)</b>					
<b>Economic Institution</b>	989	53.79498	8.192089	21.4	77
<b>Polity II</b>	989	1.91911	5.233759	-9	10
<b>Rule of Law</b>	989	-0.6828	0.640508	-2.13	1.07713
<b>Political Stability</b>	989	-0.50815	0.859507	-2.5	1.22
<b>Government Effectiveness</b>	989	-0.73158	0.599375	-1.88	1.06
<b>Central African Countries</b>					
<b>Economic Institution</b>	161	48.60928	6.739609	33.8	60.5
<b>Polity II</b>	161	-1.85093	3.581569	-6	6
<b>Rule of Law</b>	161	-1.24731	0.385248	-2.13	-0.20581
<b>Political Stability</b>	161	-0.56208	0.555439	-1.8	0.56
<b>Government Effectiveness</b>	161	-1.21867	0.387381	-1.88	-0.2
<b>Eastern African Countries</b>					
<b>Economic Institution</b>	322	54.38481	9.110512	21.4	77
<b>Polity II</b>	322	2.204969	5.185191	-7	10
<b>Rule of Law</b>	322	-0.63024	0.599774	-1.8523	1.07713
<b>Political Stability</b>	322	-0.65096	0.989393	-2.5	1.22
<b>Government Effectiveness</b>	322	-0.69289	0.569402	-1.78	1.06
<b>Southern African Countries</b>					
<b>Economic Institution</b>	368	54.19968	4.894035	33.5	66.5
<b>Polity II</b>	368	2.839674	4.571426	-6	10
<b>Rule of Law</b>	368	-0.67106	0.568396	-2.00851	1.04419
<b>Political Stability</b>	368	-0.39647	0.899391	-2.5	1.2
<b>Government Effectiveness</b>	368	-0.76712	0.481191	-1.88	0.37
<b>Western African Countries</b>					
<b>Economic Institution</b>	138	57.38951	11.24345	23.7	72
<b>Polity II</b>	138	3.195652	6.540005	-9	9
<b>Rule of Law</b>	138	-0.17821	0.662648	-1.70075	0.730522
<b>Political Stability</b>	138	-0.40986	0.64203	-2.31	0.83
<b>Government Effectiveness</b>	138	-0.1588	0.64762	-1.46	1.02

Source: Research finding.

**Table 2.** The Results of Unit Root Test

Variable	Level (t-Stat)	P-Value	1 <sup>st</sup> Diff (t-Stat)	P-Value	Decision
<b>Economic Institution</b>	-0.9481	0.1716	-11.2226	0.0000	I(1)
<b>Polity II</b>	-0.8118	0.2084	-12.1576	0.0000	I(1)

<b>Rule of Law</b>	-1.1559	0.1239	-12.1427	0.0000	<i>I</i> (1)
<b>Political Stability</b>	-1.8988	0.0288			<i>I</i> (0)
<b>Government effectiveness</b>	-2.8352	0.0023			<i>I</i> (0)
<b>GDP Per Capita</b>	-10.6030	0.0000			<i>I</i> (0)
<b>Trade Openness</b>	1.1695	0.8789	-12.2691	0.0000	<i>I</i> (1)
<b>Employment</b>	0.7750	0.7808	-6.7747	0.0000	<i>I</i> (1)
<b>Education</b>	1.4679	0.0000			<i>I</i> (0)
<b>Natural Resource Rent</b>	-2.6232	0.0044			<i>I</i> (0)
<b>Log of Land Area</b>	1.0118	0.8442	-7.6732	0.0000	<i>I</i> (1)

Source: Research finding.

## 8. Regression Result

The regression results are reported in Tables 3 to 7, while Table 3 presents results from the full sample, and results for Central, East, South, and West African countries are reported in Tables 4, 5, 6, and 7 respectively. Both the short-run and the long-run coefficients as well as the Hausman test results are reported in each of the tables.

In the SSA sample, none of the political institutional variables is statistically significant in the short run. This finding reaffirms the fact that institutional reforms do not have an instantaneous effect. There is always a lag period to see the effect of institutional reform particularly political institutional reform (see Kilishi 2017). However, in the long run, the four political institutional variables namely level of democratization, rule of law, political stability, and government effectiveness have significant positive influence on economic institutions. Relatively, rule of law has the biggest influence, followed by government effectiveness, political stability, and quality of democracy respectively in that order. A one-point increase in rule of law would on the average increase quality of economic institutions by 11.5 points. Hence, Improvement in rule of law by ensuring that all citizens, government officials, public institutions and private entities act according to the laws of the land will bring huge success in term of strengthening the quality of economic institutions. This could explain why countries with better administration of rule of law such as Mauritius, Botswana, South Africa, Namibia and Cabo Verde have higher quality economic institutions. On the other hand, countries such as Zimbabwe, Angola, Congo Democratic, Congo Republic and Guinea Bissau have lower quality economic institutions because there is weak compliance and

adherence to the rule of law in these countries. In the countries with poor administration of rule of law, the economic agents would have low confidence in the rules of the society and seldom abide by them, particularly the quality of contract enforcement, property rights, the police and the courts. Consequently, crime and violence are likely to be high in these countries and the security of life and property cannot be ensured. Therefore, to improve the quality of economic institutions in SSA generally, significance effort must be made to ensure adherence to rule of law.

A one-point increase in government effectiveness will improve quality of economic institutions by 5.034 on the average in SSA. Thus, to improve quality of economic institutions, it is imperative to improve government effectiveness, which includes improvement in the quality of public services delivery, the quality of formulation and implementation of policies. Therefore, there is need for reforms that will ensure commitment and credibility of government. Similarly, improvement in political stability and level of democratization by one-point would bring about 0.639 and 0.211 increase in quality of economic institutions on the average in SSA. In a lesser requirement, to improve quality of economic institutions there is need to improve stability of politics so as to curtail politically motivated violence and all other forms of violence and crimes, including terrorism, in order to halt unconstitutional means of government takeover. Similarly, improvement in the selection process of executive and more constraints on the exercise of executive power would assist in improving the quality of economic institutions in the continent of Africa.

The short run outcomes across the four sub-regions are not different from the outcome in the full sample. Meaning that none of the political institutional variables is statistically significant across all the four sub-regions in the short run. In the long run, there are varying outcomes across the sub-regions. In Central Africa, only rule of law and government effectiveness are significant in the long run, while polity II and political stability are not statistically significant. The two significant variables have positive effect on economic institutions. Meaning that improvement in rule of law and effectiveness of government would significantly lead to better economic institutions in Central Africa. On the average one-point increase in the quality of rule of law in Central Africa would yield to improvement in the quality of economic institutions by 11.45 points, while improvement in government effectiveness by one-point would raise quality of economic

institutions by 9.343 points. In the case of East Africa sample, three out of the four political institutional variables are statistically significant, with rule of law having the highest impact, followed by government effectiveness, and political stability in that order respectively. A point rise in rule of law would on the average increase quality of economic institutions by 12.67 in East Africa. Equally, one-point increase in government effectiveness and political stability would result to improvement in quality of economic institutions by 3.32 and 1.651 respectively. Surprisingly, none of the indicators of political institutions is statistically significant both in the short-run and long-run in the case of Southern African sample. Finally, in the case of West Africa, political stability is not statistically significant, while rule of law, level of democratization and government effectiveness are significant. However, government effectiveness is significant at 10 % with a negative sign which is contrary to expectation. A point increase in the level of adherence to rule of law would stimulate improvement in quality of economic institutions by about 27.79 points in West Africa on the average. While one-point rise in the level of democratization would improve quality of economic institution in the West Africa Sub-region by about 6.283 points. Hence, only improvement in rule of law and level of democratization would lead to better economic institutions in West Africa. It is pertinent to emphasize here that the coefficient of rule of law in West Africa is larger than the coefficients of the remaining indicators of political institutions.

**Table 3.** Sub-Sahara Africa (Full Sample)

	(1)	(2)	(3)	(4)
<b>Variables</b>	<b>Polity II</b>	<b>Rule of Law</b>	<b>Political Stability</b>	<b>Government Efficiency</b>
<b>Short-run</b>				
<b>ECT</b>	-0.285*** (0.046)	-0.253*** (0.04)	-0.289*** (0.0397)	-0.235*** (0.0358)
<b>D.GDPPC</b>	-0.0107 (0.0236)	-0.0354 (0.0227)	-0.0124 (0.0237)	-0.0159 (0.0233)
<b>D.Emp</b>	0.0801 (0.322)	0.102 (0.293)	0.207 (0.267)	0.334 (0.369)
<b>D.Educ</b>	22.35 (18.15)	24.19 (17.61)	18.68 (16.45)	25.59 (19.88)
<b>D.NatRes</b>	0.0262 (0.0551)	-0.251 (0.212)	-0.379 (0.336)	0.462 (0.409)

<b>D.top</b>	1.781 (2.481)	2.291 (2.264)	0.855 (3.034)	3.796 (2.588)
<b>D.lland</b>	-261.7 (301.1)	-160.6 (214.8)	-356.7 (361.9)	-108.1 (159.0)
<b>D.PolityII</b>	-0.194 (0.141)			
<b>D.Ruleoflaw</b>		-0.884 (1.002)		
<b>D.PolStab</b>			-0.0963 (0.433)	
<b>D.Goveff</b>				0.175 (0.795)
<b>Constant</b>	396.3*** (64.12)	614.9*** (98.20)	-1,390*** (198.2)	1,662*** (262.2)
<b>Long-run</b>				
<b>GDPPC</b>	-0.0396 (0.0603)	0.123** (0.0515)	-0.0244 (0.0314)	-0.224*** (0.0552)
<b>Emp</b>	-0.0620 (0.0800)	-0.414*** (0.0666)	-0.275*** (0.0697)	0.683*** (0.115)
<b>Educ</b>	-32.63*** (3.749)	-30.47*** (2.964)	-23.89*** (3.617)	18.16*** (3.791)
<b>NatRes</b>	-0.135*** (0.0181)	0.109*** (0.0383)	0.0840** (0.0376)	-0.193*** (0.0512)
<b>Top</b>	0.306 (0.681)	-3.825*** (1.473)	0.311 (0.953)	-1.752*** (0.296)
<b>lland</b>	-104.2*** (18.48)	-183.9* (104.5)	389.9* (199.6)	-572.6 (740.3)
<b>PolityII</b>	0.211*** (0.0637)			
<b>Ruleoflaw</b>		11.50*** (0.924)		
<b>PolStab</b>			0.639*** (0.194)	
<b>Goveff</b>				5.034*** (0.881)
<b>Hausman test</b>	0.9970	1.0000	1.0000	1.0000
<b>Observations</b>	946	946	946	946

**Source:** Research finding.

**Note:** Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 4.** Central African Countries

<b>Variables</b>	<b>Polity II</b>	<b>Rule of Law</b>	<b>Political Stability</b>	<b>Government Effectiveness</b>
<b>Short-run</b>				
<b>ECT</b>	-0.222*** (0.0532)	-0.249*** (0.0546)	-0.216*** (0.0553)	-0.229*** (0.0518)
<b>D.gdppc</b>	-0.00185 (0.0153)	-0.000481 (0.0154)	-0.00376 (0.0153)	0.00432 (0.0155)
<b>D.emp</b>	0.627 (0.408)	0.605 (0.399)	0.544 (0.403)	0.561 (0.398)
<b>D.educ</b>	20.22 (35.00)	11.25 (35.32)	20.34 (35.52)	21.87 (34.80)
<b>D.natres</b>	0.0140 (0.0269)	0.00750 (0.0270)	0.0169 (0.0270)	0.00325 (0.0273)
<b>D.top</b>	-4.544* (2.509)	-4.086 (2.515)	-4.940** (2.514)	-4.492* (2.513)
<b>D.polityii</b>	-0.225 (0.179)			
<b>D.ruleoflaw</b>		-2.715 (1.908)		
<b>D.polstab</b>			-0.836 (0.919)	
<b>D.goveff</b>				-3.861* (2.018)
<b>Constant</b>	23.72*** (8.419)	26.58*** (8.566)	21.14** (8.211)	22.57*** (8.125)
<b>Long-run</b>				
<b>Gdppc</b>	0.0174 (0.0869)	-0.00344 (0.0777)	0.0342 (0.0905)	-0.0515 (0.0895)
<b>Emp</b>	-0.911* (0.502)	-0.735* (0.423)	-0.845* (0.502)	-0.756* (0.457)
<b>Educ</b>	-15.85 (19.58)	-12.68 (17.18)	-13.81 (20.15)	3.763 (20.06)
<b>Natres</b>	-0.00688 (0.107)	0.0489 (0.0973)	-0.0368 (0.113)	0.0643 (0.111)
<b>Top</b>	7.035 (7.616)	6.576 (6.765)	10.01 (8.099)	5.730 (7.422)

<b>Polityii</b>	0.646			
	(0.448)			
<b>ruleoflaw</b>	11.45**			
	(5.200)			
<b>Polstab</b>			-1.263	
			(3.268)	
<b>Goveff</b>				9.343*
				(5.415)
<b>Hausman Test</b>	0.0096	0.0000	0.0000	0.0011

Source: Research finding.

Note: Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 5.** East African Countries

Variables	Polity II	Rule of Law	Political Stability	Government Effectiveness
	<b>Short-run</b>			
<b>ECT</b>	-0.409***	-0.190***	-0.478***	-0.362***
	(0.112)	(0.0328)	(0.114)	(0.0898)
<b>D.gdppc</b>	0.0901*	0.0347	0.0631	0.0618
	(0.0520)	(0.0316)	(0.0462)	(0.0548)
<b>D.emp</b>	0.679	0.178	0.832	1.295
	(0.698)	(0.236)	(0.669)	(0.840)
<b>D.educ</b>	42.16	-3.661	43.50	7.518
	(35.63)	(14.66)	(27.43)	(24.69)
<b>D.natres</b>	0.0945	0.0159	-1.342	0.555
	(0.152)	(0.0438)	(1.313)	(0.636)
<b>D.top</b>	1.915	-0.00355	-1.888	-0.338
	(2.822)	(1.568)	(3.998)	(3.237)
<b>D.polityii</b>	-0.295**			
	(0.134)			
<b>D.ruleoflaw</b>		-0.740		
		(1.364)		
<b>D.polstab</b>			0.234	
			(0.712)	
<b>D.goveff</b>				1.279
				(0.894)
<b>Constant</b>	-6.078***	0.345	17.75***	-11.51***
	(1.866)	(6.289)	(4.254)	(3.158)

<b>Long-run</b>				
<b>Gdppc</b>	-0.308***	-0.182	-0.106**	-0.280***
	(0.0765)	(0.204)	(0.0528)	(0.0663)
<b>Emp</b>	0.751***	0.687	0.200*	0.994***
	(0.175)	(0.448)	(0.103)	(0.160)
<b>Educ</b>	36.68***	39.39***	12.11***	40.19***
	(3.959)	(12.50)	(4.579)	(4.135)
<b>Natres</b>	-0.0642	0.0509	0.0220	-0.0655
	(0.0419)	(0.191)	(0.0347)	(0.0425)
<b>Top</b>	-3.081***	-7.260**	-1.728***	-3.099***
	(0.316)	(3.088)	(0.515)	(0.331)
<b>Polityii</b>	0.110			
	(0.126)			
<b>ruleoflaw</b>		12.67***		
		(3.032)		
<b>Polstab</b>			1.651***	
			(0.244)	
<b>Goveff</b>				3.320***
				(1.075)
<b>Hausman Test</b>	0.3404	0.0107	0.0704	0.0927
<b>Observations</b>	308	.	308	308

Source: Research finding.

Note: Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table 6.** Southern African Countries

Variables	Polity II	Rule of Law	Political Stability	Government Effectiveness
<b>Short-run</b>				
<b>ECT</b>	-0.193***	-0.204***	-0.198***	-0.194***
	(0.0322)	(0.0325)	(0.0322)	(0.0321)
<b>D.gdppc</b>	-0.0212	-0.0143	-0.0193	-0.0214
	(0.0232)	(0.0234)	(0.0232)	(0.0232)
<b>D.emp</b>	-0.0752	-0.130	-0.102	-0.0964
	(0.280)	(0.281)	(0.281)	(0.282)
<b>D.educ</b>	-0.282	0.193	-0.0243	0.272
	(14.02)	(14.05)	(14.04)	(14.06)
<b>D.natres</b>	0.0188	0.0170	0.0225	0.0216
	(0.0267)	(0.0267)	(0.0268)	(0.0272)
<b>D.top</b>	-0.269	-0.150	-0.193	-0.238

	(1.253)	(1.250)	(1.255)	(1.255)
<b>D.polity ii</b>	-0.0560			
	(0.0637)			
<b>D.rule of law</b>		-0.872		
		(0.947)		
<b>D.political stab</b>			-0.149	
			(0.467)	
<b>D.goveff</b>				0.599
				(0.872)
<b>Constant</b>	8.548**	7.575*	8.366*	8.175*
	(4.360)	(4.384)	(4.379)	(4.365)
<b>Long-run</b>				
<b>Gdppc</b>	-0.0294	-0.103	-0.0619	-0.0441
	(0.167)	(0.160)	(0.162)	(0.165)
<b>Emp</b>	0.122	0.258	0.154	0.159
	(0.318)	(0.303)	(0.306)	(0.310)
<b>Educ</b>	5.176	8.237	3.511	1.182
	(14.62)	(13.30)	(13.43)	(14.28)
<b>Natres</b>	-0.206*	-0.162	-0.201*	-0.210*
	(0.119)	(0.114)	(0.116)	(0.126)
<b>Top</b>	6.451	5.127	6.029	6.559
	(4.502)	(4.269)	(4.381)	(4.633)
<b>Polityii</b>	-0.165			
	(0.285)			
<b>Ruleoflaw</b>		3.393		
		(2.538)		
<b>Polstab</b>			-0.784	
			(1.266)	
<b>Goveff</b>				-1.002
				(3.044)
<b>Hausman Test</b>	0.0000	0.0195	0.0026	0.0530

**Source:** Research finding.

**Note:** Standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 7. West African Countries

Variables	Polity II	Rule of Law	Political Stability	Government Effectiveness
<b>Short-Run</b>				
<b>Ect</b>	-0.221*** (0.0645)	-0.177*** (0.0591)	-0.187 (0.154)	-0.0573 (0.0879)
<b>D.Gdppc</b>	-0.127* (0.0727)	-0.111 (0.0726)	-0.0839 (0.0634)	-0.180*** (0.0635)
<b>D.Emp</b>	0.142 (0.221)	0.0124 (0.223)	0.297 (0.263)	0.0753 (0.186)
<b>D.Educ</b>	11.98 (23.52)	7.735 (23.32)	-10.87 (22.55)	5.205 (35.50)
<b>D.Natres</b>	-0.0510 (0.0459)	-0.0234 (0.0446)	0.0617 (0.171)	0.0732 (0.201)
<b>D.Top</b>	1.694 (2.526)	-2.808 (2.110)	0.367 (2.790)	1.616 (1.910)
<b>D.Polityii</b>	-0.688 (0.499)			
<b>D.Ruleoflaw</b>		0.401 (2.775)		
<b>D.Polstab</b>			0.899 (1.131)	
<b>D.Goveff</b>				-1.322 (1.222)
<b>Constant</b>	6.473* (3.463)	7.854** (3.590)	2.403 (1.929)	-10.23 (12.28)
<b>Long-run</b>				
<b>Gdppc</b>	0.278 (0.468)	0.387 (0.589)	-0.00433 (0.117)	0.587 (0.578)
<b>Emp</b>	-0.116 (0.531)	0.214 (0.615)	-0.604*** (0.201)	1.030 (0.798)
<b>Educ</b>	49.16 (33.78)	-14.72 (40.20)	133.5*** (20.26)	158.0* (90.08)
<b>Natres</b>	0.309 (0.215)	0.186 (0.248)	0.0151 (0.141)	0.264 (0.175)
<b>Top</b>	-15.14 (9.250)	14.03* (7.574)	5.486** (2.769)	3.907 (5.475)
<b>Polityii</b>	6.283*** (1.954)			

<b>Ruleoflaw</b>	27.79***			
	(10.66)			
<b>Polstab</b>	0.418			
	(1.555)			
<b>Goveff</b>	-37.63*			
	(22.04)			
<b>Hausman Test</b>	0.0000	0.0004	0.0748	0.9090

**Source:** Research finding.

**Note:** Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## 9. Conclusion and Policy Implication

This paper empirically examined the short-run and long-run impact of four different categories of political institutions on the quality of economic institutions in SSA as a whole and in the four sub-regions (Central, East, South, and West Africa respectively) in SSA. Data is collected across 43 SSA countries comprising 8, 10, 10, and 15 countries from Central, East, South, and West Africa respectively. Dynamic autoregressive approach for non-stationary panel data is used for the analysis of data. Im-Pesaran-Smith panel unit root test technique is used to verify the stationary properties of the variables and the results show the combination of I (1) and I (0) variables. Hausman specification test is used to choose among three alternative estimation methods viz DFE, MG, and PMG.

The findings show that political institutions do not have short-run impact on economic institutions in SSA as a whole and across the four sub-regions. However, political institutions do have long-run influence on the quality of economic institutions, with rule of law exerting the largest impact, followed by government effectiveness, political stability, and quality of democracy in that order. The findings equally reveal that the impact of political institutions on economic institutions is not similar across the four sub-regions in SSA. None of the indicators of political institutions has significant impact in Southern African region, while rule of law and government effectiveness have positive influence on economic institutions in Central Africa. In East Africa, improvement in rule of law, political stability, and government effectiveness have significant positive effect on quality of economic institutions. Finally, in West Africa, quality of democracy and rule of law are the political institutional variables that have positive influence on the quality of economic institutions.

However, the result varies across the sub-regions, the effect of rule of law is consistent. Therefore, it is recommended that policymakers across all the countries in SSA should make effort to strengthen the principles of rule of law. This will involve making justice broadly accessible, affordable, and equitable. This will require reforming the judicial system to ensure quick, fair, effective, efficient, and impartial delivery of justice to all. Then ensure compliance and adherence to the law by both the ruled and the rulers. Conscious and decisive efforts should thus be made to ensure the existence of strong, effective and efficient political institutions in Sub-Saharan African nations. Precisely, reforms that will guarantee adherence to rule of law and enshrine effective government, stable politics and high-quality democratic processes should be made. The reforms should target increasing the rate at which people abide by the laws of the land and the level of confidence people have in the law. The reforms should also improve the credibility of the police and the court system as well as the protection of property rights for majority of the people in the society.

It is equally recommended that; the level of citizen participation in the process of selecting and monitoring government should be strengthen; minimize violence, terrorism, including political related violence and establish strong government that cannot be overthrown by unconstitutional means; reinforce the quality of public service and credibility of government; enhance the capacity to formulate and implement sound policies to promote private sector development; and augment quality of contract enforcement, protection of property rights and supremacy of the law.

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## Unemployment-GDP Growth Nexus and Labor Market Regulations: Evidence from Oil-Producing Countries

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### Abstract

This paper examines the effect of labor market regulations (LMR) on the unemployment rate for 17 oil-producing countries from 2000 to 2019. The panel corrected standard errors (PCSE), and the panel autoregressive distributed lag (ARDL) estimators are employed in this regard. The negative effect of output growth on the unemployment rate was confirmed. This study shows that a more flexible or less protective labor market in oil-producing countries is generally associated with higher unemployment rates. This result was confirmed in the static PCSE estimation. However, both results indicated that increased GDP growth in more flexible labor regulations is associated with higher unemployment rates. These findings suggest that there is a need for more empirical evidence according to the hypothesis that higher labor market flexibility leads to decreases in the unemployment rate. Therefore, the implementation of labor market regulations, whether more flexible or more rigid regulations are needed, should be under consideration of the overall economic conditions.

**Keywords:** Labor Market Regulation, Oil Countries, Output Growth, PCSE, Unemployment.

**JEL Classification** C29, J40, J64.

### 1. Introduction

In some oil-rich countries, natural resource discovery is a curse rather than a source of sustainable socio-economic advantages. According to a study by Adams et al. (2019), corruption permeating oil-rich developing countries impedes transparency and accountability, resulting in a resource curse. The mix of weak institutions and resource abundance causes the resource curse and harms the country's economy (Khanna et al., 2006). Besides, labor market effects on output growth are an issue of ongoing academic and political concern. While economic growth was supposed to be the key to increasing labor demand and reducing unemployment, empirical evidence indicates a considerable association between LMR and growth across countries. Lee (2000) indicated that relatively high rigidities featuring European labor markets weaken the relationship between output growth and unemployment. Specifically, strict or costly hiring and firing procedures represent the main

component of labor regulations associated with the high rate of unemployment, low employment levels, and a segregated labor market with some excluded groups, such as women and youth (Heckman and Pagés-serra, 2000).

This is an additional issue that needs to be analysed in oil countries. Oil-rich countries have both a high and low unemployment rate, and there has been a widespread debate that the main reason for these diverging experiences is the differences in LMR. The labor regulations are already under pressure with the persistent unemployment rate and are expected to be further stressed in the future (Gwartney et al., 2019). In oil-producing countries, oil contributes highly to the total GDP. Hence, for this increase in GDP to be an effective factor in reducing the unemployment rate, proper labor regulations are needed. Such a high level of unemployment in oil countries, apart from the impact of output fluctuations, is also driven by labor institutions and shocks.

In oil-producing countries particularly, there is a considerable variation in the LMR index.

Table 1 shows that most countries score above the average value of the LMR index. As shown, Nigeria and Brunei Darussalam come on top of the most flexible labor markets (LMR score above 8.5). On the other hand, Table 1 shows that only Iran and Venezuela have a slightly lower score than 5, representing the most rigid labor regulations among oil-producing countries.

**Table 1.** The Evolution of the LMR Index in Oil-Producing Countries

Country	2000	2005	2010	2015	2019
Algeria	4.83	5.16	4.99	5.28	5.65
Angola		3.99	4.01	4.56	5.34
Azerbaijan		6.51	6.69	6.40	6.54
Brunei Darussalam			9.01	8.69	8.79
Chad	6.22	5.95	5.99	5.36	5.37
Congo	6.01	6.29	6.48	5.66	5.66
Gabon		7.08	8.71	7.45	7.33
Iran	3.98	4.53	4.63	4.97	4.74
Kazakhstan		7.35	7.08	7.53	7.56
Kuwait	5.69	7.78	7.16	6.69	5.52
Nigeria	7.37	8.11	8.02	8.92	8.96
Oman	8.63	8.91	8.75	5.99	6.69
Qatar			7.75	6.51	6.03
Saudi Arabia			8.20	7.33	7.10
Syria	5.37	5.65	5.58	5.66	5.49
United Arab Emirates	7.55	7.48	8.50	6.97	6.72
Venezuela	3.35	3.06	3.61	2.10	2.24

**Source:** Research finding, based on LMR index dataset.

In general, the empirical evidence provided in recent studies analysing the effect of composite indicators of LMR on unemployment has controversial

outcomes and remains far from conclusive. For instance, a stream of the literature has confirmed that more rigid labor markets are associated with a higher level of unemployment (Bernal-Verdugo et al., 2012; Bertinelli et al., 2020; Feldmann, 2009). According to Dixon et al. (2017), the GDP growth rate could not help decrease unemployment due to other factors in that specific economy. In this respect, Economou and Psarianos (2016) indicated that the inverse impact of output growth on the unemployment rate is more persistent with less rigid labor regulations.

On the other hand, A wide range of analysts has indicated doubt and uncertainty about the effectiveness of the labor market flexibility in reducing the unemployment rates (Bassanini and Duval, 2006; Bayar and Maxim, 2020; Brancaccio et al., 2018; Ferreiro and Gomez, 2020; Liotti, 2022). Accordingly, the flexibility of the labor market can positively influence unemployment rates. In addition to its direct impacts, labor market flexibility indirectly inhibits employment and economic growth through many channels. For example, Liotti (2022) supports this argument with the Keynesian demand theory. That is, the effectiveness of labor market flexibility in reducing the unemployment rate depends on the economic expectation of firms. Also, Ferreiro and Gomez (2020) argue that the effect of labor market flexibility on unemployment highly depends on the sample of countries and years analysed. Therefore, a better understanding of whole economic conditions is necessary to establish the labor market policy to mitigate the negative effect of oil dependence on economic growth and employment outcomes in oil-rich countries.

Additionally, the effect of LMR on unemployment may vary according to the relative number of workers in a country, whether skilled or unskilled. The labor movement into the expanding sector depends on labor skills (Gupta and Dutta, 2010). Raising the minimum wage causes the employment of low-skill workers to decrease and the unemployment rate to increase (Chu et al., 2020). Based on those mentioned above, there is no consensus about the impacts of LMR on unemployment. In this concern, this work highlights at least two important aspects: the effectiveness of labor market flexibility in reducing the unemployment rate depends on the economic expectations of firms, and the effect of labor market flexibility on unemployment reduction highly depends on the sample of countries and years analysed. Consequently, this issue deserves further empirical analysis.

This study expands the literature by examining how the impact of output growth on the unemployment rate varies depending on oil-producing countries' labor regulations. Based on studies by Furceri (2012) and Selwaness and Zaki (2019), labor market rigidity has a strong impact on unemployment. However, the interaction term between the output growth and LMR was not included in these studies. Therefore, we make a novel contribution to the analysis of unemployment

and output growth by integrating labor regulations and output growth to explain the impact of these regulations on the unemployment rate.

Due to the evidence that labor-market efficiency improvements are likely to require reforms in more than one labor market field (Bassanini and Duval, 2009; Furceri, 2012), this paper focuses on the composite indicators of the LMR index. The composite indicators will provide better insight into the policy impact. The structure of labor market institutions is sometimes too complicated to be captured in a single or two indicators. Therefore, we focus on the LMR index by the Economic Freedom of the World (EFW), which accounts for a large, broad variety of factors that are also likely to impact labor market performance (Gwartney et al., 2005).

Labor market institutions are not only complex but also very heterogeneous, i.e., different types of workers exist within different countries. LMR will have a diverse effect on labor outcomes depending on the country's relative abundance of skilled or unskilled workers. Gupta and Dutta (2010) assumed that skilled labor moves from one sector to another, while unskilled labor does not. As a novelty in our analysis, the labor is divided into skilled and unskilled labor. In this sense, we use the education index to assess labor skill levels (calculated using mean years of schooling and expected years of schooling).

Eventually, this paper integrates LMR and output growth to explore the impact of these regulations on the unemployment rate. This research provides the policymakers with an insight into labor market policies and the effect of these policies across oil-producing countries. This objective could assist policymakers in adopting appropriate policy measures to improve the quality of labor regulations.

The remainder of this study is organized as follows. Section 2 describes the relative studies in the field. Section 3 discusses the empirical methodology and the data applied in the current paper. Section 4 presents the estimation results. Finally, the main conclusions are provided in section 5.

## **2. Relative literature**

In general, LMR is developed to protect and improve workers' welfare. Labor institutions or laws are often cited in the literature as determining factors influencing the unemployment rate. Therefore, researchers and international organisations have been encouraged to develop various indicators of the institutional intensity of labor markets. For instance, the OECD (2006) introduced four types of labor market institutions: an index of employment protection legislation (EPL), unemployment insurance benefits, the ratio of expenditure on active labor market policies to GDP, and the total tax wedge on low wages. On the other hand, Gwartney et al. (2005) developed the Economic Freedom of the World index by using a composite measure based on five indicators: the impact of the

minimum wage, flexibility in hiring and firing, collective bargaining, unemployment benefits, and conscripts.

Numerous studies have used the indicators proposed by the OECD (2006). For example, Van Ours (2015) used three labor market institutions: unemployment benefits, unions and wage bargaining, and employment protection legislation (EPL). This study explores the implications of the Great Recession through an examination of labor market data from twenty OECD countries. As a result, young employees have been adversely affected by the Great Recession in terms of unemployment and employment. Labor market institutions do not seem to matter a lot. Bertinelli et al. (2020) consider three dimensions of LMR to investigate the impact of LMR on the response of the unemployment differential to relative labor productivity. The dimensions of LMR used are the replacement rate as a proxy for unemployment benefits, employment protection legislation (EPL), and worker bargaining power captured by the bargaining coverage. This study found that the unemployment differential is more responsive to the relative labor productivity where labor regulation is higher.

On the other hand, several studies relied on the LMR index by the Economic Freedom of the World index (EFW). Overall, the empirical research on LMR is divided into two groups. The first group has focused on single indicators of LMR, while the second group has focused on composite indicators of LMR. A study by Siregar (2020) focused on the single indicator of LMR using panel data from 2001 to 2015. This study discusses the effect of minimum wages on the unemployment rate and their impact on employment in Indonesia's formal and informal sectors. The GMM estimator was used, and the results indicated that an increase in the minimum wage lowers formal and informal sector employment. Similar results were obtained by Chu et al. (2020). This paper discussed the dynamic impacts of the minimum wage in a Schumpeterian model with an endogenous market structure. The findings confirmed that increasing the minimum wage lowers the employment of low-skill workers and raises the unemployment rate.

On the contrary, Bonin et al. (2019) found no evidence that the minimum wage caused a decline in regular employment. By applying difference-in-differences approaches, this paper examines the impacts of the introduction of the minimum wage in Germany in 2015 on regional employment and unemployment. The results indicated that there was no proof of higher levels of unemployment. Moreover, a study by Wahba and Assaad (2017) investigated the impacts of labor regulation changes on the incidence of formal employment in Egypt. They focused on the impact of implementing more flexible labor regulations in 2003 on the probability of non-contractual workers being granted a formal employment contract. This paper used a difference-in-difference estimator that measures the difference between pre-and post-law and confirmed that less rigid LMR increase formal employment.

Otherwise, few studies have focused on the composite indicators of LMR (J. D. Gwartney et al., 2005). For example, Feldmann (2009) investigated the impacts of LMR on unemployment using the FGLS method in 73 economies from 2000 to 2003. This research found that rigid regulation generally appears to increase unemployment. Tight hiring and firing rules and military conscription seem to have negative impacts. Female unemployment appears to be increasing because of more centralised collective bargaining. Furceri (2012) examines the static and dynamic relationship between unemployment and labor market developments in Algeria. The results confirmed that a rigid labor market and relatively low output-employment elasticities are the main factors that explain the high level of unemployment. Also Selwaness & Zaki (2019) used the composite indicators of LMR. This study investigated the interaction between export performance and LMR on employment level. Using a random-effects model on MENA countries, the results indicated that rigid labor markets decrease the positive impact of exports on employment. Thus, labor market rigidity may limit job creation that satisfies the increased labor demand in expanding sectors.

In short, the theoretical and empirical arguments favour deregulating the labor market remain controversial and inconclusive, and there is no consensus regarding the effectiveness of labor market flexibility. For instance, Bayar and Maxim (2020) investigated the effect of the labor market and business regulations on the unemployment rate in a sample of 11 EU countries from 2000 to 2016. This paper confirmed that while higher labor market flexibility reduces unemployment in Bulgaria, Poland, and Romania, it increases unemployment in Hungary, Latvia, Lithuania, and Slovenia. Also, the empirical studies by Ferreiro and Gomez (2020); Herrero et al. (2020); Liotti (2020; 2022) have confirmed the doubts about the effectiveness of labor market flexibility in reducing the unemployment rate. In this respect, Liotti (2022) investigates the effect of the LMR index on youth unemployment in 28 European countries from 2000 to 2018. This paper applied a static fixed Effect and the dynamic PMG models and found that the higher labor market flexibility reduces youth unemployment only for a specific group. The results of this study raise doubts about the validity of the neoclassical economic theory regarding the effectiveness of labor market flexibility in decreasing the unemployment rate.

## **2. Empirical Strategy**

To link the unemployment rate to labor regulations, we rely on a reduced-form unemployment equation that is consistent with a variety of theoretical models of labor market equilibrium, including wage-setting/price-setting (Nickell, 1998; Nickell and Layard, 1999) models, and later extended by Feldmann (2009);

Heckman and Pagés-serra (2000); Rovelli and Bruno (2007). Specifically, our econometric model is specified as follows:

$$UNEM_{it} = \alpha_i + \beta_1 GDP_{it} + \beta_2 LMR_{it} + \beta_3 GDP_{it} * LMR_{it} + \beta_4 LMR_{it} * D_{it} + \gamma' X_{it} + \varepsilon_{it} \quad (1)$$

The subscript “*i*” designates oil-producing countries chosen for the current research, and the subscript “*t*” denotes time. The dependent variable  $UNEM_{it}$  is the unemployment rate for a country *i* at a given time *t*,  $GDP_{it}$  represents the gross domestic product,  $LMR_{it}$  is the labor regulations index, while  $GDP_{it} * LMR_{it}$  is the interaction term that captures the impact of LMR on GDP growth and unemployment. The interaction term  $LMR_{it} * D_{it}$  represents the influence of labor regulations on unemployment based on the skilled of labor, where  $D_{it}$  represents dummy variables that take the value of 1 for countries whose cross-period average of skilled labor index exceeds the average value of the entire sample.  $X_{it}$  is the set of the control variables that consist of trade openness (proxied by the ratio of total exports and imports to GDP) and the size of government (measured as the ratio of government consumption to GDP), labor productivity growth, and the error term  $\varepsilon_{it}$ .

The labor market regulations might be guilty of having caused the high unemployment rate as well as the slow economic growth among oil-producing nations. In this respect, hiring regulations and minimum wage represent the first sub-component of the labor market regulation index which is linked to the unemployment rates. Many researchers are interested in the “minimum wage” levels that governments have appointed since the 1980s to investigate unemployment issues in markets with a high regulatory level. Besides, our analysis included labor productivity growth as a control variable since it was found to have an impact on unemployment reduction (Bertinelli et al., 2020). Our model above shows that the responsiveness of unemployment to GDP is contingent upon the regulations of the labor market. It thus allows us to evaluate whether the impact of GDP on unemployment varies between countries with different values of LMR.

This study uses two basic tests to select the appropriate model between the Pooled model (P-OLS), the fixed-effect (FE), and the random effect (RE). First, we use the LM test (Breusch and Pagan, 1980) to choose the appropriate approach between the P-OLS and the RE model. The presence of the country or individual-specific term ( $\lambda$ ) distinguishes the P-OLS model from the RE model. The rejection of the null hypothesis indicates RE is the appropriate model. Second, the Hausman (1978) test is used to differentiate the RE and FE models. Rejecting the null hypothesis implies that the FE is the suitable model.

Lastly, this study has provided an estimation with the panel corrected standard errors (PCSE) to assure an efficient estimation. Beck et al. (1995)

introduced that the PCSE is robust to cross-panel heteroskedastic, contemporaneously cross-sectionally correlated standard errors. In this respect, this research investigates the presence or absence of the cross-panel heteroscedastic and the serial correlation in the residuals to ensure estimation efficiency. With this concern, we apply the Modified Wald test (Greene, 2000) to examine the presence of group-wise heteroskedasticity and the Wooldridge (2010) test for serial correlation.

## 2.1 Robustness Analysis

For robust analysis, this study also estimates a dynamic model specification of Equation 1 to test whether LMR influences the change in unemployment over time. Several empirical studies assumed that the unemployment rate levels depended on their previous values and included the lagged unemployment rate in their models (Liotti, 2020; Sahnoun and Abdennadher, 2022; Sarkar, 2020). Therefore, to deal with the possible hysteresis of the unemployment rate, this paper investigates the impact of LMR on the unemployment rate in oil-producing countries by utilising the ARDL model. Thus, a dynamic panel model is formulated from Eq. 1 as follows:

$$\begin{aligned} \Delta UNEM_{it} = & \alpha_i + \beta_0 UNEM_{it-1} + \beta_1 GDP_{it} + \beta_2 LMR_{it} \\ & + \beta_3 GDP_{it} * LMR_{it} + \beta_4 LMR_{it} * D_{it} + \gamma' X_{it} \\ & + \mu_i + \varepsilon_{it} \end{aligned} \quad (2)$$

where  $\Delta$  is the change in the previous period,  $UNEM_{it-1}$  is the lagged level of unemployment, and  $\mu_i$  is the country-specific effect.

Furthermore, the dynamic panel specification of (2), which investigates the long-run and short-run relationships as suggested by Pesaran et al. (1999), can be written as:

$$\begin{aligned} \Delta UNEM_{it} = & \mu_i + \Phi_i [UNEM_{i,t-1} - \theta_i \chi_{it}] + \sum_{j=1}^{p-1} \Upsilon_{ij}^* \Delta UNEM_{i,t-j} \\ & + \sum_{j=0}^{q-1} \tilde{\alpha}_{ij}^* \Delta \chi_{i,t-j} + u_{it} \end{aligned} \quad (3)$$

where  $UNEM_{it}$  represents the dependent variable,  $\chi_{it}$  denotes a vector of regressors, and  $\Phi_i = - (1 - \sum_{j=1}^p \Upsilon_{ij})$ ,  $\beta_i = \sum_{j=0}^q \tilde{\alpha}_{ij}$ ,  $\Upsilon_{ij}^* = - \sum_{m=j+1}^p \Upsilon_{im}$ ,  $\tilde{\alpha}_{ij}^* = - \sum_{m=j+1}^q \tilde{\alpha}_{im}$ ,  $j = 1, 2, \dots, q-1$ . While the  $\theta_i = - \beta_i / \Phi_i$  which is defined as the long-run relationship and  $\tilde{\alpha}_{ij}^*$  is the short-run coefficient. The parameter  $\Phi_i$  measures the error-correcting speed of the adjustment term. If  $\Phi_i = 0$ , then there would be no evidence for a long-run relationship. The significantly negative of  $\Phi_i$  is expected to support the evidence of the cointegration between the variables.

In this setup, Pesaran and Smith (1995) suggested three alternative estimators to estimate the above model. The first estimator is the mean-group estimator (MG).

The MG estimator produces consistent estimates based on the average of the parameters in the long run and short run, and it can be estimated for every single country. The second estimator is the pooling mean-group estimator (PMG), which assumes that the intercept, short-run coefficients, and error variances are heterogeneous across the groups while the long-run coefficient is constrained to be homogenous. Thus, the PMG estimator involves both pooling and averaging and captures the long-run and short-run effects among the variables (Pesaran et al., 1999). As a result, Pesaran et al. (1999) suggested that if the long-run homogeneity restrictions are valid, the maximum likelihood based on the PMG approach would be more efficient than the MG counterpart. The dynamic fixed effect (DFE) is the third estimator. The DFE estimator works like the PMG, which constrains the coefficient of the cointegrating vector to be the same across groups. Also, the speed of adjustment and short-run coefficients are constrained to be equal in the DFE estimator.

Lastly, the dynamic heterogeneous panel ARDL (PMG, MG, DFE)-method is applicable to a panel where both cross-sectional observations and time series are large, which is consistent with this study. A panel unit root test was conducted for all variables even though Pesaran et al. (1999) indicated that this method is suitable and can be applied to stationary and non-stationary regressors. In this regard, two specification tests are employed to check the stationarity of the panel data. The panel unit root test introduced by Im et al. (2003), and Fisher-type Choi (2001) test.

Furthermore, the Hausman test is performed to choose the appropriate method among PMG, MG, and DFE. The Hausman test is applied to select either (PMG or MG) or (PMG or DFE). For the selection between PMG and MG, the acceptance of the null hypothesis indicates that the PMG estimator is more appropriate than MG. In contrast, rejecting the null hypothesis implies that the MG estimator is more efficient than PMG. For the selection between PMG and DFE, if the null hypothesis is accepted, this indicates that the PMG estimator is preferred over the DFE. On the other hand, rejecting the null hypothesis means that the DFE estimator is favourable over PMG.

## **2.2 Data**

The sample study of the present paper consists of an unbalanced panel of 17 oil-producing countries over the period 2000–2019. In this paper, oil countries where oil rents contribute 10 percent or higher of the total GDP are selected. Oil rents as a share of GDP with a threshold of 10 percent are used (Groce, 2020; Markowitz et al., 2020). To measure the degree of labor market flexibility, we use the composite indicator of the LMR index by the Economic Freedom of the World (EFW). The composite indicator is standardised on a zero-to-10 range, with the lower value of the indicator representing a more rigid labor market and the higher

value indicating a more flexible regulation. Prior to 2000, the main variable LMR index was released every fifth year; since then, it has been published yearly. However, the LMR data began later for a small sample of oil countries, resulting in our data being strongly unbalanced.

These data were sourced from statistics provided by the World Bank's World Development Indicators (WDI), Fraser Institute's Economic Freedom of the World (EFW) database, and the International Labor Organization (ILO). Table 2 shows the expected signs of coefficient estimates based on theoretical considerations and previous research.

**Table 2.** The Expected Sign of the Coefficients

Variable	Source	Expected sign
▪ Unemployment (UR)	▪ World Development Indicators (WDI)	
▪ Total output (GDP)	▪ World Development Indicators (WDI)	Negative
▪ Labor market regulations (LMR)	▪ World Economic Freedom (J. D. Gwartney et al. 2005)	Positive/ Negative
▪ Skilled labor (Dummy variable)	▪ UNESCO Institute for Statistics (2020)	Positive/ Negative
▪ Trade openness (TOP)	▪ World Development Indicators (WDI)	Negative
▪ Government size (GOVS)	▪ World Development Indicators (WDI)	Positive
▪ Labor productivity growth (LPG)	▪ International labor organisation database (ILO).	Positive/ negative
▪ The financial crisis (CR)	▪ Laeven and Valencia (2018), IMF	Positive

**Source:** Research finding.

### 3. Empirical Results

#### 3.1 The Main Results

Table 3 shows the summary statistics of the variables used. As shown in Table 3, the mean value of the LMR index accounts for 6.5, while the average unemployment rate was 7.5.

**Table 3.** A Summary of Statistics

Variable	Observation	Mean	Std. Dev	Minimum	Maximum
UNEM	259	7.518571	5.889658	.11	29.77
GDP	259	3.764479	6.406531	-26.34	34.47
LMR	259	6.554981	1.370538	2.86	8.81
Gove cons (% of GDP)	259	13.80233	5.721829	.9517466	30.00
Trade (% of GDP)	259	83.40839	31.7253	20.72252	176.74
LPG	259	.3701158	6.335777	-23.83	33.49

**Source:** Research finding.

The selection between a RE or FE is based on the Hausman test. As illustrated in Table 4, the FE model was recommended over the RE. However, the

result of the Modified Wald test has indicated the presence of group-wise heteroscedasticity as reported in Table 5. Thus, the PCSE estimation results are the basic results.

**Table 4.** The Selection of the Appropriate Model

	<b>P-(OLS) or RE</b>	<b>RE or FE</b>
Breusch-Pagan LM test	11.69 (0.0003)	
Hausman test		23.72 (0.000)

**Source:** Research finding.

The last column of Table 5 presents the PCSE estimation. The results confirmed the negative effect of GDP growth on the rate of unemployment in all specification models. As shown in the PCSE estimation results, a one percent increase in GDP growth reduces the unemployment rate by 0.14 percent. Regarding LMR, these results indicate that the effect of LMR is positive and statistically significant, suggesting that in oil-producing countries, more flexible or less protective labor markets are generally associated with higher unemployment rates.

LMR positively affects the unemployment rate, suggesting that a more flexible LMR means more economic growth is needed to reduce unemployment. Also, through the interaction term, LMR has dampened the effect of GDP growth on the unemployment rate. In other words, increased GDP growth in more flexible labor markets in oil countries is associated with higher unemployment. Therefore, there is evidence that labor market flexibility may dampen the effect of GDP growth on the change in unemployment. In this sense, this result seems to be in line with those of researchers who have been critical of the advantages of labor market flexibility in decreasing unemployment rates. For instance, Herrero et al. (2020); Langot and Yassin (2015); Liotti (2020, 2022) argued that more flexible hiring and firing regulations (less rigidity) lead to a higher rate of unemployment.

In oil-producing countries, this finding might be explained by the increased oil dependence, which involves the movement of capital and labor from other sectors to non-tradable ones. Thus, the cost of production in the traditional tradable sector will increase (Omojolaibi and Egwaikhide, 2014). Hence, greater labor market flexibility reduces employment protection, making it easier for firms to carry out individual and collective dismissals. This is in line with Liotti (2022), who explains this finding by the substitution effect, in which firms continuously hire and fire workers to reduce the cost of production. With this respect, O'Higgins and Moscariello (2017) argue that there is no incentive for firms to improve the skills of labor who remain locked in a perpetual and expanding precariousness trap.

A further potential explanation of this finding comes from the theoretical aspect. According to the “neoclassical labor market theory,” the higher flexibility of the labor market leads to hiring more workers and therefore lowers the hiring costs for firms (Blanchard and Summers, 1986). However, this condition works only with positive expectations of firms about the economy. Based on Keynesian effective demand theory, in an economic downturn, firms would have negative expectations about the economy, there would be an aggregate demand gap, and their hiring costs would increase. Thus, implementing higher labor flexibility to reduce unemployment will fail to achieve this goal.

Moreover, we include a dummy variable to explore whether the LMR produces different effects on the unemployment rate based on the country’s skilled labor. The dummy takes the value of 1 for countries whose cross-period average of skilled labor index exceeds the average value of the entire sample. As shown in the result, the coefficient of the dummy variable takes a negative sign, indicating that more flexible labor regulations lead to a decline in the unemployment rate for countries with skilled labor. In this context, Gupta and Dutta (2010) assumed that skilled labor moves easily from one sector to another. This is in line with the findings of this study that more labor flexibility may lead to unemployment reduction if the country is dominated by skilled labor. Overall, these results are in line with the argument by O’Higgins and Moscariello (2017) that is no incentive for firms to improve labor skills. Thus, more labor flexibility leads to a higher unemployment rate.

Regarding the other control variables, this paper found that labor productivity growth has a statistically positive influence on the unemployment rate. This result is consistent with Siregar (2020), who shows that productivity growth has a significant and positive effect on the unemployment rate. Besides, findings obtained by Chen and Semmler (2018); Ferraresi et al. (2019) have indicated that labor productivity increases the unemployment rate in the short run. On the other hand, the effect of trade openness and government consumption is not statistically significant. Finally, the introduction of the crisis dummy, as presented has a positive and statistically significant impact on unemployment. This indicates that in a crisis period, unemployment seems to be higher.

**Table 5.** The Main Results of the Effect of LMR On Unemployment

Variables	FE	RE	FGLS	PCSE
GDP	-0.192*** (0.0513)	-0.166*** (0.0501)	<b>-0.147***</b> <b>(0.0500)</b>	<b>-0.147***</b> <b>(0.0435)</b>
LMR	-0.0560 (0.164)	0.0728 (0.0687)	<b>0.105*</b> <b>(0.0556)</b>	<b>0.105***</b> <b>(0.0358)</b>
GDP*LMR	0.0129 (0.00804)	0.0124 (0.00791)	<b>0.0113</b> <b>(0.00789)</b>	<b>0.0113*</b> <b>(0.00642)</b>
LMR*D-Skilled	-0.0194 (0.223)	-0.0337 (0.0301)	<b>-0.0402*</b> <b>(0.0221)</b>	<b>-0.0402**</b> <b>(0.0159)</b>

Gove cons (% of GDP)	0.00124 (0.0251)	0.0142 (0.0147)	<b>0.0125</b> <b>(0.0122)</b>	<b>0.0125</b> <b>(0.00764)</b>
Trade (% of GDP)	-0.00602 (0.00507)	0.00143 (0.00256)	<b>0.00195</b> <b>(0.00199)</b>	<b>0.00195</b> <b>(0.00174)</b>
LPG	0.110*** (0.0230)	0.0788*** (0.0193)	<b>0.0655***</b> <b>(0.0186)</b>	<b>0.0655***</b> <b>(0.0140)</b>
CR	0.463 (0.314)	0.452 (0.312)	<b>0.472</b> <b>(0.314)</b>	<b>0.472*</b> <b>(0.243)</b>
Constant	1.135 (1.079)	-0.511 (0.517)	<b>-0.763*</b> <b>(0.420)</b>	<b>-0.763**</b> <b>(0.300)</b>
Observations	242	242	<b>242</b>	<b>242</b>
R-squared	0.172			<b>0.130</b>
Number of countries	17	17	<b>17</b>	<b>17</b>
Modified Wald test for GroupWise heteroskedasticity	14828.69 (0.0000)			
F-test	5.65(0.000)			
Wald test		37.67(0.000)	<b>36.14(0.000)</b>	<b>121.89(0.000)</b>

**Source:** Research finding.

**Note:** Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Furthermore, this analysis also considers the influence of the sub-components of the LMR index on the unemployment rate. In the previous analysis, only the average effect of LMR on unemployment was assessed, not considering the impact of sub-indicators on unemployment. According to Aleksynska and Cazes (2014); Liotti (2020), there is no empirical or theoretical justification for including the military conscription index; therefore, it was excluded from the estimation analysis. The definition of each sub-indicator is as follows<sup>1</sup>:

- Hiring regulations and minimum wage: This measure is based on the “World Bank’s Difficulty of Hiring Index” (lower ratings are assigned to countries with greater difficulty of hiring).
- Hiring and firing regulations: This sub-component is based on the “World Economic Forum’s Global Competitiveness Report” (this measure assigns a lower rating to state in which regulations impede the free hiring and firing of workers).
- Centralised collective wage bargaining: This sub-component is also based on the “WEF’s Global Competitiveness Report”, which gives ratings based on the centralisation of the bargaining process (this measure gives higher ratings if county wages are set by a more decentralised bargaining process).
- Hours’ regulations: This sub-indicator is utilised based on the “World Bank’s Doing Business” data (Employing Labor section); it includes the

<sup>1</sup>. The definition of each sub-component is adopted from Bernal-Verdugo et al. (2012) and Gwartney et al. (2020).

following elements: whether there are constraints on holiday work or night work; whether the length of the working days can be 5.5 days or more; whether there are restrictions on overtime work; and whether the average paid annual leave is 21 working days or longer. If there are no restrictions, countries tend to receive higher ratings.

- Mandated cost of work dismissal: This index is based on the “World Bank’s Doing Business report” (this measure rates country according to the cost of the requirements for advance notice, penalties due when dismissing a redundant worker, and severance payments).
- Conscription: This index is based on the military duration (this measure gives a lower rating to countries with longer conscription periods).

Table 6 shows the PCSE estimation results of the influence of each of the sub-indicators on the unemployment rate. The results confirmed that all LMR sub-indicators positively affect the unemployment rate except lower dismissal cost, which was found to affect unemployment negatively. Specifically, more flexible labor regulations lead to a higher unemployment rate. Also, through the interaction term, Table 6 shows that hiring regulations, minimum wages, and decentralised collective wage bargaining have dampened the effect of GDP growth on the unemployment rate. In other words, with the higher flexibility of labor regulation, more GDP growth is needed. This finding is consistent with Langot and Yassin (2015); OECD (2016), who indicate that easy firing and hiring regulations may increase unemployment. It is also consistent with Bassanini and Duval (2006), who confirmed that higher decentralised bargaining increases the unemployment rate.

**Table 6.** PCSE Estimation Results of the LMR Sub-Indicator

Variables	(1)	(2)	(3)	(4)	(5)	(6)
GDP	-0.124*** (0.0107)	-0.103*** (0.0125)	-0.226*** (0.0380)	-0.083*** (0.0183)	-0.034*** (0.0133)	-0.109*** (0.00564)
$B_i$	0.0500*** (0.00912)					
GDP * $B_i$	0.00609*** (0.00130)					
$B_{ii}$		0.0541*** (0.00918)				
GDP * $B_{ii}$		0.00432*** (0.00163)				
$B_{iii}$			0.131*** (0.0172)			
GDP * $B_{iii}$			0.0188*** (0.00474)			
$B_{iv}$				0.0338** (0.0153)		
GDP * $B_{iv}$				0.000344		

				(0.00213)		
$B_v$					-0.038***	
					(0.0124)	
$GDP * B_v$					-0.004***	
					(0.00124)	
LPG	0.079***	0.072***	0.086***	0.072***	0.068***	0.094***
	(0.00686)	(0.00660)	(0.0101)	(0.00735)	(0.0101)	(0.00512)
Constant	-0.234***	-0.120***	-0.699***	-0.0998	0.381***	-0.00558
	(0.0835)	(0.0323)	(0.120)	(0.120)	(0.0975)	(0.0196)
Observations	257	232	232	257	243	257
R-squared	0.135	0.095	0.151	0.090	0.091	0.127
Number of countries	19	18	18	19	18	19

**Source:** Research finding.

**Note:** *i*, hiring regulations and minimum wage; *ii*, Hiring and firing regulations; *iii*, Centralized collective wage bargaining; *iv*, Hours' regulations; *v*, Mandated cost of work dismissal. Standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

### 3.2 Robustness Estimation

To check the robustness of the earlier findings, we investigate the impact of LMR on the unemployment rate in oil-producing countries by utilizing the ARDL model. In this respect, this study performs the panel unit root tests introduced by Im et al. (2003) and Fisher-type Choi (2001) to check the stationarity of the variables. As shown in Table 7, GDP, trade (% of GDP), and LPG are stationary at level for both IPS and ADF tests. However, the results also indicated that all variables are stationary at the first differences for both criteria. Thus, the result confirmed that these variables are integrated in the order I (1) and I (0); hence the panel ARDL model can be employed.

**Table 7.** Unit Root Test

Variables	IM, Pesaran, and Shin (IPS)		Augmented Dickey- Fuller (ADF)	
	Level	First Difference	Level	First Difference
UNEM	-0.8086 (0.2094)	-7.8666 *** (0.0000)	-0.1182 (0.4529)	-6.0394 *** (0.0000)
GDP	-4.5725 *** (0.0000)	- 10.3372 *** (0.0000)	-4.4191 *** (0.0000)	-8.9225 *** (0.0000)
LMR	-0.0892 (0.4645)	-5.7901 *** (0.0000)	1.1586 (0.8767)	-4.0122 *** (0.0000)
Gove cons (% of GDP)	-0.1927 (0.4236)	-5.8836 *** (0.0000)	0.7776 (0.7816)	-2.7389 *** (0.0031)
Trade (% of GDP)	-1.4848* (0.0688)	-6.2634 *** (0.0000)	-2.3637 *** (0.0090)	-4.6036 *** (0.0000)

LPG	-4.9539*** (0.0000)	-9.8268 *** (0.0000)	-5.1052*** (0.0000)	-8.8823*** (0.0000)
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**Source:** Research finding.

**Note:** Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Before the analysis results, we corroborated the existence of cross-sectional dependence among oil countries. The null hypothesis of the weak cross-sectional dependence in a panel data model was tested using the Pesaran (2015) test. The results in Table 8 revealed that the null hypothesis of weak cross-sectional dependence is rejected. This indicates that cross-country observations are influenced by common considerations.

**Table 8.** Cross-sectional Dependence

Variables	CD test
UNEM	9.430*** (0.000)
GDP	4.202*** (0.0000)
LMR	16.775*** (0.0000)
Gove cons (% of GDP)	18.845*** (0.0000)
Trade (% of GDP)	11.405*** (0.0000)
LPG	1.984** (0.047)

**Source:** Research finding.

**Note:** Standard errors in parentheses; \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ ,  
\*  $p < 0.1$ .

Furthermore, we conduct the Hausman test to select the appropriate method. Firstly, to choose between PMG and MG, Table 9 shows that the null hypothesis is accepted; therefore, PMG is more appropriate than MG. Secondly, based on the Hausman test result between PMG and DFE, the null hypothesis is rejected, indicating that the DFE estimator is more efficient than the PMG. Thus, only the DFE estimator findings are presented due to its gain in efficiency and consistency compared to the PMG.

**Table 9.** The Selection of the Appropriate Model

	PMG or MG	PMG or DFE
Hausman test	0.75 (0.6871)	
Hausman test		123.59 (0.0000)

**Source:** Research finding.

Table 10 shows the results of the DFE estimators based on the panel ARDL (1, 2, 2, 2). The lag length selection was according to the Akaike Information Criteria (AIC) and Bayesian Information Criterion (BIC). The DFE estimator is similar to the PMG estimator, which evaluates the long-run effects of explanatory variables on the unemployment rate. In this regard, the error correction coefficients (ECT) findings show that estimated coefficients are negatively significant, providing evidence of the long-run cointegrating relationship.

Concerning the long-run effects, the findings in Table 10 are consistent with the static results and confirm the inverse impact of GDP growth on the unemployment rate in the long run. Regarding the effects of the LMR on the unemployment rate, the findings indicate a non-statistically significant impact in

all specifications models. However, through the interaction term, these findings are in line with the static results, which are found to be positively and statistically significant. In other words, an increase in GDP growth in more flexible labor markets in oil countries is associated with higher levels of unemployment. Additionally, these findings show that the dummy variable, which considers whether the flexibility of labor regulations produces a different impact on unemployment based on labor skills, remains negative but not statistically significant.

Among the control variables, the results of Table 10 show that labor productivity growth has a statistically positive impact on the unemployment rate. These findings are in line with the results obtained by the PCSE estimator. In contrast, the results do not indicate any significant effect of trade openness and government consumption on the unemployment rate. Lastly, introducing the crisis dummy variable was found to have a statistically significant effect on the unemployment rate. The positive sign indicates that the economic crisis led to an increase in the unemployment rate.

**Table 10.** The Results of the Dynamic Heterogeneous Panel Estimation

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP	-0.146**	-0.927***	-0.140*	-0.133*	-0.155**	-	-0.119*
	(0.0734)	(0.356)	(0.0736)	(0.0754)	(0.0762)	0.713***	(0.0718)
LMR	0.500	-0.115	0.878	1.321	0.582	1.153	0.436
	(0.718)	(0.750)	(1.242)	(0.882)	(0.733)	(0.933)	(0.707)
GDP*LMR		0.135**					
		(0.0586)					
LMR*D-skilled			-0.565				
			(1.531)				
Gove cons (% GDP)				0.280			
				(0.190)			
Trade (% GDP)					0.0180		
					(0.0347)		
LPG						0.634**	
						(0.253)	
CR							4.479*
							(2.355)
ECT	-	-0.151***	-	-	-	-	-
	0.152***	(0.0243)	0.154***	0.146***	0.153***	0.120***	0.154***
	(0.0247)	(0.0243)	(0.0252)	(0.0249)	(0.0249)	(0.0249)	(0.0246)
$\Delta$ GDP	0.0119*	0.0736***	0.0116*	0.00860	0.0126*	-0.0105	0.0113*
	(0.0064)	(0.0270)	(0.0065)	(0.0065)	(0.0066)	(0.0120)	(0.0064)
$\Delta$ LMR	-0.131	-0.0782	-0.207	-0.117	-0.125	-0.157*	-0.117
	(0.0977)	(0.0985)	(0.175)	(0.0995)	(0.0997)	(0.0937)	(0.0975)
$\Delta$ GDP*LMR		-0.0108**					
		(0.00458)					
$\Delta$ LMR*D-skilled			0.111				
			(0.212)				
$\Delta$ Gove cons(% of GDP)					-		

				0.0486**			
				(0.0233)			
ΔTrade (% of GDP)					0.00143		
					(0.00416)		
ΔLPG						0.0285**	
						(0.0129)	
ΔCR							-0.143
							(0.132)
Constant	0.598	1.129	0.599	-0.759	0.298	0.172	0.628
	(0.709)	(0.724)	(0.712)	(1.034)	(0.912)	(0.695)	(0.705)
Observations	225	225	225	225	225	225	225

**Source:** Research finding.

**Note:** Standard errors in parentheses; \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

#### 4. Conclusion

This study investigates the effects of output growth on unemployment rates according to labor market regulations in oil-producing countries. Our findings confirmed an inverse effect of output growth on the unemployment rate. Regarding our interest factor, labor market regulations (LMR), this study proved a positive impact of LMR on the unemployment rate. In other words, a more flexible or less protective labor market in oil-producing countries is associated with higher unemployment rates. The positive sign of the interaction term coefficient between output growth and the LMR index dampens the effect of output growth on the unemployment rate. More specifically, we found that increasing the flexibility of labor regulations leads to a decrease in the unemployment rate only in countries where skilled labor is dominated. Thus, our findings indicate doubt about the hypothesis that higher labor market flexibility results in unemployment reductions. This result is contrary to the neoclassical labor market theory in which the higher flexibility of the labor market leads firms to hire more workers and therefore lowers the hiring costs (Blanchard and Summers, 1986). Even though the findings mentioned above are antithetical to neoclassical labor market theory, this result is supported by the empirical work by Liotti (2022). The findings also support Omojolaibi and Egwaikhide (2014) argument that the rise of oil dependence involves the movement of capital and labor from other sectors to non-tradable ones. Thus, the cost of production in the traditional tradable sector will increase. In this respect, greater labor market flexibility, such as easy hiring and firing regulations, makes it easier for firms to carry out individual and collective dismissals. In all, the effect of labor market regulations on the unemployment rate is controversial. As a result of this analysis, there is a need for more empirical evidence according to the hypothesis that higher labor market flexibility results in a decrease in the unemployment rate.

These findings have important implications for labor market policy implementation in oil-producing countries. These findings conclude that LMR could be costly regarding undesirable distributional consequences and

employment losses. Policymakers in oil-producing countries should ensure fiscal incentives to encourage firms to hire young people with permanent contracts, preventing these workers from sliding into the insecure employment trap. Many oil countries need support to create and enhance better education. Therefore, governments should invest and spend more on education and training policies that allow young workers to access the labor market. In brief, in implementing LMR, whether more flexible or rigid regulations are needed, it is essential to consider the relevant economy's specific characteristics. For instance, the demographic groups, unemployment level, and the labor force's skill levels.

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## The Allocation of Groundwater Resources and Managing Conflict between Stakeholders: Evidence from Iran

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### Abstract

Scarce water resources often involve decision-makers with conflicting interests. Effective management requires balancing objectives and strategies of multiple stakeholders. The present study analyzes the potential compromise solutions between stakeholders, using a combination of game theory and a positive mathematical programming (PMP) model. The two key players are the government, which minimizes environmental impacts such as groundwater withdrawal, and local farmers, who maximize economic profit. We employ four conflict resolution methods to calculate the players' payoffs. The results show that creating a transactional relationship between the stakeholders reduces groundwater extraction by 36% and 37%, while the farmers' net income only drops by 8% and 9%, respectively, compared to the baseline scenario.

**Keywords:** Conflict Resolution, Game Theory, Groundwater Resources, Multi-Objective Optimization, Positive Mathematical Programming.

**JEL Classification:** C61, C72, Q25, Q34, Q56.

### 1. Introduction

Over the decades, the world has witnessed rapid population growth and excessive resource consumption, which has led to unsustainable natural resource management practices and poorly implemented policies. These factors contribute to water scarcity in several parts of the world, posing a significant threat to human survival and regional development (Darbandsari et al., 2020; Huang et al., 2021). At the same time, water allocation is becoming a source of conflict, intensifying competition among different sectors reliant on water resources which can often lead to disputes between stakeholders (Naderi, 2024). Disagreements and conflicts are prevalent among stakeholders or beneficiaries of common natural resources (Nazari et al., 2020). These conflicts arise from divergent perspectives on utilizing common

resources (Fang et al., 1993; Madani, 2010). For instance, rational interactions concerning a specific issue influence group members and cause conflict when no single member has control over it (Dillon, 1962; Fang et al., 1993). The present study analyzes the potential compromise solutions between groups of stakeholders, using a combination of game theory (GT) and positive mathematical programming (PMP).

Effective water resource management requires the involvement of multiple stakeholders with conflicting or competitive objectives and strategies (Fang et al., 2002; Zamani et al., 2019a). In the absence of market mechanisms and exclusive property rights that typically govern the exploitation of natural resources, conflicts arise among multiple stakeholders competing for water resources (Wei and Gnauck, 2007). Therefore, developing accurate plans to ensure a reliable water supply and maintain allocation priorities is crucial (Naghdi et al., 2021). Achieving a balance between surface and groundwater extraction and optimizing their use is essential for sustainable resource management. To prevent aquifer depletion, water shortages, and related issues, stakeholders must develop optimal allocation tools for water resource management. Among the various models used in water resource management, game theory is considered one of the most effective. Game theory addresses conflicts with multiple objectives by considering the benefits all stakeholders gain from resource exploitation and their interactions to maximize these benefits (Wang et al., 2003; Raquel et al., 2007; Madani and Hipel, 2011; Nazari et al. 2020). Game theory produces more accurate results than conventional optimization methods because it accounts for the behavior of involved parties. This aspect is often overlooked by conventional approaches when dealing with problems involving multiple decision-makers and criteria (Chhippi-Shrestha et al., 2019; Madani et al., 2015; Bočková et al., 2015; Lee, 2012).

Most studies on conflict resolution focus on its applications in various domains of water management, such as agricultural disputes (Raquel et al., 2007; Oftadeh et al., 2017), reservoir operation problems (Shirangi et al., 2008; Zanjani et al., 2018; Shapira et al., 2019), river-reservoir systems (Nandalal and Simonovic, 2003; Kittikhoun and Staubli, 2018; Zeng et al., 2019; Mason, 2020), and the conjunctive use of surface and groundwater (Bazargan-Lari et al., 2009; Parsapour-Moghaddam et al., 2015; Rezaei et al., 2017).

Fewer studies explore the management of water resources, leading to the proposal of various quantitative and qualitative methods for water resource allocation (Alizadeh et al., 2017; Madani and Dinar, 2012).

Our research is situated within this emerging body of literature, specifically examining the application of game theory in conflict resolution for water resource management (Li et al., 2023; Di et al., 2021; Naghdi et al., 2021; Darbandsari et al., 2020; Nazari et al., 2020; Chhippi-Shrestha et al., 2019; Zeng et al., 2019; Kicsiny and Varga, 2019; Madani, 2010; Wei et al., 2010; Raquel et al., 2007).

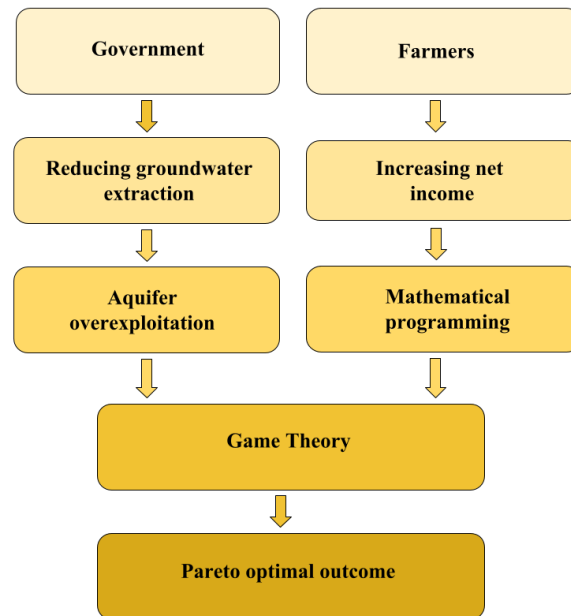
Some of few empirical studies in this line of literature, Chhippi-Shrestha et al. (2019) and Raquel et al. (2007) are the most relevant for our purposes. Chhippi-Shrestha et al. (2019) apply the GT approach to multi-criteria decision analysis for sustainable water reuse in Canada. They find that the weights of sustainability indicators and dimensions affect Pareto optimality and hence the final decision. Raquel et al. (2007) apply game theory to multi-objective conflict for a groundwater problem in Mexico. They find that groundwater extraction decreases when an optimal trade-off is found between conflicting economic and environmental objectives.

Our work extends these findings by integrating conflict resolution methods with a positive mathematical programming model to analyze the potential solutions among groups of stakeholders. Our results go beyond academic discussion to provide actionable insights for policymakers. Understanding how stakeholder groups respond to shared resources is crucial for informing effective decision-making and resource management strategies.

The remainder of the paper is organized as follows. Section 2 explains the structure of the framework, the case study, and the water management problem. Section 3 discusses the results. Finally, Section 4 summarizes the findings and provides conclusions.

## **2. Methodology**

Initially, we define the framework of the game by identifying players and their objectives, and then apply a game theory model to calculate each player's payoffs.



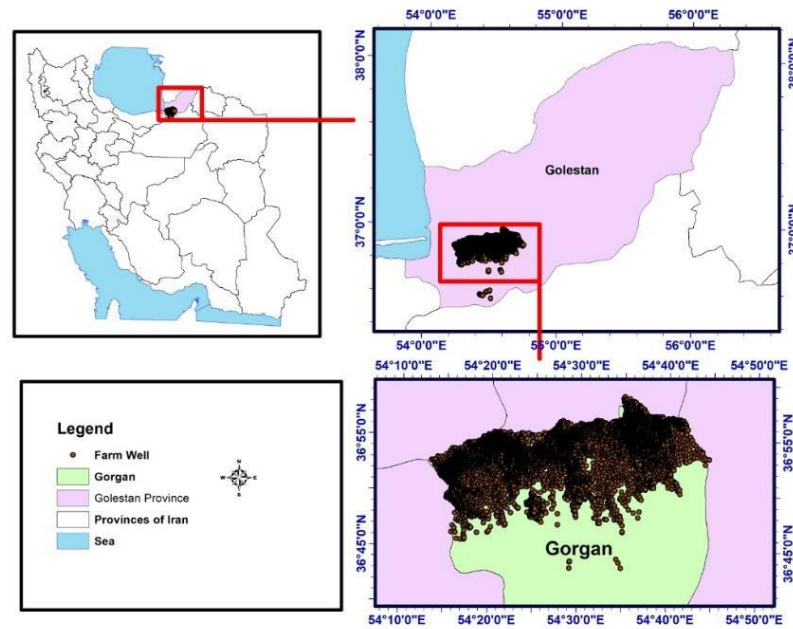
**Figure 1.** The Diagram of the Empirical Method

**Source:** Research finding.

### 2.1 Case Study and Water Management Problem

We evaluate the proposed method in Gorgan, the capital of Golestan Province in northern Iran. The city, which borders the Caspian Sea to the west, serves as a significant case study location. The region is an agricultural area heavily reliant on groundwater for crop irrigation. It encompasses approximately 19,945 wells, with an average extraction of 248 million cubic meters (MCM) per well annually (Iran Water Resources Management Company, 2021). Figure 2 illustrates the geographical location of the case study and its groundwater points.

Groundwater resources in the region are overdrawn, leading to a significant reduction in levels. Increased groundwater pumping has resulted in water-level declines of 4.93 meters during 2010-2020 (Iran Water Resources Management Company, 2021). Water resource management is a complex issue that requires consideration of multiple objectives.



**Figure 2.** Geographical Location of Gorgan and its Groundwater Points

**Source:** Research finding.

Given the competitive nature of groundwater resources and the absence of regional research focusing on economic and environmental objectives, this study applies a game theory conflict resolution to achieve these objectives. This study contributes to the existing body of literature by potentially being one of the first to apply PMP and GT optimization-based techniques to manage water resources in the Gorgan region. We utilize data on production costs and prices of agricultural products, alongside additional regional water management information<sup>1</sup>.

In modeling the problems outlined above, we consider ten possible groundwater extraction scenarios based on a ten-year historical report on groundwater (Table 1).

**Table 1.** Different Scenarios of Groundwater Extraction in Gorgan (MCM)

Scenarios	1	2	3	4	5	6	7	8	9	10
Groundwater extraction	160	179	195	214	228	264	296	328	358	370

**Source:** Iran Water Resources Management Company, 2021.

<sup>1</sup>. Production cost and price data are derived from 88 standard questionnaires administered by the Iranian Ministry of Agriculture. Water management data are obtained from the Regional Water Organization of Golestan Province and the Iran Water Resources Management Company.

To assess the economic and environmental impacts of groundwater extraction, we use a PMP-based methodology along with four conflict resolution methods: Non-symmetric Nash solution, non-symmetric Kalai-Smorodinsky, non-symmetric monotonic, and non-symmetric equal loss solutions to determine the optimal extraction level.

## 2.2 Game Framework

Players form a fundamental component of any game, including beneficiaries, stakeholders, and decision-makers involved in the process (Nazari et al., 2020). The set of players is denoted by  $N$ , and the strategic form of the game with  $n$  players is as follows:

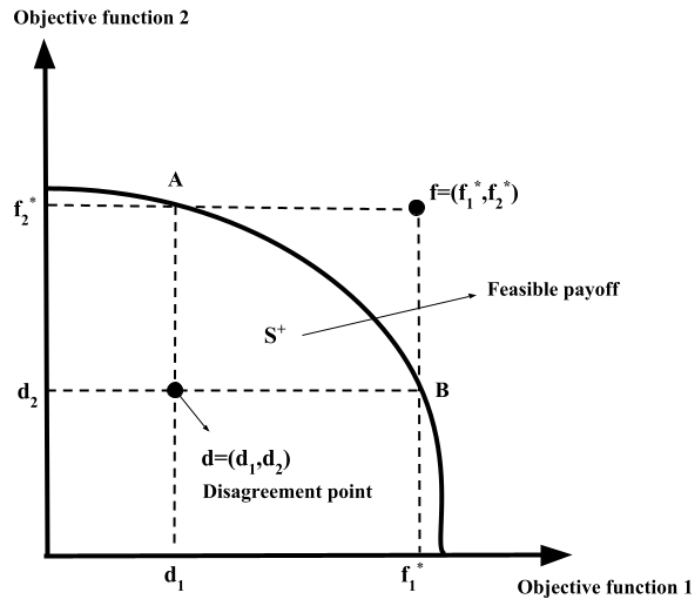
$$N = \{1, 2, \dots, n\} \quad (1)$$

The two key players are the government, which minimizes environmental impacts such as groundwater withdrawal, and local farmers, who maximize economic profit. The government represents the Ministry of Agriculture, while the farmers consist of individuals extracting water for farming activities. Hence,  $n = 2$ , and  $N = \text{total farmers} + \text{government}$ . Since the objectives have different value ranges, we transform them into normalized forms while retaining their characteristics. The procedure is as follows.

$$X_{new} = \frac{X - X_{min}}{X_{max} - X_{min}} \quad (2)$$

This normalization scales the data between 0 and 1, referred to as strategic or matrix form. Formally, the model represents the conflict as a pair  $(S, d)$ , where  $S = S_1 \times \dots \times S_n$  denotes the Cartesian product of the players' strategy sets (Nazari et al., 2020).  $S$  represents a finite subset of  $\mathbb{R}^2$  referring to feasible simultaneous sets of payoffs. The disagreement point  $d = (d_1, d_2)$  indicates the worst payoff for players 1 and 2 ( $d_1 = d_2 = 0$ ). This vector, known as the "nadir," provides a reasonable basis for both sides to reach an agreement.  $f_1$  and  $f_2$  denote the coordinate lines, and the Pareto frontier represents a strictly decreasing concave function  $g$  defined over the interval  $[d_1, f_1^*]$ , where  $g(f_1^*) = d_2$ . Figure 3 illustrates this concept. If vector  $d$  represents the status-quo payoff, the set  $S^+$  restricts the feasible payoff set  $S$  to the region DAB in Figure 3.

$$S_+ = \{(f_1, f_2) | f \in S, f \geq d\} \quad (3)$$



**Figure 3.** Pareto Frontier of the Two Stakeholders

**Source:** Research finding.

### 2.2.1 Conflict Resolution Methods

The Nash solution models bargaining interactions between two players who are uncertain about a feasible payoff. This method identifies a unique point on the Pareto frontier that maximizes the joint payoff, considering the disagreement point for both players, thus preventing an unbounded gain for competitors (Eq. 4). Harsanyi and Selten (1972), Kalai and Smorodinsky (1975), Chun (1988), and Anbarci (1993) have modified and expanded Nash's original approach.

$$\begin{aligned} & \text{Maximize } (f_1 - d_1)(f_2 - d_2) \\ & \text{Subject to } d_1 \leq f_1 \leq f_1^*, f_2 = g(f_1). \end{aligned} \quad (4)$$

The maximization problems outlined above constitute a two-dimensional optimization framework. At the points where  $f_1 = d_1$  and  $f_1 = f_1^*$ , the objective function equals zero. Incorporating the second constraint into the objective function yields the following formulation:

$$\begin{aligned} & \text{Maximize } (f_1 - d_1)(g(f_1) - d_2) \\ & \text{Subject to } d_1 \leq f_1 \leq f_1^* \end{aligned} \quad (5)$$

A simple one-dimensional algorithm solves this problem. Furthermore, the first-order condition facilitates the derivation of four conflict resolution methods.

#### 2.2.1.1 Method 1

The non-symmetric Nash solution reformulates Nash's original solution (Nash, 1950), and provides a unique solution to the problem (Harsanyi and Selten, 1972).

$$\text{Maximize } (f_1 - d_1)^{w_1}(f_2 - d_2)^{w_2} \quad (6)$$

In Equation (5), the vector  $w = (w_1, w_2)$  assigns unequal weights to both players, with the sum of the weights equal to 1 ( $w_1 + w_2 = 1$ ). These weights are based on the relative importance of each player's objective. The values for  $w_1$  and  $w_2$  can be adjusted as shown in Figure 4(a) to reflect the importance of each player's goal.

#### 2.2.1.2 Method 2

The Kalai-Smorodinsky (KS) solution offers an alternative to Nash's bargaining solution. We calculate it geometrically by drawing a straight line between the point of disagreement  $(d_1, d_2)$  and the ideal point  $(f_1^*, f_2^*)$  as shown in Figure 4(b). The KS solution occurs at the intersection of the linear segment and Pareto frontier (Kalai and Smorodinsky, 1975). Hence, we formulate the unique solution within the interval  $(d_1, f_1^*)$  as follows:

$$d_2 + \{(f_2^* - d_2)/(f_1^* - d_1)\}(f_1 - d_1) - g(f_1) = 0 \quad (7)$$

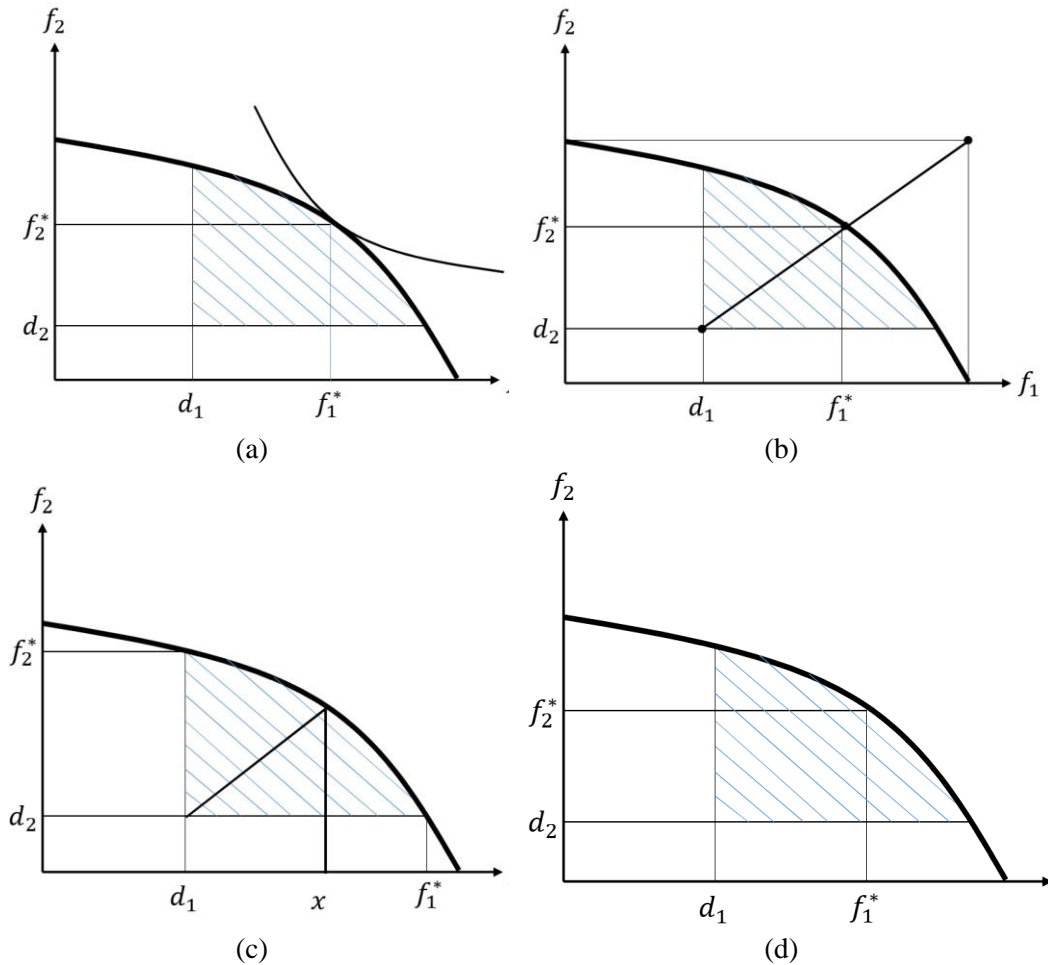
Both normalized objectives increase at the same rate along the line connecting the point of disagreement to the ideal point  $(f_1^*, f_2^*)$ . Different weights apply when the importance of the objectives varies. The higher weight goes to the more important objective, improving it more rapidly. The non-symmetric KS solution results from applying different weights to the KS solution. It also finds an optimal solution at the intersection of the Pareto frontier and straight line (Figure 4(b)).

$$g(f_1) = (w_2/w_1)f_1 \quad (8)$$

#### 2.2.1.3 Method 3

The area monotonic solution uses the straight line passing through the point of disagreement  $(d_1, d_2)$ , and the frontier that splits the set  $S^+$  into two half sets (Figure 4(c)). Since the given weights are not equal ( $w_1 \neq w_2$ ), the non-symmetric conflict modifies accordingly. Based on the non-symmetric area monotonic solution, the ratio of the two areas should equal  $\frac{w_1}{w_2}$ . Therefore, the root of the non-linear equation below, within the interval  $(d_1, f_1^*)$  provides the coordinate solution (Anbarci, 1993).

$$\begin{aligned}
 w_2 \left[ \int_{d_1}^x g(t) dt - \frac{1}{2} (x - d_1) (g(x) + d_2) \right] \\
 = w_1 \left[ \int_x^{f_1^*} g(t) dt - (f_1^* - x) d_2 + \frac{1}{2} (x - d_2) (g(x) - d_2) \right]
 \end{aligned} \tag{9}$$



**Figure 4.** Pareto frontier of the two stakeholders using non-symmetric Nash solution (a), Kalai- Smorodinsky solution (b), Area monotonic solution (c), and the equal loss solution

**Source:** Research finding.

#### 2.2.1.4 Method 4

The equal loss solution gives equal weights to both objectives, allowing the two parties to reach an agreement simultaneously at the same rate. In contrast, non-

symmetric equal loss solution assigns different weights to the objectives. The more important objective experiences a slower rate of loss, and the ratio of the speeds is  $\frac{w_1}{w_2}$  (Figure 4(d)). Hence, we assign the point  $(f_1^* - x)w_1 = (f_2^* - g(x))w_2$  on the Pareto frontier (Chun, 1998).

$$(f_1^* - x)w_1 = (f_2^* - g(x))w_2 \quad (10)$$

### 2.3 Estimation of Economic Objective

To determine the payoffs of economic objectives, we formulate the PMP. We calibrate the PMP models through a three-step procedure (Kanellopoulos et al., 2010; Cortignani and Severini, 2011; Howitt et al., 2012), as follows:

#### 2.3.1 Step 1. Base Linear Model

In the first stage, we apply a linear programming (LP) optimization model subject to resource constraints. We consider two types of constraints to calculate the players' payoff. The structure of PMP is defined as follows:

$$\text{Max } Z = \sum_{j=1}^n (P_j Y_j - C_j) X_j \quad (11)$$

$$\sum_{i=1}^n X_j \leq T\text{Land} \quad (12)$$

$$A_{\min} \leq X_j \leq A_{\max} \quad (13)$$

$$\sum_{j=1}^n W_j X_j \leq T\text{Water}_m \quad (14)$$

$$X_j = \tilde{X}_j + \varepsilon \quad (15)$$

Equation (11) represents a linear gross margin maximization model where  $X_j$  denotes land use for crop  $j$  (ha),  $P_j$  and  $Y_j$  represent the price (IRR per kg) and yield of crop  $j$  (kg per ha), respectively.  $C_j$  denotes the total cost of crop  $j$  (IRR per ha) including pumping, land, irrigation, labor, machinery, and fertilizer costs.  $n$  denotes the number of crops considered in the model. Accordingly, Equation (12) represents land constraint where  $T\text{Land}$  is the total available land, fixed 65,688 hectares. Equation (13) ensures that the allocated area for crop  $j$  does not exceed the maximum allowable area for that crop and meets or exceeds the minimum area required to fulfill food demand. Equation (14) defines the monthly water usage constraint, ensuring that the water requirement for each crop does not exceed the

total amount of water extracted from the wells in a given month. Here,  $W_j$  represents the irrigation water requirement (IWR) of crop  $j$ , and  $TWater_m$  denotes the total groundwater extracted in month  $m$ . Finally, we add calibration constraints for the land use of each crop to ensure unique dual shadow prices for each crop activity.

### 2.3.2 Step 2. Estimation of Yield Parameter with Maximum Entropy

Next, we estimate the parameters of the quadratic PMP yield function for crops using the shadow value derived from the calibration constraint in Equation (16). The quadratic function is as follows:

$$Y_i = \alpha_{ij}NX_{ij} - \beta_{ij}NX_{ij}^2 \quad (16)$$

where  $\alpha_{ij}$  and  $\beta_{ij}$  represents the intercept and slope of the non-linear yield function, respectively.  $NX_{ij}$  represents the amount of input  $i$  used in crop  $j$ . Estimating the non-linear parameters,  $\alpha_{ij}$  and  $\beta_{ij}$ , using shadow prices represents an ill-posed problem that classical econometric approaches cannot solve (Paris and Howitt, 1998). The Maximum Entropy technique addresses this issue by estimating the parameters of the non-linear yield function (Howitt and Msangi, 2014; Zamani et al., 2019a)

### 2.3.3 Step 3. Non-Linear Calibrated Model

In the final step, we use the following non-linear quadratic objective function replacing the linear one.

$$Max Z = \sum_i \left[ \sum_j P_i(\alpha_{ij}NX_{ij} - \beta_{ij}NX_{ij}^2) - \sum_i \sum_j C_{ij}NX_{ij} \right] \quad (17)$$

In this step, we calibrate the obtained non-linear model, including Equations (17), (12), (13), and (14), to reproduce the base-year information. Additionally, the quadratic objective form prevents over-specialization of solutions and offers greater flexibility in simulating policy scenarios. (Lee et al., 2019). According to Zamani et al. (2019b), policy scenarios related to limited water extraction require changes to the right-hand side of the water constraints in Equation (3). Thus, we first develop the baseline scenario, which is obtained from the calibrated model based on the land use in the reference year (2020).

## 3. Results

Table 2 summarizes the results of cropping patterns from the PMP model, with the first row showing groundwater extraction scenarios ranging from 160 to 370 MCM.

It also presents the maximum net income generated by each cropping pattern for every groundwater extraction scenario. Specifically, our findings compare various cropping patterns and groundwater extraction scenarios to the baseline scenario (370 MCM). The results show that reducing groundwater extraction decreases both the area under crops and farmers' net income. Specifically, reducing groundwater withdrawal from 370 MCM (10th Scenario) to 160 MCM (1st Scenario) (-57%) causes the total cultivated area to decrease from 65,087 to 29,181 hectares (-55%), while net income drops from 2,410 to 1,740 billion IRR (-28%).

Table 3 presents the payoff matrix for the two players, with the fourth and fifth columns displaying economic and environmental objectives, respectively.

To compute the environmental objective for each scenario, we calculate aquifer overexploitation by dividing groundwater withdrawal by groundwater recharge, using a historical data series of 10 years (*Withdrawal/Recharge*), following the method proposed by Kloezen and Garces-Restrepo (1998). Before applying game theory, we generate the alternatives from 0 to 1, referred to as normalized, for each groundwater extraction scenario. Table 4 shows the normalized payoff matrix for the two players in the economic and environmental categories.

Higher water consumption corresponds to increased net income, while aquifer overexploitation results in negative environmental impacts. Consequently, we apply different weights and scale them within the range of [0, 1]. Figure 5 illustrates the Pareto frontier for the two players, while Tables 5 to 8 present the computational results derived from the four conflict resolution methods under varying weight selections.

**Table 2.** Net Income and Cropping Pattern for Different Groundwater Extraction Scenarios

Scenarios	1	2	3	4	5	6	7	8	9	10
<b>Groundwater extraction (MCM)</b>	160	179	195	214	228	264	296	328	358	370
<b>Cropping pattern (ha)</b>										
<b>wheat</b>	12337	13575	14618	15855	16767	18940	20828	22717	24487	25025
<b>Soya</b>	5098	5594	6013	6509	6875	7851	8728	9605	10427	10713
<b>Potato</b>	1000	1461	1849	2310	2650	3320	3863	4406	4915	5052
<b>Canola</b>	1212	1406	1570	1765	1909	2346	3753	3160	3541	3768
<b>Bean</b>	989	994	999	1005	1909	1020	1031	1040	1050	1041
<b>Corn</b>	871	1064	1226	1419	1562	1906	2206	2506	2788	2822
<b>Rice</b>	7196	7551	7850	8205	8466	8996	9430	9864	10271	10460
<b>Tomato</b>	377	504	611	738	832	1063	1266	1469	1659	1753
<b>Spring cotton</b>	0	0	0	0	0	484	1038	1592	2112	2299
<b>Summer cotton</b>	13	175	311	437	592	805	970	1135	1289	1326
<b>Barley</b>	88	145	194	252	295	443	584	726	859	828
<b>Total</b>	29181	32469	35241	38495	41857	47174	53697	58220	63398	65087
<b>Net income (Billion IRR)</b>	1740	1850	1930	2020	2080	2210	2290	2360	2400	2410

Source: Research finding.

**Table 3.** The Payoff Matrix of the Two Stakeholders

Scenarios	Groundwater extraction (MCM)	Land used (hectare)	Net income (Billion IRR)	Aquifer overexploitation coefficient
1	160	29181	1740	1
2	179	32469	1850	1.11
3	195	35241	1930	1.21
4	214	38495	2020	1.33
5	228	41857	2080	1.42
6	264	47174	2210	1.65
7	296	53697	2290	1.85
8	328	58220	2360	2.05
9	358	63398	2400	2.23
10	370	65087	2410	2.31

Source: Research finding.

**Table 4.** Normalized Payoff Matrix of the Two Stakeholders

Scenarios	Groundwater extraction (MCM)	Land used (hectare)	Net income (normalized)	Groundwater extraction (normalized)
1	160	29181	0	1
2	179	32469	0.16	0.91
3	195	35241	0.28	0.83
4	214	38495	0.41	0.73
5	228	41857	0.5	0.66
6	264	47174	0.7	0.48
7	296	53697	0.82	0.32
8	328	58220	0.92	0.16
9	358	63398	0.98	0.02
10	370	65087	1	0

Source: Research finding.

**Table 5.** Computational Results of Non-Symmetric Nash Solution

Groundwater extraction (MCM)	Net income (Billion IRR)	Environmental returns (f <sub>2</sub> )	Economic returns (f <sub>1</sub> )	Weight of environmental impacts (w <sub>2</sub> )	Weight of economic impacts (w <sub>1</sub> )
370	2410	0	1	0	1
332	2380	0.179	0.956	0.025	0.975
323	2370	0.224	0.948	0.05	0.95
315	2360	0.26	0.939	0.075	0.925
309	2360	0.291	0.929	0.1	0.9
303	2350	0.32	0.918	0.125	0.875
297	2340	0.346	0.906	0.15	0.85
292	2330	0.371	0.894	0.175	0.825
287	2330	0.395	0.881	0.2	0.8
282	2320	0.418	0.868	0.225	0.775
277	2310	0.441	0.854	0.25	0.75
273	2300	0.463	0.839	0.275	0.725
268	2290	0.484	0.824	0.3	0.7
264	2280	0.505	0.808	0.325	0.675
259	2270	0.526	0.792	0.35	0.65
255	2250	0.546	0.775	0.375	0.625
251	2240	0.567	0.757	0.4	0.6
247	2230	0.587	0.739	0.425	0.575
242	2220	0.607	0.725	0.45	0.55
238	2210	0.627	0.71	0.475	0.525
<b>234</b>	<b>2190</b>	<b>0.648</b>	<b>0.679</b>	<b>0.5</b>	<b>0.5</b>
230	2180	0.668	0.657	0.525	0.475
225	2160	0.688	0.635	0.55	0.45

221	2140	0.709	0.611	0.575	0.425
217	2130	0.729	0.587	0.6	0.4
212	2110	0.75	0.561	0.625	0.375
208	2090	0.771	0.535	0.65	0.35
204	2070	0.792	0.507	0.675	0.325
199	2060	0.814	0.478	0.7	0.3
194	2040	0.835	0.448	0.725	0.275
190	2010	0.857	0.416	0.75	0.25
188	1990	0.865	0.383	0.775	0.225
186	1970	0.875	0.348	0.8	0.2
185	1940	0.88	0.312	0.825	0.175
181	1920	0.898	0.274	0.85	0.15
180	1890	0.903	0.234	0.875	0.125
175	1880	0.926	0.216	0.9	0.1
170	1860	0.95	0.192	0.925	0.075
165	1800	0.974	0.091	0.95	0.05
160	1760	0.998	0.044	0.975	0.025
160	1740	1	0	1	0

Source: Research finding.

**Table 6.** Computational Results of Kalai- Smorodinsky Solution

Groundwater extraction (MCM)	Net income (Billion IRR)	Environmental returns ( $f_2$ )	Economic returns ( $f_1$ )	Weight of environmental impacts ( $w_2$ )	Weight of economic impacts ( $w_1$ )
370	2410	0	1	0	1
365	2400	0.025	0.988	0.025	0.975
359	2390	0.052	0.973	0.05	0.95
353	2380	0.081	0.969	0.075	0.925
347	2380	0.111	0.969	0.1	0.9
340	2380	0.142	0.969	0.125	0.875
333	2370	0.176	0.952	0.15	0.85
326	2370	0.209	0.951	0.175	0.825
319	2370	0.242	0.949	0.2	0.8
312	2360	0.275	0.937	0.225	0.775
305	2360	0.309	0.928	0.25	0.75
298	2340	0.343	0.906	0.275	0.725
290	2330	0.378	0.883	0.3	0.7
283	2310	0.413	0.859	0.325	0.675
276	2290	0.449	0.834	0.35	0.65
268	2280	0.485	0.809	0.375	0.625
260	2260	0.521	0.782	0.4	0.6
253	2240	0.557	0.754	0.425	0.575
245	2220	0.593	0.724	0.45	0.55

238	2200	0.628	0.694	0.475	0.525
<b>231</b>	<b>2180</b>	<b>0.663</b>	<b>0.663</b>	<b>0.5</b>	<b>0.5</b>
224	2160	0.697	0.63	0.525	0.475
217	2140	0.73	0.597	0.55	0.45
210	2110	0.761	0.562	0.575	0.425
204	2090	0.791	0.527	0.6	0.4
198	2060	0.819	0.491	0.625	0.375
192	2040	0.845	0.455	0.65	0.35
188	2020	0.868	0.418	0.675	0.325
183	1990	0.889	0.381	0.7	0.3
179	1970	0.907	0.344	0.725	0.275
176	1940	0.923	0.307	0.75	0.25
173	1920	0.935	0.271	0.775	0.225
171	1890	0.945	0.236	0.8	0.2
170	1870	0.953	0.202	0.825	0.175
169	1850	0.957	0.169	0.85	0.15
168	1830	0.96	0.137	0.875	0.125
168	1810	0.961	0.106	0.9	0.1
165	1790	0.977	0.081	0.925	0.075
164	1770	0.982	0.052	0.95	0.05
161	1750	0.996	0.025	0.975	0.025
160	1740	1	0	1	0

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Source: Research finding.

**Table 7.** Computational Results of Area Monotonic Solution

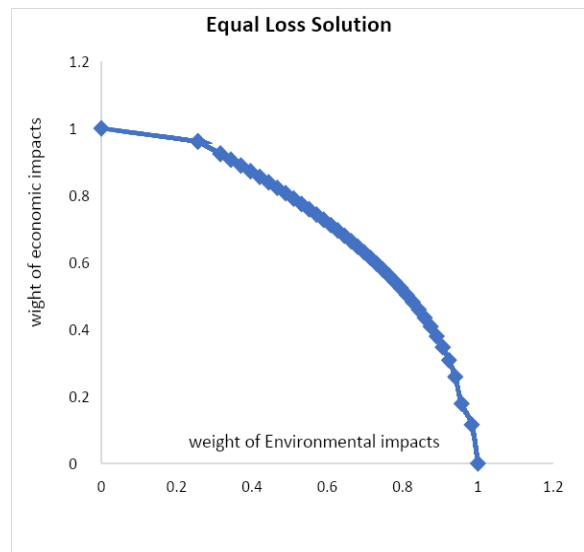
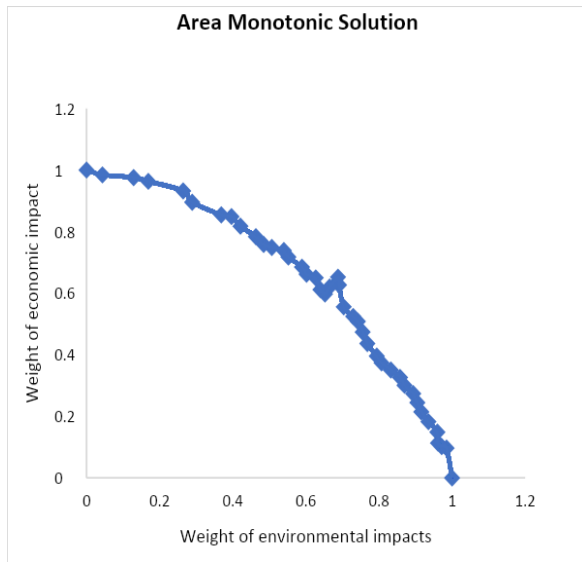
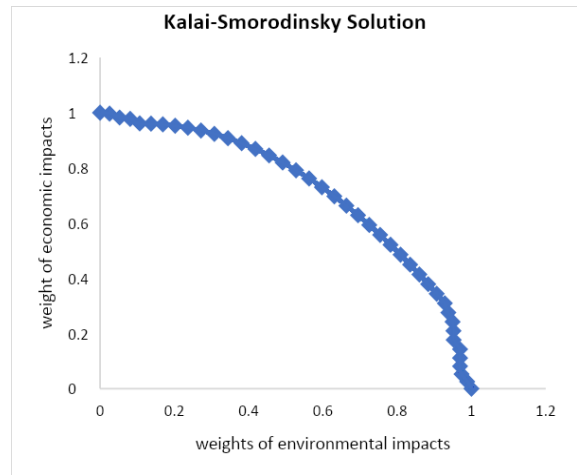
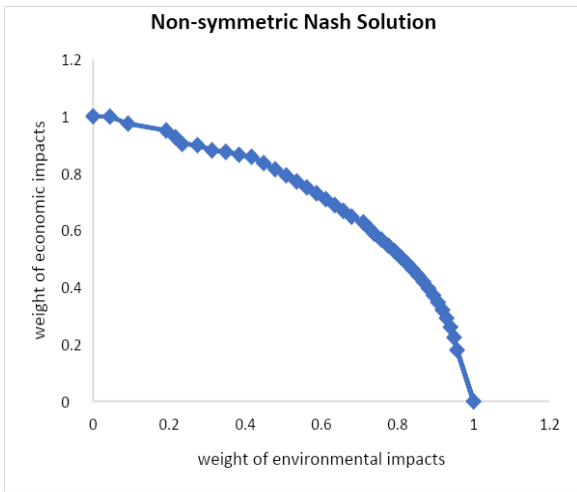
<b>Groundwater extraction (MCM)</b>	<b>Net income (Billion IRR)</b>	<b>Environmental returns (f<sub>2</sub>)</b>	<b>Economic returns (f<sub>1</sub>)</b>	<b>Weight of environmental impacts (w<sub>2</sub>)</b>	<b>Weight of economic impacts (w<sub>1</sub>)</b>
370	2410	0	1	0	1
350	2390	0.096	0.984	0.025	0.975
349	2390	0.101	0.971	0.05	0.95
346	2380	0.113	0.961	0.075	0.925
339	2380	0.148	0.959	0.1	0.9
332	2360	0.182	0.935	0.125	0.875
325	2350	0.214	0.915	0.15	0.85
319	2340	0.244	0.904	0.175	0.825
313	2330	0.273	0.893	0.2	0.8
307	2320	0.3	0.869	0.225	0.775
302	2310	0.326	0.857	0.25	0.75
296	2290	0.35	0.832	0.275	0.725
292	2280	0.373	0.806	0.3	0.7
287	2270	0.395	0.794	0.325	0.675
278	2250	0.436	0.768	0.35	0.65
271	2240	0.473	0.755	0.375	0.625
263	2230	0.508	0.742	0.4	0.6
260	2220	0.524	0.729	0.425	0.575
253	2210	0.555	0.703	0.45	0.55
238	2200	0.626	0.69	0.475	0.525
<b>233</b>	<b>2200</b>	<b>0.652</b>	<b>0.687</b>	<b>0.5</b>	<b>0.5</b>
240	2180	0.62	0.665	0.525	0.475
245	2170	0.597	0.652	0.55	0.45
242	2160	0.611	0.639	0.575	0.425
234	2150	0.649	0.626	0.6	0.4
231	2140	0.661	0.621	0.625	0.375
226	2130	0.684	0.589	0.65	0.35
219	2100	0.717	0.552	0.675	0.325
215	2110	0.738	0.539	0.7	0.3
213	2070	0.748	0.506	0.725	0.275
211	2060	0.758	0.484	0.75	0.25
206	2050	0.783	0.463	0.775	0.225
198	2020	0.817	0.42	0.8	0.2
192	2000	0.848	0.396	0.825	0.175
191	1980	0.854	0.368	0.85	0.15
182	1930	0.895	0.289	0.875	0.125
174	1910	0.932	0.264	0.9	0.1
168	1850	0.963	0.168	0.925	0.075
165	1820	0.957	0.128	0.95	0.05
163	1760	0.984	0.043	0.975	0.025
160	1740	1	0	1	0

**Source:** Research finding.

**Table 8.** Computational Results of Equal Loss Solution

Groundwater extraction (MCM)	Net income (Billion IRR)	Environmental returns ( $f_2$ )	Economic returns ( $f_1$ )	Weight of environmental impacts ( $w_2$ )	Weight of economic impacts ( $w_1$ )
370	2410	0	1	0	1
346	2390	0.115	0.983	0.025	0.975
333	2380	0.178	0.956	0.05	0.95
316	2360	0.258	0.939	0.075	0.925
305	2350	0.308	0.923	0.1	0.9
297	2340	0.346	0.906	0.125	0.875
290	2330	0.379	0.89	0.15	0.85
284	2320	0.408	0.874	0.175	0.825
279	2310	0.434	0.858	0.2	0.8
274	2300	0.458	0.842	0.225	0.775
269	2290	0.481	0.827	0.25	0.75
264	2280	0.502	0.811	0.275	0.725
260	2270	0.522	0.795	0.3	0.7
256	2260	0.542	0.779	0.325	0.675
252	2250	0.56	0.763	0.35	0.65
248	2240	0.587	0.747	0.375	0.625
245	2220	0.596	0.73	0.4	0.6
241	2210	0.613	0.714	0.425	0.575
238	2200	0.63	0.697	0.45	0.55
234	2190	0.646	0.68	0.475	0.525
<b>231</b>	<b>2180</b>	<b>0.663</b>	<b>0.663</b>	<b>0.5</b>	<b>0.5</b>
227	2170	0.679	0.645	0.525	0.475
224	2160	0.695	0.627	0.55	0.45
221	2140	0.711	0.609	0.575	0.425
217	2130	0.727	0.59	0.6	0.4
214	2120	0.742	0.571	0.625	0.375
211	2100	0.758	0.551	0.65	0.35
207	2090	0.774	0.531	0.675	0.325
204	2080	0.79	0.51	0.7	0.3
201	2060	0.806	0.489	0.725	0.275
197	2050	0.822	0.467	0.75	0.25
194	2030	0.838	0.444	0.775	0.225
190	2020	0.855	0.42	0.8	0.2
187	2000	0.871	0.396	0.825	0.175
183	1980	0.888	0.37	0.85	0.15
180	1970	0.906	0.343	0.875	0.125
176	1950	0.924	0.316	0.9	0.1
176	1950	0.924	0.316	0.925	0.075
168	1920	0.96	0.256	0.95	0.05
168	1910	0.96	0.256	0.975	0.025
160	1740	1	0	1	0

Source: Research finding.



**Figure 5. Pareto Frontier of the Two Stakeholders**  
**Source:** Research finding.

**Table 9. The Optimal Solution of Water Extracted with Equal Weights (Million Cubic Meters)**

Weight of environmental impacts	Non-symmetric Nash solution	Kalai-Smorodinsky solution	Area monotonic solution	Equal loss solution
0.5	234	231	233	231

**Source:** Research finding.



The computational results presented in the tables indicate that as the environmental objective becomes more important in the analysis, less water is allocated to agricultural irrigation optimally. The greater the importance weight given to the economic attributes, the higher the net income, demonstrating this trend across all four methods. When we prioritize economic benefit as the main objective, the optimal groundwater withdrawal reaches its maximum level of 370 million cubic meters. Conversely, when we prioritize the environment as the sole objective, we minimize groundwater extraction. This result aligns with Raquel et al., (2007) who demonstrate that the optimal decision depends on the relative importance weights assigned to conflicting objectives. It also mirrors the findings of Chhipi-Shrestha et al. (2019), who show that the weights of sustainability indicators and dimensions affect Pareto optimality and, consequently, the final decision. According to the Nash and non-symmetric monotonic area solutions, the optimal amounts of extracted water are 234 and 233 million cubic meters, respectively. Meanwhile, the non-symmetric Kalai-Smorodinsky solution and non-symmetric equal loss solution yield an optimal extraction of 231 million cubic meters. Table 9 summarizes the optimal groundwater extraction amounts.

As Table 9 shows, when we assign equal weights to economic and environmental objectives, groundwater extraction decreases by 36% and 37%, while farmers' net income drops by only 8% and 9%. Our study aligns with the findings of Nazari et al. (2020), who demonstrate that creating a compromise solution between the two key players—farmers and the government—leads to a reduction in groundwater withdrawal. Similarly, Raquel et al. (2007) report that groundwater extraction decreases when an optimal trade-off is found between conflicting economic and environmental objectives. Furthermore, our results are consistent with those of Naghdi et al. (2021), Raquel et al. (2007), and Li et al. (2023), who highlight the effective performance of the proposed method in managing the exploitation and allocation of groundwater resources.

#### **4. Conclusion**

In the current study, we implement four conflict resolution methodologies coupled with a positive mathematical programming model to consider trade-offs between the involved rational stakeholders. The two key players in this research are the government, which seeks to minimize the negative environmental impacts, including groundwater extraction, and local farmers, who aim to maximize economic profit. We generate ten initial alternatives to explore different

groundwater extraction scenarios. According to the results of this study, groundwater extraction decreases by 36% and 37%, while farmers' net income only decreases by 8% and 9%. Nonetheless, the government can compensate for farmers' economic losses by setting a minimum support price. Our findings also reveal a gap between water demand and the supply capacity of water resources. To address water shortages, it is essential to explore alternative (non-conventional) water sources, such as recycled water, brackish water, and rainwater. Additionally, we should consider several general guidelines and potential solutions, including the implementation of advanced technological solutions and practices that enhance water efficiency. Overall, managing water resources is a country-dependent endeavor, which limits its implementation in many nations. To achieve better water resource management, we must address not only physical, economic, environmental, and financial perspectives but also consider social and political goals. Conflicts over water resources may not be as straightforward as they seem; however, the GT approach can simulate and explain the complexities of water-related problems by considering stakeholders' rational behavior, especially in the absence of markets and exclusive ownership rights. This approach offers solutions for different players in both cooperative and non-cooperative conditions, based on various types of information. This flexibility is a significant advantage of GT over conventional optimization techniques. Finally, we acknowledge the limitations of our analysis. This study focuses on two-dimensional games to address water problems. However, future research could explore games with three or more objectives. The approach outlined above can also be applied to various other natural resource problems that inherently involve collective action. We hope that future researchers will extend the implications of this work to other areas.

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### **Declaration of Conflicting Interests**

The author declares no conflict of interest concerning the research, authorship, and/or publication of this article.

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## The Impact of Relative Commissions on Sale of Various Types of Life Insurance: An Application of Game Theory

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### Abstract

Iran's below-average life insurance penetration rate relative to the global average, is caused by several factors. Sellers' behavior and motivations can be one of these factors. Given that the distorted prices divert the resources, the imbalanced sales commission rate could generate a conflict of interest among the players in life insurance market. Universal life insurance has a substantially higher commission rate than other types. Therefore, it can incentivize sellers to offer more universal life insurance than term life insurance, regardless of customers' needs. In this paper, we postulate that the existing sales commission system in the Iranian life insurance industry may deviate customer demand and raise the likelihood of policy surrendering. This issue is a principal-agent problem for insurer and seller, and supplier-induced demand (SID) for seller and customer. In the form of signaling games, these conflicts of interests among the players has been analyzed using descriptive-analytical method based on game theory. We observed that if the seller has the same desire to sell different types of life insurance, there is a greater likelihood that they will provide genuine advice to the customer. By reducing the surrender rate, the situation can be improved.

**Keywords:** Principal-Agent Problem, Sales Commission, Sales Intermediaries, Signaling Games, Supplier-Induced Demand.

**JEL Classification:** C73, D82, G22.

### 1. Introduction

According to the welfare viewpoint, risk coverage is the defining characteristic of life insurance, which is so crucial for insurers and policyholders (including the risk of death, risk of disablement, etc.). In order to attract more customers, investment savings aspect were added to life insurance at one point in its history. In addition to provide risk coverage, the insurer invests the remainder of the received premium then the principal interest will return to the policyholder. On

the Iranian insurance market, sales representatives (including brokers and agents) receive a commission based on a percentage of the premium for their efforts. This study's issue is the composition and ramifications of these commissions. According to Regulation No. 83 of the Iranian Central Insurance (the Iranian insurance market regulator), the following commission structure applies to the sale of individual life insurance:

- The maximum sales commission for individual term life insurance with an annual premium is 25% of the received premium.
- The maximum sales commission for the other type of individual life insurance (universal life insurance) is 75% of the first-year premium if it does not to exceed 30 per thousand in the capital. 40% of this commission is paid upon receipt of the first-year premium, followed by 15% per year in the second through fifth years upon receipt of the necessary insurance premiums.

Obviously, universal life insurance commissions are far higher than term life insurance commissions. Therefore, the intermediaries may profit more from the sale of each universal life insurance unit. According to Ahmadzadeh et al. (2019), Wharton et al. (2016), and Reifner et al. (2012), the majority of life insurance sellers are persuading customers for their own gain. They attempt to sell a product with a higher selling remuneration. According to Madadi et al. (2020), the Iranian life insurance commission structure should be modified. Alternatively, universal life insurance premiums are more expensive than term life insurance premiums, hence, according to the findings of Mohammadi (2013) and Webb (2009), low-risk customers tend to pay less for life insurance premiums, while high-risk customers tend to spend more. It is possible to assume that the imbalanced sales commission rate of life insurance generates a conflict of interest between the sales representative and other players (insurer and policyholder). Therefore, the null hypothesis of this study is that the current structure of life insurance sales commissions in Iran is not socially optimal.

Sellers of life insurance have extensive knowledge about the products, premiums, commission, etc. They are essentially market makers who connect policyholders' insurance needs with insurers capable of providing those needs (Cummins and Doherty, 2006). However, the majority of customers are unaware of this information regarding insurance products. So, the sales representatives can use their superior knowledge to persuade customers to demand specific life insurance product that provides them with greater remuneration. Thus, this is an illustration of supplier-induced demand, which will be analyzed using a signaling

game. The research question is: How does changing the structure of sales commissions for life insurance affect the game's equilibrium?

Numerous studies have been undertaken on supplier-induced demand up to this point. Evans (1974), Wennberg et al. (1982), Rice and McCall (1983), Reinhardt (1985), Birch, (1988), Labelle et al. (1994), and Richardson and Peacock (2006) have studied the asymmetric information problem and supplier-induced demand for the physician-patient interaction. Using a questionnaire and the logit method, Abdoli and Varharami (2011) determined that induced demand by general practitioners is more than that of others. Behbahani and Esmaili (2019), Asgari et al. (2020), and Kazemian and Alvandi (2021) have investigated the conditions and causes of demand induction by Iranian healthcare providers. Pournaghi Keikeleh et al. (2022) have quantified supplier-induced demand caused by the 2014 Health reform plan in Iran, and their findings demonstrate the existence of SID resulting from the plan. Khandan (2023) has predicted and investigated the impact of individual and contractual characteristics of insurance policies on the lapse (or surrender) of life insurance. Ikegami et al. (2021), Zabrodina et al. (2020) investigated about induced demand in hospitals' care sectors. Also studies of Yu et al. (2020), Longden et al. (2018), Dzampe & Takahashi (2022) and Meyer (2016) are the recent studies about supplier induced demand in health care system and doctor's incentives. Among the articles, Abdoli (2004) utilized game theory method and a signaling game to study physician-induced demand. None of these studies examined the SID for the life insurance market, as is evident. They all investigated physician-patient relationships in the health insurance market or physician-induced demand. So, this study adopted a new approach to analyzing the impact of changing commissions on the Iranian life insurance market.

## **2. Research Method**

To begin analyzing the research hypothesis, the actions and reactions of the seller and customer of life insurance is evaluated as signaling games. Spence (1973) established the signaling theory after observing information asymmetry between firms and potential employees. The more informed side of contract attempts to send signals containing specific information, to the less informed side. The sender must decide how to communicate or signal, and the receiver must determine how to interpret the signal (Connelly et al., 2011). After that, the insurer is added to the game as player who can change the life insurance commission structure for life insurance. The impact of the change in commission have been analyzed using

improvement criteria. Pareto improvement happens when no one is harmed and at least one person benefits from a reallocation (Layard and Walters, 1987). A reallocation is a Kaldor (1939) improvement if those who made better-off could hypothetically compensate those made worse-off and yet be in a better situation than before. The improvement proposed by Hicks (1939) follows a reallocation; those who made worse-off cannot pay those who made better-off to dissuade them from the change. If a change in the commission structure of life insurance results in a better-off situation, it can be inferred that the current situation (or commission structure) is not socially optimal.

### **3. Modeling the Game**

At the inception, for modeling the game, the strategy and types of players should be defined. Based on customers' needs, there are three types of customers:

- Customers who do not require life insurance because they want to take their risks by themselves (NL type);
- Customers who choose to buy life insurance and prefer universal life insurance if they have complete information (UL type);
- Customers who choose to buy life insurance and prefer term life insurance if they have complete information (TL type).

Customers are different from each other not only in needs but also in their personal traits, they may be “optimistic” or “meticulous” about the seller’s advice, and their acquaintance with life insurance and their needs. They could be “well-informed” or “miss-informed”. Therefore, the following strategies can be considered for the customers:

1. Purchasing universal life insurance (UL);
2. Purchasing term life insurance (TL);
3. Not purchasing any life insurance products (O);
4. Surrendering the policy of life insurance (X) in the next step after buying a product.

For life insurance sellers, only personal traits are considered, so, seller types can also defined based on their intelligence and communication ability. The following strategies can be considered for the seller:

1. Offering to purchase universal life insurance or sending the customer the universal life insurance signal ( $S_{UL}$ );
2. Offering to purchase term life insurance or sending the customer the term life insurance signal ( $S_{TL}$ ).

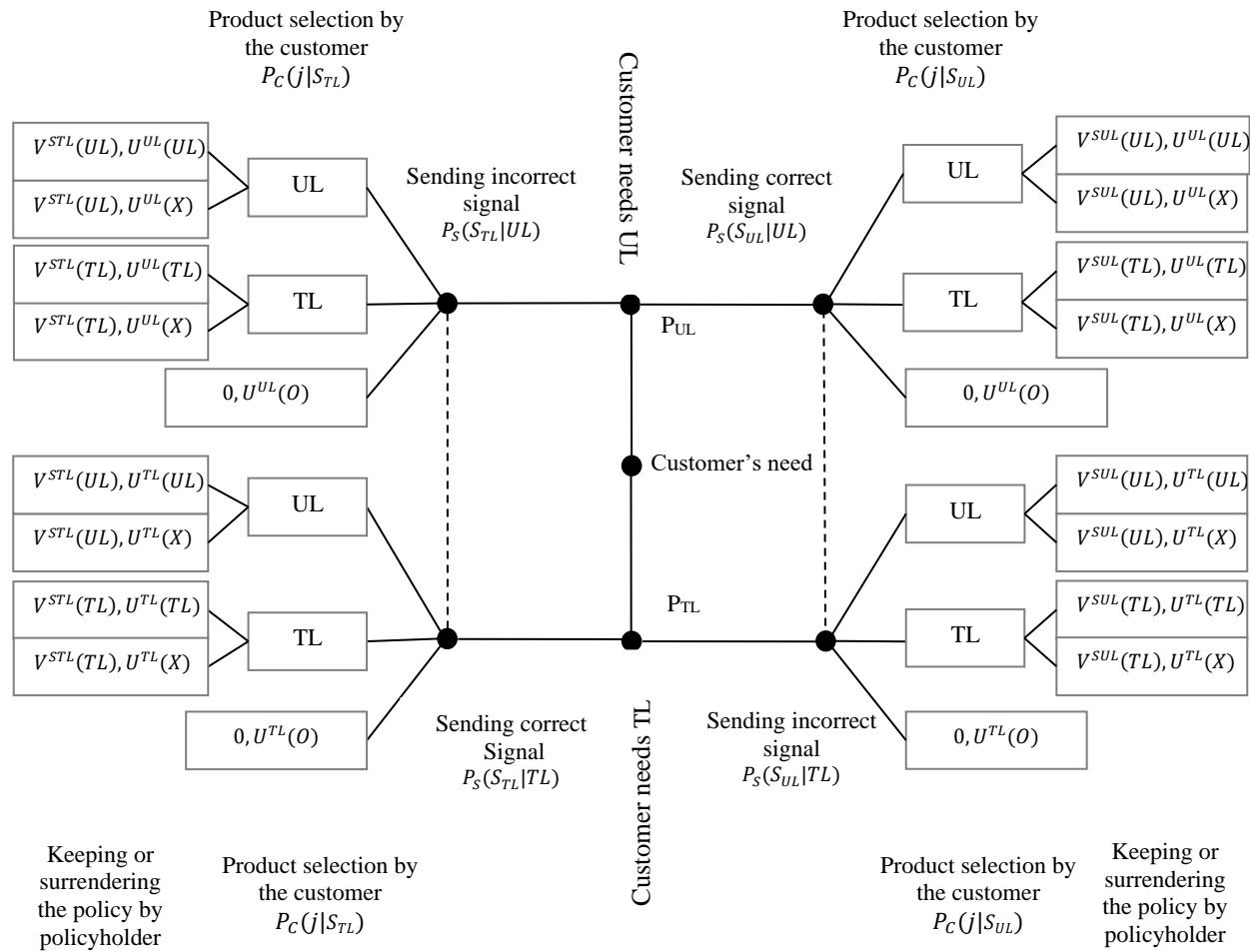
The insurer's strategies are related to the life insurance sale commission. These are the insurer's strategies:

1. Reduce the ratio of universal life insurance commission ( $C_{UL}$ ) to term life insurance commission ( $C_{TL}$ ). It implies reduce the  $C_{UL}/C_{TL}$ ;
2. Increase the payment period of the universal life insurance sales commission.

### **3.1 Game with two Players (Seller and Customer)**

The customer goes to the insurance seller to purchase a life insurance policy, and since most customers do not have adequate knowledge about the characteristics of various types of products, they seek assistance from the seller. The seller additionally sends  $S_{UL}$  or  $S_{TL}$  signals based on the customer's traits and the type of their needs. Therefore, there are three stages for this game: the first move is made by the seller by sending signals, the second stage is the customer's product selection, and the last step is the customer's decision to retain or surrender the policy. Given that the flow of information from the seller to the customer is dominant, the interaction between these two players can be depicted in the framework of signaling games in expanded form in Figure 1.





**Figure 1.** The Extended Form of the Seller-Customer Game for Life Insurance

**Source:** Research finding.



U and V represent the customer's utility and the seller's benefit, respectively. For example,  $U^{UL}(TL)$  is the customer's utility when they need universal life insurance but has already purchased term life insurance. Or  $V^{SUL}(TL)$  is the sellers' advantage when they send the  $S_{UL}$  signal and the customer purchases term life insurance. For the purpose of simplification, we suppose that:

$$i = S_{UL}, S_{TL} \qquad j = UL, TL, O$$

If the customer needs UL, the seller would suggest them with  $P_S(i|UL)$  probability which product to buy (by sending  $S_{UL}$  and  $S_{TL}$  signals), and the seller sends signals with  $P_S(i|TL)$  probability for the customers who need TL. The customer cannot identify their appropriate product with certainty, so it is indicated by dots. If the customer buys a product with a probability of  $P_L(UL, TL|i)$ , they can surrender it in the future (S) or keep it with a probability of  $1 - P_X(UL, TL|i)$ . So, we have:

$$\begin{aligned} \sum_i P_S(i|UL) = 1, & \quad \sum_i P_S(i|TL) = 1 & \quad P_{TL} + P_{UL} = 1 \\ \sum_j P_C(j|S_{UL}) = 1, & \quad \sum_j P_C(j|S_{TL}) = 1 & \end{aligned} \quad (1)$$

To determine the equilibrium of this game, we must first compare the customer's utility and the seller's benefit based on their characteristics. if the customer purchases the required item, they will obtain greater utility. The following can be deduced:

$$\begin{aligned} u^{TL}(TL) &> u^{TL}(UL) > u^{TL}(O) \\ u^{UL}(UL) &> u^{UL}(TL) > u^{UL}(O) \\ u^{NL}(O) &> u^{NL}(UL), u^{NL}(TL) \\ u^{NL}(O) &= u^{UL}(UL) = u^{TL}(TL) \end{aligned} \quad (2)$$

The more the sellers receive in commission on the sale, the greater their benefits. According to Regulation 83, the following can be deduced:

$$\begin{aligned} V^{SUL}(UL) &> V^{SUL}(TL) > V^{SUL}(O) = 0 \\ V^{STL}(UL) &> V^{STL}(TL) > V^{STL}(O) = 0 \end{aligned} \quad (3)$$

According to Figure 1, the seller may choose one of these strategies:

- |                               |                               |
|-------------------------------|-------------------------------|
| 1- $(S_{UL} UL), (S_{UL} TL)$ | 2- $(S_{TL} UL), (S_{TL} TL)$ |
| 3- $(S_{UL} TL), (S_{TL} UL)$ | 4- $(S_{UL} UL), (S_{TL} TL)$ |

For example,  $(S_{TL}|UL)$  indicates that the customer requires universal life insurance (UL) but the seller has only offered term life insurance (sends  $S_{TL}$  signal). At their first move (second stage of the game), the customer may select one of the following strategies:

- |                               |                               |
|-------------------------------|-------------------------------|
| 1- $(UL S_{UL}), (UL S_{TL})$ | 2- $(TL S_{UL}), (TL S_{TL})$ |
| 3- $(O S_{UL}), (UL S_{TL})$  | 4- $(UL S_{UL}), (TL S_{TL})$ |
| 5- $(O S_{UL}), (TL S_{TL})$  | 6- $(O S_{TL}), (UL S_{UL})$  |
| 7- $(TL S_{UL}), (O S_{TL})$  | 8- $(O S_{TL}), (O S_{UL})$   |

The customer’s second (last) move, which include surrendering or retaining the insurance policy, are as follows:

- |             |             |
|-------------|-------------|
| 1- $(X UL)$ | 2- $(X TL)$ |
|-------------|-------------|

For example,  $(TL|S_{UL})$  indicates that the customer has received the  $S_{UL}$  signal but has purchased term life insurance.

### 3.2 Equilibrium of the Game with Two Players (Current Situation)

According to this notion, the customer should use the information received by the seller to select products, and the seller should evaluate the customer’s potential response to each signal sent (Abdoli, 2004). The impact rate of the signals determines the equilibrium based on the seller’s and customer’s personal traits, as indicated in Table 1.

**Table 1.** The Impact of Signals Sent Based on the Type of Players

Seller types	Customer types	Seller signals	Customer strategy	Equilibrium
Intelligent and persuasive	<i>Optimistic or misinformed</i>	$(S_{UL} UL), (S_{UL} TL)$	$(UL S_{UL}), (TL S_{TL})$	Pooling $S_{UL}$
	<i>Meticulous or well-informed</i>	$(S_{UL} UL), (S_{TL} TL)$	$(UL S_{UL}), (TL S_{TL})$	Separating
Careless and Unpersuasive	<i>Optimistic or misinformed</i>	$(S_{UL} UL), (S_{UL} TL)$	$(O S_{UL}), (TL S_{TL})$ or $(O S_{TL}), (UL S_{UL})$	Pooling $S_{UL}$
	<i>Meticulous or well-informed</i>	$(S_{UL} UL), (S_{UL} TL)$	$(UL S_{UL}), (UL S_{TL})$ or $(TL S_{UL}), (TL S_{TL})$ or $(O S_{TL}), (O S_{UL})$	Pooling $S_{UL}$

**Source:** Research finding.

Therefore, intelligent sellers identify the customer type and attempt to sell at least one product to each customer, with universal life insurance taking precedence. In other words, when they faced with meticulous type of customer the equilibrium is separating. Because the intelligent sellers know that the meticulous customers will not be persuaded just by consultation from the seller and they will collect the information in other ways too. So, in this situation the signals contains

influential information and separates the customer's needs. The seller expected benefit function of this game is:

$$\begin{aligned}
 v &= v(UL, TL, O) \\
 UL(\text{Information}(S_{UL}, S_{TL}, K)) &\in \{0,1\} \\
 TL(\text{Information}(S_{UL}, S_{TL}, K)) &\in \{0,1\} \\
 O(\text{Information}(S_{UL}, S_{TL}, K)) &\in \{0,1\}
 \end{aligned} \tag{4}$$

It means that the seller's benefit is a function of customers choice, and customers choice is a function of their information. Part of this information is obtained by seller's signals and another part is their own knowledge (K). Customers are well-informed with  $P_w$  probability or misinformed with  $P_m$  probability. So we have:

$$\begin{aligned}
 \text{Max } v(UL, TL, O) &= \\
 P_w P_{TL} P_S(S_{TL}|TL)v^{STL}(UL, TL, O) &+ P_{UL} P_S(S_{UL}|UL)v^{SUL}(UL, TL, O) \\
 + P_m [P_{TL} P_S(S_{TL}|TL)v^{STL}(UL, TL, O) & \\
 + P_{UL} P_S(S_{UL}|UL)v^{SUL}(UL, TL, O)] & \\
 \text{Subject to } UL + TL + O &= 1
 \end{aligned} \tag{5}$$

According to statistics<sup>1</sup>, the majority of customers are misinformed and would purchase the product offered by the seller. Thus, in this kind of game, if a pooling equilibrium exist, no information will be transferred to the customers by this equilibrium (Abdoli, 2020). Based of equation (3) and (5), the equilibrium strategy for the majority of sellers is  $(S_{UL}|UL)$ ,  $(S_{UL}|TL)$ , and for the majority of customers is  $(UL|S_{UL})$ ,  $(TL|S_{TL})$ . It indicates that the dominant strategy of the majority of sellers is to send  $S_{UL}$  regardless of customer needs, and the majority of customers follow the seller signals.

### 3.3 Game with Three Players

In this model, the role of insurers and central insurance is to establish conditions or a playing field for interactions between sellers and customers. In other words, Figure 1 depicts the interactions between the seller and customer, which constitute a subgame of the overall game. The insurer's strategies influence the seller's behavior and their signals. Then, by changing the seller's signals, the customer's choice could also change. Therefore, there will be a figure identical to Figure 1 for each insurer's strategies. To analyzing the impact of a change in commission structure on players' behavior, it is necessary to define the benefit and utility functions for each one.

<sup>1</sup>. Ahmadzadeh et al. (2019)

**A) Insurer**

Benefit function for the insurer (G) is as follows:

$$\begin{aligned}
 G &= G(P_t, C, I, X, SV) \\
 &= \text{Benefits} - \text{Costs} \\
 &= P_t(P_t^{UL}, P_t^{TL}, X) - C(C_{UL}, C_{TL}) - SV - I \\
 \frac{\partial G}{\partial P_t} \frac{\partial P_t}{\partial P_t^{UL}} &> 0 \quad \frac{\partial G}{\partial P_t} \frac{\partial P_t}{\partial P_t^{TL}} > 0 \quad \frac{\partial G}{\partial P_t} \frac{\partial P_t}{\partial X} < 0 \quad \frac{\partial G}{\partial C} < 0
 \end{aligned}
 \tag{6}$$

The insurer pays a percentage of the premium as a commission (C) to the seller for selling life insurance products. The insurer’s revenue is directly related to the number of customers or insurance premiums received over time (P<sub>t</sub>) and inversely related to the payment of indemnity (I), the surrender of a life insurance policy by the policyholder (X), and the payment of the surrender value (SV).

**B) Seller**

The seller’s benefit also depends on the commission obtained (C) for selling each insurance product, marketing costs (M), and fixed costs (F). So, the seller benefit function (V) is:

$$\begin{aligned}
 V &= U(C_{UL}, C_{TL}, M, K) \\
 &= C(C_{UL}(P_{t=1}), C_{TL1}(P_t), C_{TL2}(P_t), C_{TL3}(P_t)) - K - M \\
 \frac{\partial V}{\partial C} &> 0
 \end{aligned}
 \tag{7}$$

where C<sub>TL1</sub> is the commission for selling individual term life policy covering the risk of death with annual premium, C<sub>TL2</sub> is the commission for selling group term life policy with annual premium, and C<sub>TL3</sub> is term life insurance with holus-bolus premiums. Since the quantity of sales is directly related to marketing costs and fixed costs, it is complicate to determine if it has a positive or negative impact on the seller’s profit.

**C) Customer or Policyholder**

The customer’s expected utility before purchasing is a function of premium (P), reserve, and indemnification (I). But after the purchase, the risk coverage (RC) is added to the customer’s utility function. This depends on whether the policy is retained or surrendered (X). This is for customers who require life insurance:

$$\begin{aligned}
 U_1 &= U_1(P_t, I) \\
 U_2 &= U_2(RC, P_t, I) \\
 &= RC(X, K) + SV + I - P_t
 \end{aligned}
 \tag{8}$$

$$\frac{\partial U_2}{\partial RC} \frac{\partial RC}{\partial X} < 0$$

$$\frac{\partial U_2}{\partial RC} \frac{\partial RC}{\partial K} > 0$$

The aggregate utility function is:

$$W = G + V + U \quad (9)$$

If a change in commission increases equation 7, or in other words causes a better-off in situation, it can be concluded that the existing commission structure is not optimal since a change in commission results in a better situation than the current one.

#### 4. The Impact of Commission Structure Change on the Equilibrium

The current situation is one in which the insurer takes no action to change the commission rate. In this case, the basic model is identical to Figure 1. According to Ahmadzadeh et al. (2019), UL policyholders comprise over 85% of all life insurance policyholders, while this proportion is approximately 50% in the leading countries in insurance industry. Therefore, In the current situation, the dominating strategy of the seller is  $(S_{UL}|UL)$ ,  $(S_{UL}|TL)$ . Since the majority of customers are misinformed, they choose  $(UL|S_{UL})$ ,  $(TL|S_{TL})$  and purchase the product offered by the seller.

##### 4.1 Commission Reduction for Universal Life Insurance

Changes in seller behavior are proportional to the amount of UL commission reduction. It is assumed that the reduction in UL commission rate would result in a gain equivalent to TL from the sale of UL. Thus, Equation 3 is modified as follows:

$$\begin{aligned} V^{UL}(UL) &= V^{UL}(TL) > V^{UL}(O) = 0 \\ V^{TL}(UL) &= V^{TL}(TL) > V^{TL}(O) = 0 \end{aligned} \quad (10)$$

The sales representative gets indifferent between sending the  $S_{TL}$  and  $S_{UL}$  signals. Therefore,  $(S_{UL}|UL)$ ,  $(S_{UL}|TL)$  is no longer the dominant strategy. Consequently, the probability of sending the incorrect signal ( $(P_S(S_{UL}|TL)$  and  $P_S(S_{TL}|UL)$ ) is decreased, while the probability of sending the correct signal ( $(P_S(S_{UL}|UL)$  and  $P_S(S_{TL}|TL)$ ) or the selection of the fourth strategy of the seller  $(S_{UL}|UL)$ ,  $(S_{TL}|TL)$  is increased. By reducing universal life insurance commission, the seller's benefit would decrease. So, we have:

$$\begin{aligned} V_0 &> V_1 \\ V_1 - V_0 &= -\Delta C_{UL} \cdot \Delta UL + C_{TL} \cdot \Delta TL \end{aligned} \quad (11)$$

For the customer, the higher the probability of receiving the correct signal, the higher the probability of purchasing the correct product, and the smaller the

probability of surrendering policy  $P_X(UL, TL|i)$  in the future (more risk coverage). The sign of  $-\Delta X$  is positive given that the surrendering of the insurance policy (X) is inversely related to the customer's utility. So, we have:

$$\begin{aligned} U_1 &> U_0 \\ U_1 - U_0 &= -\Delta X \end{aligned} \quad (12)$$

Thus, not only does the insurer pay less commission, but by decreasing the surrender rate, it also earns more premium. As previously stated,  $\frac{\partial G}{\partial X} < 0$ , hence the sign of  $-\Delta P_X$  is positive.

$$\begin{aligned} G_1 &> G_0 \\ G_1 - G_0 &= \Delta C_{UL} \cdot \Delta UL - \Delta P_X(UL, TL|i) \end{aligned} \quad (13)$$

As a result of this change in status, according to the Kaldor-Hicks Compensation Criteria, those who made better-off (insurer and policyholder) can compensate those who made worse-off (seller) and still be in a better situation than before. The Insurer by paying  $\Delta C_{UL} \cdot \Delta UL$  to the seller can compensate the seller's loss even more than  $V_0$  and still be in a better situation due to the reduction in the surrendering rate of the insurance policy.

This conclusion would be true if the amount of life insurance sales does not decrease and in that way, the null hypothesis of this study cannot be rejected. But by decreasing the sales remuneration, the seller's motivation for selling life insurance products would decrease too and the insurer's benefit would decrease, respectively. It indicates that  $\Delta TL + \Delta UL < 0$ . Consequently, the overall impact of this strategy is not clear.

#### 4.2 Commission Increase for Term Life Insurance

With same assumption like previous change, the seller gets indifferent between sending the  $S_{TL}$  and  $S_{UL}$  signals. Therefore,  $(S_{UL}|UL)$ ,  $(S_{UL}|TL)$  strategy for seller is no longer dominant in this situation.

$$\begin{aligned} V_2 &> V_0 \\ V_2 - V_0 &= \Delta C_{TL} \cdot TL - C_{UL} \cdot \Delta UL \\ \Delta TL + \Delta UL &\geq 0 \end{aligned} \quad (14)$$

With an increase in the commission rate, the motivation of the seller to work harder will also increase, and they will sell more life insurance policies. This modification would improve the seller's benefit while maintaining the customer's utility same as Equation (12). The chance of receiving a correct signal to the customer would increase, and the surrender rate would fall. The insurer's benefit

would decrease by paying more commission to the seller, on the other hand, they gains more premiums from the reduction of surrendering probability.

$$\begin{aligned} G_2 &> G_0 \\ G_2 - G_0 &= -\Delta C_{TL} \cdot \Delta TL + C_{UL} \Delta UL - \Delta P_X(UL, TL|i) \\ \Delta TL + \Delta UL &\geq 0 \end{aligned} \quad (15)$$

According to the Kaldor-Hicks Compensation Criteria, the customer's utility will increase in this instance due to the greater likelihood of getting a correct signal. On the other hand, the seller can compensate the insurer and still be in a better situation. Because the insurer's total loss is less than  $\Delta C_{TL} \cdot \Delta TL$ . By increasing the term life insurance commission, a better situation based on social welfare criteria could be achieved. Thus, the current commission structure is not socially optimal.

#### 4.3 Increase in Payment Period for UL Sales Commission

It is assumed that extending the payment period for UL sales commission would be such that the seller gets indifferent between selling UL and TL. Consequently, the seller's gain would decrease:

$$\begin{aligned} V_0 &> V_3 \\ V_3 - V_0 &= -\Delta PV(C_{UL}) - (\Delta UL + \Delta TL) \\ \Delta UL + \Delta TL &\leq 0 \end{aligned} \quad (16)$$

The net present value of the seller's profit from selling UL will decrease and be added to the insurer's benefit as a result of this modification. The seller's motivation for selling life insurance products will also drop. For insurer, we have:

$$\begin{aligned} G_3 &> G_0 \\ G_3 - G_0 &= \Delta PV(C_{UL}) - (\Delta UL + \Delta TL) - \Delta P_X(UL, TL|i) \\ \Delta UL + \Delta TL &\leq 0 \end{aligned} \quad (17)$$

Given that the seller's behavior in this condition is identical to that in the first state, the customer's utility would be greater than the current situation. If the number of sales does not decrease, or  $(\Delta UL + \Delta TL) \geq 0$ , it can be stated that the new situation will be strictly better than the current situation. Consequently, the null hypothesis cannot be rejected based on this assumption. But because a change in commissions alters the seller's motives, the result of this strategy is unclear.

## 5. Conclusion

According to Central Insurance Regulation No. 83, the sales commission for universal life insurance is significantly larger than for term life insurance,

therefore the majority of sales representatives and brokers attempt to sell more universal life insurance products. Based on Ahmadzadeh et al. (2019) 85% of all life insurance policies in Iran are universal life insurance. In the top insurance-producing nations, this proportion is approximately 50%. According to the studies conducted on a similar issue of this research and the examination of the hypothesis, the following can be deduced:

If the seller has the same motivation to sell different types of life insurance, the chance of providing genuine advice to the customer will increase. By reducing the surrendering (or lapse) rate, a better situation can be achieved. Assuming that the seller's overall motivation to sell not weakened, because a reduction in Universal life insurance commission will decrease the seller's benefit, so it could result a negative impact on level of selling caused by reduction in seller's motivation. Therefore, the insurer can make the seller indifferent to selling each type of life insurance without decreasing the seller's motivation by employing a combination of the aforementioned strategies (for instance the insurer can decrease the universal life insurance commission and increase the term life insurance commission at the same time). According to welfare improvement criterion, a better situation can be achieved, and the current structure of life insurance sales commissions is not socially optimal.

## **6. Policy Recommendation**

1. In addition to the insurer's strategies, if surrendering the life insurance policy causes a reduction in the seller's revenue like the insurer, then a better situation could be achieved, and the seller will advise the customer according to their needs;
2. To mitigate the negative effects of asymmetric information, In addition to influencing the seller's behavior, artificial intelligence could be considered as a mechanism for customers to purchase products directly from the insurer;
3. This paper has examined only one of the obstacles facing the Iranian life insurance industry and its solution can assist to improve the industry's status to some degree. However, persistent inflation is the most important factor contributing to the decline in life insurance prevalence. Therefore, this topic should be considered in future studies.

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