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RESEARCH PAPER

Economic Sanctions and Consumption Inequality in Iran

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Abstract

Economic sanctions impose high costs on the national economy of the sanctioned countries. However, through punished countries, sanctions costs are not evenly distributed among all domestic economic agents. Although the distributional effects of sanctions have been subject of some research, much of the debates on the impacts of sanctions on inequality have mainly focused on income. However, for economists, the distinction between income and consumption could make a significant difference, especially if changes in incomes did not fully transmit to consumption. Our study contributes to this strand of literature by exploiting the concept of "consumption inequality" and empirically examining it in a sanctioned economy. To this end, we constructed a two-step approach of the Factor Augmented Vector Autoregressive Model by developing an index composed of many economic variables to capture the effects of sanctions on the Iranian economy from 1985 to 2019. Our findings indicate that there are time spans during which sanctions have imposed more impacts on the economy. They also display that the effects of sanctions on the Iranian economy were followed by increases in economic inequality, but the consumption inequality increased more relentlessly. Furthermore, income inequality and consumption inequality respond differently to shocks, which emphasizes the importance of the distinction between inequality indices. Our findings indicate that consumption inequality responds to economic shocks and that economic sanctions have significant and continuous effects on consumption inequality in Iranian society.

Keywords: Consumption Inequality, Income Inequality, Sanctions.

JEL Classification: D30, D63, F51.

1. Introduction

Historically, as a long-lasting instrument, primarily after World War II, economic sanctions have been a tool of coercive foreign diplomacy by some states and

international organizations. Global Sanctions Database (GSDB) shows an increase in sanctions from a total of 21 in 1950 to 473 by 2019 (see Kirilakha et al. 2021)[1]. Although there is no consensus on their effectiveness (Whang, 2011), economic sanctions can significantly affect the economic situation of sanctioned country. Research indicates that sanctions have adverse effects on sanctioned economies (e.g. Caruso, 2003; Dizaji and van Bergeijk, 2013; Kaempfer and Lowenberg, 2007; Neuenkirch and Neumeier, 2015; Peksen and Son, 2015; Yang et al., 2009) as well as on income equality in the sanctioned countries especially when poor people in the sanctioned country bear most of the costs of sanction policy. Increasing income inequality could harm both the political and the economic stability of the sanctioned country, leaving adverse effects on democracy in the country and bearing humanitarian consequences (Fails, 2012; Knack and Keefer, 1997; Landman and Larizza, 2009; Muller, 1985; Nepal et al., 2011; Neuenkirch and Neumeier, 2016; Solt, 2008).

Mainly drawn on Stolper-Samuelson theorem (1989), the distributional effects of sanctions have been the subject of some research (e.g. Afesorgbor and Mahadevan, 2016; Jeong, 2020). Our study contributes to this strand of literature by exploiting the concept of "consumption inequality" and empirically examining it in a sanctioned economy. There have been many sanctions against Iran imposed by some countries, especially the United States, and international entities with varying degrees in intensity and numbers in time. This feature makes Iran's economy a good case for investigating the economic effects of sanctions including their distributional consequences. Most research on the rising inequality including sanctions impacts on inequality has mainly focused on income. However, for economists, an individual utility function refers to consumption and leisure, so the distinction between income and consumption could make a significant difference, especially if changes in incomes did not fully transmit to consumption, because of temporary changes in incomes or if there was the possibility of borrowing or transfer from the government (Attanasio and Pistaferri, 2016).

Sanctions against Iran have a long history of more than 4 decades, after the 1979 revolution. There have been several sanctions against Iran imposed by some countries, especially the United States, and international entities. Because the sanctions have evolved during the time and don't have the same structure, it is necessary to distinguish them based on their specific features. We can see several

[1]. See GSDB website for more information and papers about sanctions at the link https://www.globalsanctionsdatabase.com/

periods of sanctions imposed on the Iranian economy, based on their specific features.

Period 1 (1979 to 2005): In this period, sanctions were imposed on the Iranian economy, primarily by the U.S. During that time, other international governments had not imposed any sanctions, so the U.S. sanctions did not impose significant restrictions on the Iranian economy. Furthermore, their impacts on several parts of Iran's economy were not comparable to other phases of sanctions. After seizing the American Embassy in Tehran by revolutionary students, the first sanction was imposed by the US in the form of freezing assets and the trade embargo[1]. The sanctions were lifted in January 1981 as part of the Algiers Accords, which was a negotiated settlement of the hostages' release. While the Iran–Iraq War, which began in September 1980, was in progress, United States sanctions prohibited weapon sales and all U.S. assistance to Iran in 1984[2].
In 1995, in response to the Iranian nuclear program and Iranian support of organizations (including Hezbollah, Hamas, Palestine Islamic Jihad), U.S. President, Bill Clinton, issued several executive orders against Iran[3]. The Iran and Libya Sanctions Act (ILSA)[4] was signed on 5 August 1996 (H.R. 3107, P.L. 104–172)[5]. George Bush's administration also imposed sanctions on Iranian economy in the form of Executive Orders numbers 13224 (2001) and 13382 (2005).

Period 2 (2006 to 2010): During this period, besides the U.S. sanctions, United Nations Security Council imposed several sanctions in the form of resolutions, following the report by the International Atomic Energy Agency Board of Governors regarding Iran's non-compliance with its safeguards agreement and the Board's finding that Iran's nuclear activities had raised questions within the competency of the Security Council[6]. This wave of sanctions was more severe than the first period because they included the Iranian nuclear-related materials and technology, the Iranian army, freezing assets, Iranian transport systems, and the Iranian financial and banking systems.

1. Executive Order 12170
2. Levs, J. (23 January 2012). A summary of sanctions against Iran. CNN. Archived from the original on 10 May 2018; Retrieved 9 May 2018.
3. Executive Order 12957 of 15 March 1995, banned U.S. investment in Iran's energy sector, and Executive Order 12959 of 6 May 1995, banned U.S. trade with and investment in Iran.
4. ILSA was renamed in 2006 the Iran Sanctions Act (ISA) when the sanctions against Libya were terminated.
5. Katzman, Kenneth (13 June 2013). Iran Sanctions. Federation of American Scientists. Congressional Research Service. Archived (PDF) from the original on 26 July 2013; Retrieved 29 July 2013.
6. Resolution 1969 passed on July 2006, resolution 1737, passed on December 2006, resolution 1747 passed on March 2007, resolution 1803 passed on March 2008, resolution 1835 Passed in September 2008, resolution 1929 passed on June 2010.

Period 3 (2011 to 2014): With this wave of sanctions to isolate Iran from the global economy, many Iranian sectors like the transaction sector were sanctioned by some countries. The main feature of these sanctions was restriction on Iranian oil export and the Iranian financial and banking system.

In this period, the sanctions on the Iranian Economy and Iranian entities became wider. Besides tightening UN and U.S. sanctions, European Unions also added to them for sanctioning the Iranian economy. Barak Obama's administration started a broad sanction campaign against the Iranian Economy (Including the Iranian Central Bank, Iranian petroleum and petrochemical industry, Iranian automobile industry, steel, and many significant sectors), and the UN Security Council levied more sanctions against the Iranian Economy to stop Iranian nuclear enrichment program. European Union also set sanctions which imposed restrictions on cooperation with Iran in foreign trade, financial services, energy sectors and technologies, and banned the provision of insurance and reinsurance by insurers in member states to Iran and Iranian-owned companies. On January 2012, the EU agreed on an oil embargo on Iran, effective from July, and to freeze the assets of Iran's central bank.[1] On March 2012, all Iranian banks identified as institutions in breach of EU sanctions were disconnected from SWIFT, the world's hub of electronic financial transactions.

Period 4 (2015 to 2017): After the third sanction period against the Iranian Economy, Iran and the P5+1 countries (the five permanent members of the United Nations Security Council—China, France, Russia, United Kingdom, United States—plus Germany) engaged in negotiations for an agreement on the Iranian nuclear program. They reached the agreement in Vienna on July 2015, named Joint Comprehensive Plan of Action (JCPOA). Based on JCPOA, UN and EU sanctions against the Iranian economy were removed. US sanctions on the third party to trade with Iranian entities was also removed, although many sanctions of US on Iranian economy were retained. The sanctions were removed with provisions to re-impose the sanctions in case of non-performance by Iran, under the JCPOA. After the agreement was run, many restrictions on the Iranian Economy were removed and it experienced some years of economic growth and an increase in oil and non-oil exports.

Period 5 (2018 up to now): When Donald Trump took the office in the U.S., political pressures on Iran increased to change some articles of JCPOA (freezing the Iranian nuclear program a longer time, and bringing the Iranian missile program

[1]. Nasseri, L. (12 February 2012). Iran Won't Yield to Pressure, Foreign Minister Says; Nuclear News Awaited. Bloomberg. Archived from the original on 23 December 2014; Retrieved 13 February 2012.

in negotiations), but Iran refused the changes. So, the U.S. re-imposed the sanctions before JCPOA and imposed new sanctions on the Iranian economy and Iranian entities, especially sanctions on Iranian banks, financial sectors, oil exports, steel and petrochemical exports, automobile sector, and so on. After the sanction and restrictions, Iranian oil and non-oil export reduced, and the collaboration of Iranian firms with foreign corporations was interrupted.

To analyze the effects of sanctions on Iranian consumption inequality, we need to use some indices which capture inequality in consumption among Iranian families. In the inequality literature, there are several measures to report consumption inequality. In this study, we have used two indices; Coefficient of variation of consumption (the ratio of the standard deviation of consumption between deciles to their average consumption at a percentage scale) and Palma inequality index which is a ratio of average consumption in the tenth decile to the sum of the average consumption of the first four consumption deciles.

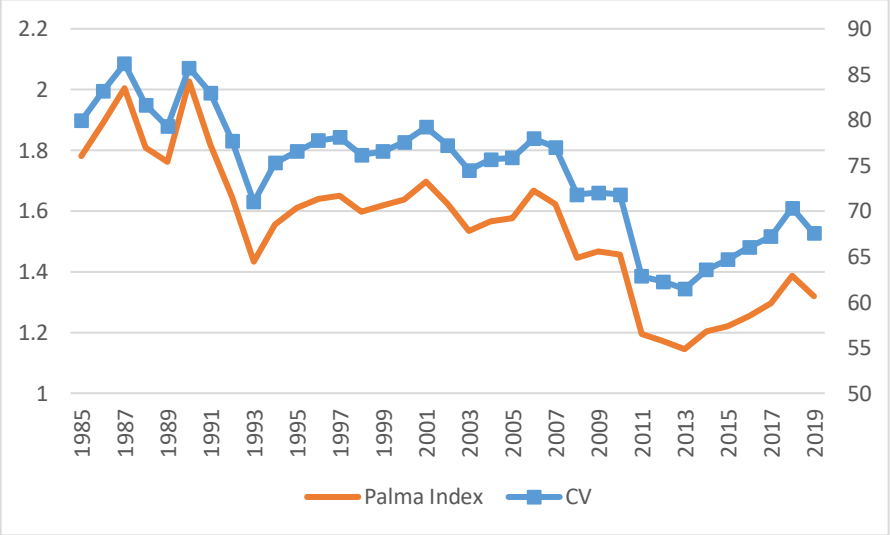

Figure 1. Consumption Inequality Indices among Iranian Family
Source: Research finding.

The figure shows a long-run decreasing trend in consumption inequality, but both indices turned to increasing inequality after 2013. To analyze the effects of sanctions on consumption inequality, we need to construct a model, which explained in section 3.

This article is organized as follows. Section 2 contains the literature review and in section 3 we will describe our empirical strategy. Section 4 contains our empirical results and finally in section 5 we will conclude the paper.

2. Literature Review

In a non-sanctioned economy, economic actors earn a share of domestic output depending on the structural of the economy. However, sanction impose restrictions on the system of the economy and change the income shares of the domestic actors. For example, due to the sanction format, trade sanctions can reduce foreign trade. This situation will change the income distribution to the detriment of economic actors involved in trade sectors.

Some research has indicated that the effects of economic sanctions on the penalized economy might depend on the type of sanctions (or sanctions instrument). The sanction arrangement and its various restriction types could affect income and consumption distribution. (Brooks, 2002; Jeong, 2020). Moreover, the economic structure of the penalized economies has an important role in determining the distributional effects of sanctions on the economy. In an economic structure with one commodity export section and a primitive non-export economy, export restrictions put on by trade sanctions may have great distributional effects to the detriment of modern sectors, however, in a diversified economy with many export products, it may be difficult to predict distributional effects of export restrictions.

In the literature, the potential effect of economic sanctions on income inequality was developed primarily based on the Stolper-Samuelson theorem (e.g. Cooper, 1989; Wang, 1991). According to the Stolper-Samuelson theorem, import restriction sanctions favor the factors that are used intensively in the import-competing sectors, due to the increase in the domestic demand for import-competing goods and services (Stolper and Samuelson, 1941). However, in that case the consumers of imported goods in sanctioned economy are adversely affected, simultaneously the consumers may be offset by benefits delivered in their roles as consumers of exporting goods (Black and Cooper, 1988)). At the same time, factors of production may be allocated in sectors of the economy in such a way that people hit by import sanctions from higher import-competing goods earn benefits from increasing wages in the production of import-competing goods. Moreover, this type of sanctions can decrease the relative price of exporting goods. Overall, Black and Cooper (1988) concluded that making the final effect on the income distribution of the sanctioned economy is not clear. Wang (1991) used the

Harris-Todaro model for agricultural and manufacturing sectors to compare the effects of import and export embargoes on national incomes and found that these two sanction instruments have asymmetrical effects on income distribution.

These analyses point to the fact that the economic structure of the sanctioned economy and sanctions instrument have to be included in the analyses because the impact of sanctions could differ depending on sanctioned economy's level of trade openness, its intensity of labor and capital, and its composition of foreign trade. For instance, Black and Cooper (1988) concluded that if domestic exporters use more labor-intensive production processes, the labor force is expected to suffer more from sanctions relative to capital owners. On the other hand, export-oriented sectors of labor-abundant countries intensively use unskilled labor, while import-competing sectors use skilled labor and capital. In labor-scare countries, skilled labor and capital are intensively used by export-oriented sectors, while import-competing sectors demand intensively more unskilled labor. Therefore, free trade is likely to reduce income inequality in labor-abundant countries because unskilled workers earn fewer wages than skilled workers and capital owners, as the reverse is also true in labor-scare countries (Ahlquist and Wibbels, 2012; Chang and Wu, 2016). Unlike the prediction derived from the Stolper-Samuelson Theorem, another strand of research points out that labor-abundant developing countries mainly export intermediate goods, though produced intensively using unskilled labor, for which the technology to produce is still more skilled-labor-intensive in a labor-abundant country. Thus, workers employed in export-oriented sectors are relatively wealthy and skilled in labor-abundant countries. Consequently, international trade may further widen income inequality even in a labor-abundant developing country (e. g. Feenstra and Hanson, 1997; Ha, 2012; Zhu and Trefler, 2005). All these point out that the effects of trade sanctions on income inequality may not be clearly predicted based on the Stolper-Samuelson Theorem and more factors should be included in the analyses, including the type of sanctions instrument and economic structure of the sanctioned economy (for example, factor endowments of the country; Jeong, 2020).

Income Inequality or Consumption Inequality? Which variable should be included in an inequality research, income or consumption? It is a primary question in this section of the study. Most inequality studies have concentrated on income inequality and less on consumption inequality. One reason is the easier availability of data about wages and other earnings of the labor force (Heathcote et al., 2010). Although analyzing income inequality data is practicable, analyzing consumption distribution is a better indicator of family welfare than income distribution because

the utility function in economics tradition is directly related to consumption, so, the joint analysis of consumption and income in an inequality study is more informative. For example, the joint analysis of both variables gives information about the presence of the consumption-smoothing mechanisms. It is important to know households' perception of an income shock as temporary or permanent, so, a single income analysis is not sufficient for an accurate investigation. Large and temporary income shocks have little welfare effects if consumers can smooth income shocks. Moreover, measurement errors in gathering consumption data are less than income data (Gnambs and Kaspar, 2016).

Because of different dynamics in relative prices of goods consumed by different income levels of society, consumption dynamics could be different by income levels, making a significant gap between income inequality and consumption inequality. If consumption distribution at a point in time has a smaller variance relative to income distribution, it shows that changes in consumption are smoother than income changes, so, the distinction between income and consumption will be crucial. The different trends in consumption and incomes could be because of the possibility of saving and borrowing for consumers and also the existence of transfers subsidies from governments. Finally, higher consumption of leisure could partly offset lower consumption of goods when it comes to overall welfare measurement (Attanasio and Pistaferri, 2016).

The main message of modern consumption theories is that risk-averse consumers prefer to have a smooth consumption flow (see the life-cycle hypothesis of Modigliani and Brumberg (1955) and the permanent income hypothesis of Friedman (1957)). Therefore, consumers base their consumption decisions on the permanent part of their income, rather than the current income. So, changes in income distribution will not map exactly onto consumption distribution. The possibility of consumption-smoothing depends highly on availability of tools to consumers, which facilitate the transfer of resources over time, including access to sufficiently developed financial (credit and insurance) markets, the existence of government transfers, and charity and NGOs, especially for low-income classes.

In the following we review the main studies that aim to gauge consumption inequality or consumption distribution and investigate their trends. It should be noted that consumption inequality and consumption distribution are equivalent so we may use the two interchangeably in the text.

One of the most important research issues was to evaluate the trends of consumption and income distribution simultaneously to determine the consumption smoothing condition. Cutler and Katz (1992) were the first to

examine this issue. They proved that the change in the consumption distribution is parallel to the changes in the income distribution. In other words, they indicated that all income shocks were considered as permanent shock by consumers. However, Slesnick (1994), Gottschalk et al. (1994), and Krueger and Perri (2005) showed that consumption inequality grows less and at a slower pace than income inequality. Indeed, they proved that a significant portion of income shocks were both temporary and uninsured.

There is a considerable difference between consumption and income inequality studies if consumers can smooth out transient shocks. In other words, it is recommended to study consumption inequality and income inequality simultaneously only if the consumption smoothing mechanism against transient income shocks is done correctly by consumers. However, some studies (e.g., Attanasio and Steven, 1996; Blundell et al., 2008, Dynarski et al., 1997) have shown that some consumers are not able to smooth the transient shocks because they are heterogeneous. There are some features like different demographic characteristics, wealth levels, various regions and religions that have a considerable impact on the response of consumers.

In recent years, the issue of heterogeneous consumers has been noticed by researchers all over the world. Anderson, Inoue and Rossi (2016) studied the impacts of fiscal policy shocks on consumers, that which differ due to individual characteristics. They found that unexpected fiscal shocks have considerable different impacts on consumers depending on their income and age levels. Moreover, governments' spending policy shocks tend to decrease consumption inequality. De Giorgi and Gambetti (2017) used a factor vector autoregressive model to characterize the cyclical dynamics of the consumption distribution and to investigate the responses of the consumption distribution to technology shocks and various uncertainty shocks. They found that the right-side of the consumption distribution, including educated households, has a larger and quicker response than other parts of the distribution to the shocks. In addition, they showed that shocks reduce consumption inequality. Najarzadeh et al. (2021) examined the consumption responses of different kinds of individuals to macroeconomic fluctuations using the urban Households Income and Expenditure dataset issued by the Statistical Center of Iran and a factor augmented vector autoregressive model. The results demonstrated that a positive oil revenue shock has only a considerable positive effect on the left tail of consumption distribution or the consumption of households with low educational attainments. Moreover, the shocks reduce consumption inequality. Nam et al. (2021) studied the impact of

macroeconomic uncertainty shocks on the household consumption choices. They found that a positive shock to financial, real, and macroeconomic uncertainty indices considerably decrease U.S. households' consumption. Further, they indicated that families that are more uncertain about their future consumption react to economic uncertainty more sensitively. Yang et al. (2021) investigated the impact of social networks on consumption using China Household Finance Survey panel data. They showed that the positive effect of social networks on family's consumption is greater in rural areas and for low-income groups. Furthermore, their results proved that social networks can alleviate the negative effect of exogenous shocks on consumption and play an informal insurance role.

3. Empirical Methodology

To analyze the impacts of economic sanctions on (income or consumption) inequality in Iran, we have constructed a two-step approach. We reckon that sanctions intensity on the Iranian economy is not smooth. In addition, there are time spans in which sanctions have imposed more impacts than other times. To estimate these effects on the Iranian economy, we have constructed an index composed of many economic variables. Sanctions usually impose their effects on the economy in the form of unpleasant changes in economic conditions, so we must construct an index whose changes show the impacts of sanctions on the Iranian economy.

The standard approach to model the effects of sanctions on an economy is the use of dummy variables (including time dummies or dummies for sanctions type). However, the idea of constructing an index for the effects of sanctions on the economy is an alternative to the standard approach. Some recent research has used an index for modeling the effects of sanctions on the sanctioned economy. For example, Dreger et al. (2016) constructed a sanction index for modeling anti-Russian sanctions imposed after the Ukrainian crisis. This index has been expanded in Kholodilin and Netšunajev (2019). Bali and Rapelanoro (2021) constructed another index using sanctions type and time to model the effects of EU sanctions on the Russian economy. Moreover, Li and Li (2022) constructed an index by nighttime lights to analyze the effects of economic sanctions on regional differences in Russia.

Furthermore, some researchers have used indices to model the effects of sanctions on the Iranian economy. Laudati and Pesaran (2021) constructed an index using newspaper coverage to model the effects of sanctions on the Iranian economy. The main weakness of the index is its dependence on the news. Although

at the beginning of the implementation of a sanction the frequency of its news on international publications increases and the index shows more intensity, but with time even if the said sanctions have not changed, they are not at the forefront of the news, so the index may show less intensity. Another point is that this index is based on international newspapers, while a significant part of the domestic news is related to the problems caused by sanctions which can be reflected in the domestic newspapers.

As stated in the theoretical background, the final effects of sanctions on the sanctioned economy is not clear (Black and Cooper (1988)). Also, the impact of sanctions could differ depending on sanctioned economy's level of trade openness, its intensity of labor and capital, and its composition of foreign trade. All of this tell us that modeling the effects of sanctions on the sanctioned economy is so complicated. As stated in the theoretical literature, one of the special features of sanctions is that there is no clear index to measure its intensity. So, using latent variable method in the empirical analysis can be an appropriate approach. Because of the latent variable approach and time series nature of our dataset, we have adopted a FAVAR approach to analysis. Our approach to construct an index of sanctions intensity is based on their effects on the macroeconomic variables. Our idea is that if sanctions have imposed unpleasant impacts on macroeconomic variables, we can observe that the sanctions have some effects on the Iranian economy. Heydari et al. (2021) also constructed a sanction intensity index using factor analysis to analyze the effects of sanctions on employment in Iranian economic sectors.

Following the FAVAR approach initiated by Bernanke et al. (2005), our model is constructed in the form of a small-scale FAVAR model. It should be noted that in comparison to the VAR model, the FAVAR model consists of a two-step approach (by principal component estimation) and thereby enables researchers to add more variables than a simple VAR. It then in the second step includes unobservable and observable variables unitedly in the VAR model. Assuming that F_t and Y_t have the following dynamics,

$$\begin{bmatrix} F_t \\ Y_t \\ I_t \end{bmatrix} = \Phi(L) \begin{bmatrix} F_{t-1} \\ Y_{t-1} \\ I_{t-1} \end{bmatrix} + \upsilon_t \qquad (1)$$

where Y_t is a $M \times 1$ vector of macroeconomic variables, I_t is an index of inequality (income or consumption inequality), F_t is an unobservable variable which shows economic conditions, $\Phi(L)$ is a conformable lag polynomial of finite order and υ_t

is a vector of stochastic shocks. Because F_t is not observable, we need to have an estimation for it to estimate equation (1), hence we have adopted a two-step approach. In the first step, we estimate the unobservable variable, F_t, then we use its estimate in (1). We assume that information about F_t can be extracted from a set of macroeconomic variables, X_t, which is a $N \times 1$ vector of many macroeconomic variables, which could also include elements in Y_t. Indeed, following FAVAR tradition we have the following relation between unobservable F_t and observables in X_t:

$$X_t = \Lambda F_t + e_t \quad (2)$$

where Λ is a $N \times 1$ vector of factor loadings, and e_t is a $N \times 1$ vector of mean zero and uncorrelated error terms. We assume that $N + 1 \gg M + 2$, which means that information set includes large enough variables more than M (number of variables in Y_t) plus 2 (including F_t and I_t). We can interpret (2) as a mechanism which shows relation between unobservable driver of economic conditions (or economic prosperity), F_t, and its projection in observable variables in X_t, like many mirrors in deferent aspects. We can estimate factor loadings in the vector Λ in the form of a factor model, using maximum likelihood method. After that, we can use of an estimate of F_t (which we show it by $\hat{F}_t$) in equation (1) and estimate it using standard methods of estimation of VAR models, like least squares method, by enough lag selection for $\Phi(L)$.

To estimate equations (1) and (2), we should select appropriate variables. Firstly, for the inequality index, I_t, in (1), we used three alternative indices; the Gini coefficient of income inequality (GINI), consumption coefficient of variation (CV), and Palma index of consumption inequality (PALMA). We have three estimation of (1) that are comparable because we have chosen three alternative variables for I_t.

For Y_t, we used inflation rate and GDP per capita based on inequality studies tradition that says inequality increases in lower per capita incomes, and the reverse is true in upper incomes[1]. In addition, some studies indicated that inflation affects inequality, but the direction of the effects is not specified and depends on many factors, estimation techniques, and data set attributes. For example, Balcilar et al. (2018) showed a nonlinear relationship between inflation and income inequality in the U.S.. Furthermore, Thalassinos et al. (2012) analyzed the relationship between income inequality and inflation in 13 European countries from 2000 to 2009 and showed that inflation had a positive significant impact on income inequality.

[1]. see Kuznets (1955).

To estimate (1), we need to have an estimation of F_t (which we show it by $\hat{F}_t$) which can be done by estimation of the loading factors in (2) (i.e., Λ), by the maximum likelihood method. To estimate loading factors in (2) we should specify an appropriate dataset of the vector X_t. Recall that we have postulated that F_t is non-observable, but it can be traced in variables of the vector X_t, so we need to specify macroeconomic variables which reflect the effects of economic sanctions. Indeed, we can interpret F_t as economic conditions (or economic prosperity) index, and its projection in observable variables in X_t, like many mirrors in different aspects. Table 1 shows the variables in the vector X_t and their abbreviation.

Table 1. Variables in the Vector X_t and Their Abbreviation

EXCHANGE	Percentage change of market exchange rate
CAP	Capital account balance
GDP	GDP growth (in Constant prices)
GDPPER	GDP per capita
INF	Percentage change in Consumer Price Index
NONOIL	Non-oil export (millions of Dollars)
OILINCOME	Oil exports (millions of Dollars)
CPRIVATE	Percentage change in consumption by private sector (in constant prices)
GPRIVATE	Percentage change in consumption by government sector (in Constant prices)
INVESTMENT	Percentage change in fixed capital formation (in constant prices)
DEFLATOR	Percentage change in GDP deflator

Source: Research finding.

Our assumption implied in Table 1 is that the sanctions effects are reflected in the variables of Table 1, so they can be candidates for being included in vector X_t. To select the variables in vector X_t we have also used the results and approaches of previous studies regarding the effects of sanctions on Iran's economy (see e. g. Heydari et al., 2021 for a similar work in this approach). For example, sanctions decrease oil incomes, reduce GDP growth, increase capital outflows, and decrease fixed capital formation.

Our data are in annual frequency and collected from the time series data set of the Central Bank of Iran (Economic Time Series Database, 2021) and the Statistical Center of Iran (HIES[1], 2020). Because we have 3 different inequality indices, we have 3 Vector Autoregression (VAR) models. Our VAR model of the GINI index span from 1969-2019, but VAR models of CV and PALMA are restricted to 1985-2019 because the data of consumption deciles have been

[1]. Households Income and Expenditure Survey

published since 1985. Variables in Table 1 also span from 1969 to 2019, so $\hat{F}_t$ also span from 1969 to 2019. It is necessary to say that we have tested the stationarity of all variables using the ADF (augmented dickey fuller) test and the KPSS test and have found that all the variables are integrated of order zero, I (0). To capture the effects of the Iran-Iraq war and also political instabilities of the 1979 revolution, we defined a dummy variable, named WAR, which is 1 between 1979-1988 and 0 otherwise, to include areas of the revolution, seizing the American Embassy in Tehran by revolutionary students (1979), and Iran-Iraq war (1980-1988) in the VAR models.

4. Empirical Results

Firstly, we estimated equation (2) using the maximum likelihood method. Table 2 shows the estimated factor loadings (vector $\widehat{\Lambda}$) and model evaluation tests; chi-squared and Bartlet Chi-squared. The null hypothesis of the two tests is that the correlation matrix of the variables in Table 1 is an identity matrix, meaning that there is no relationship between the variables of the vector X_t. In other words, an identity correlation matrix means the variables are unrelated and not ideal for factor analysis. A significant statistical test shows that the correlation matrix is not an identity matrix. Table 2 shows that two test statistics are significant at 95 percent confidence interval, which means there is a meaningful relationship between the variables and the factor loadings, so we can estimate $\hat{F}_t$.

Table 2. Estimates of Factor Loadings of Equation (2)
Method: Maximum of Likelihood

	Loadings		
	F1	Communality	Uniqueness
EXCHANGE	0.125860	0.015841	0.984159
CAP	-0.811230	0.658095	0.341905
GDP	0.071992	0.005183	0.994817
GDPPER	0.909399	0.827006	0.172994
INF	-0.154810	0.023966	0.976034
NONOIL	0.822703	0.676841	0.323159
OILINCOME	0.900826	0.811487	0.188513
CPRIVATE	-0.006071	3.69E-05	0.999963
GPRIVATE	-0.028167	0.000793	0.999207
INVESTMENT	-0.077230	0.005965	0.994035
DEFLATOR	-0.181374	0.032897	0.967103
	Chi-square statistic	Bartlett chi-square	

Test Statistics	148.9405	129.7024
Probability	0.0000	0.0000
Parameters	22	
Degrees-of-freedom	44	

Source: Research finding.

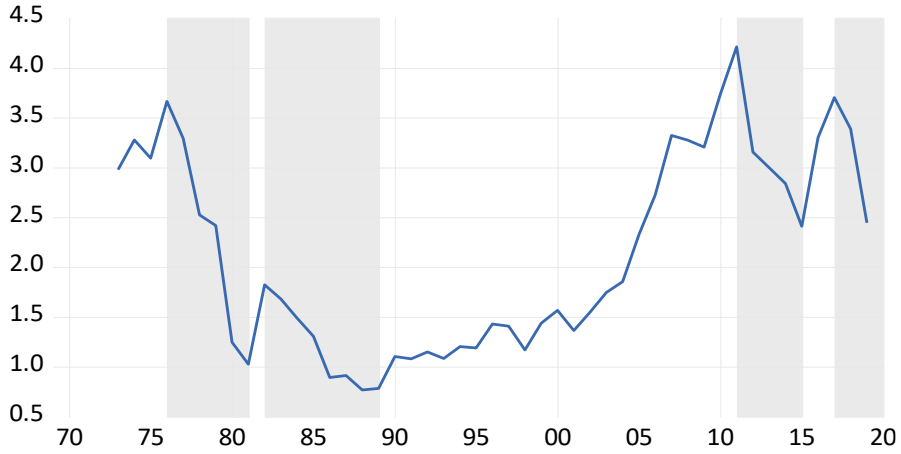

Figure 2. Estimated Index of Economic Condition ($\hat{F}_t$) Based on Table 2
Source: Research finding.

Figure 2 shows the estimated $\hat{F}_t$ based on the factor loadings in Table 2. There are four distinct periods of significant falling of the index; a) 1976-1981 is the period of political inconstancy (including the 1979 revolution and the beginning of the war between Iran and Iraq), b) 1982-1988 includes events of the war up to acceptation of the UN resolution number 598 by Iran and end of the war, c) 2011-2015 which is the era of the intense Iranian economic sanctions by the UN, EU and US (oil embargo, sanctions against Iranian Central Bank and financial sanctions) which ended with JCPOA, and d) 2017-2019 which is the era of the maximum pressure campaign of Trump's administration against the Iranian economy. The figure shows that sanctions and political instabilities could change the direction of $\hat{F}_t$, so we can interpret it as an economic condition index or an economic prosperity index. In other words, bad political events and economic sanctions can reflect their effects as turning the direction of $\hat{F}_t$ to lasting descends as long as the effects endure. Furthermore, we can use of $\hat{F}_t$ as an acceptable estimate of the economic condition and its ongoing descends as the signs of a bad political environment, mainly because of economic sanctions (in the case of the Iranian recent decades of economic history).

By estimating equation (2), we can estimate equation (1) using the standard method of least squares [1]. Before estimating the VAR models, it is necessary to test the stationarity of the variables and to determine their lag lengths. Based on the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity test, we cannot reject the null hypothesis of stationarity for the study variables at 5 percent type I error (Table 3). We have also determined lag orders by information criteria (Akaike information criteria and Swartz Bayesian information criteria). To ensure that the lag orders are appropriate, we have tested the hypothesis of no serial correlation in all the VARs' residuals. We would change the lag orders in the VAR model until the rejection of the no serial correlation hypothesis (Table 4).

Table 3. KPSS Unit Root Test of the Variables of the Three VAR Models

Variable	KPSS Test Statistics	Test Results
F	0.307018*	Stationary
GDPPER	0.23359*	Stationary
GINI	0.134693*	Stationary
INF	0.314439*	Stationary
PALMA	0.064436*	Stationary
CV	0.078267*	Stationary

Source: Research finding.
Note: * Denotes significant at 95 percent level.

Table 4. Serial correlation Test of 3 VAR residuals

Var with CV as Inequality index (CV VAR)			
Lag	LR stat	df	Prob.
1	21.43681	16	0.1623
2	18.09661	16	0.3183
3	16.52256	16	0.4171
4	13.34631	16	0.6473

Var with GINI as Inequality index (GINI VAR)			
Lag	LR stat	df	Prob.
1	26.53404	16	0.0470
2	12.46881	16	0.7111
3	10.04337	16	0.8644
4	16.20753	16	0.4386

Var with PALMA as Inequality index (PALMA VAR)			
Lag	LR stat	df	Prob.
1	22.59451	16	0.1250

[1]. Variables are in logarithmic form.

2	17.33560	16	0.3642
3	16.37736	16	0.4269
4	11.34324	16	0.7878

Source: Research finding.

Note: Null hypothesis: No serial correlation at lag h.

Besides implementing LM tests of serial correlation, we have tested the normality of the residuals by the Jarque-Bera chi-squared test. The idea is that if the VARs are well specified, their residuals will behave approximately stochastically with no significant skewness and excess kurtosis relative to the normal distribution. The results show no significant deviation from the normal hypothesis in the three VAR residuals (Table 4).

Table 5. Test of Normality in VAR Residuals

VAR Residual	Jarque-Bera	df	Prob.
CV VAR	7.668560	8	0.4665
GINI VAR	13.52926	8	0.0949
PALMA VAR	3.205043	8	0.9208

Source: Research finding.

Figure 3 shows responses of the inequality indices of the three VAR models to one standard deviation innovation to shocks. To identify the shocks, we have followed the approach by Pesaran an Shin's (1998) Generalized Impulses, which is insensitive to the ordering of the variables in the VARs. As various panels of the figure show, responses of CV and PALMA indicators as alternative indices of consumption inequality are alike. However, GINI responses to the shocks of different variables are unlike them.

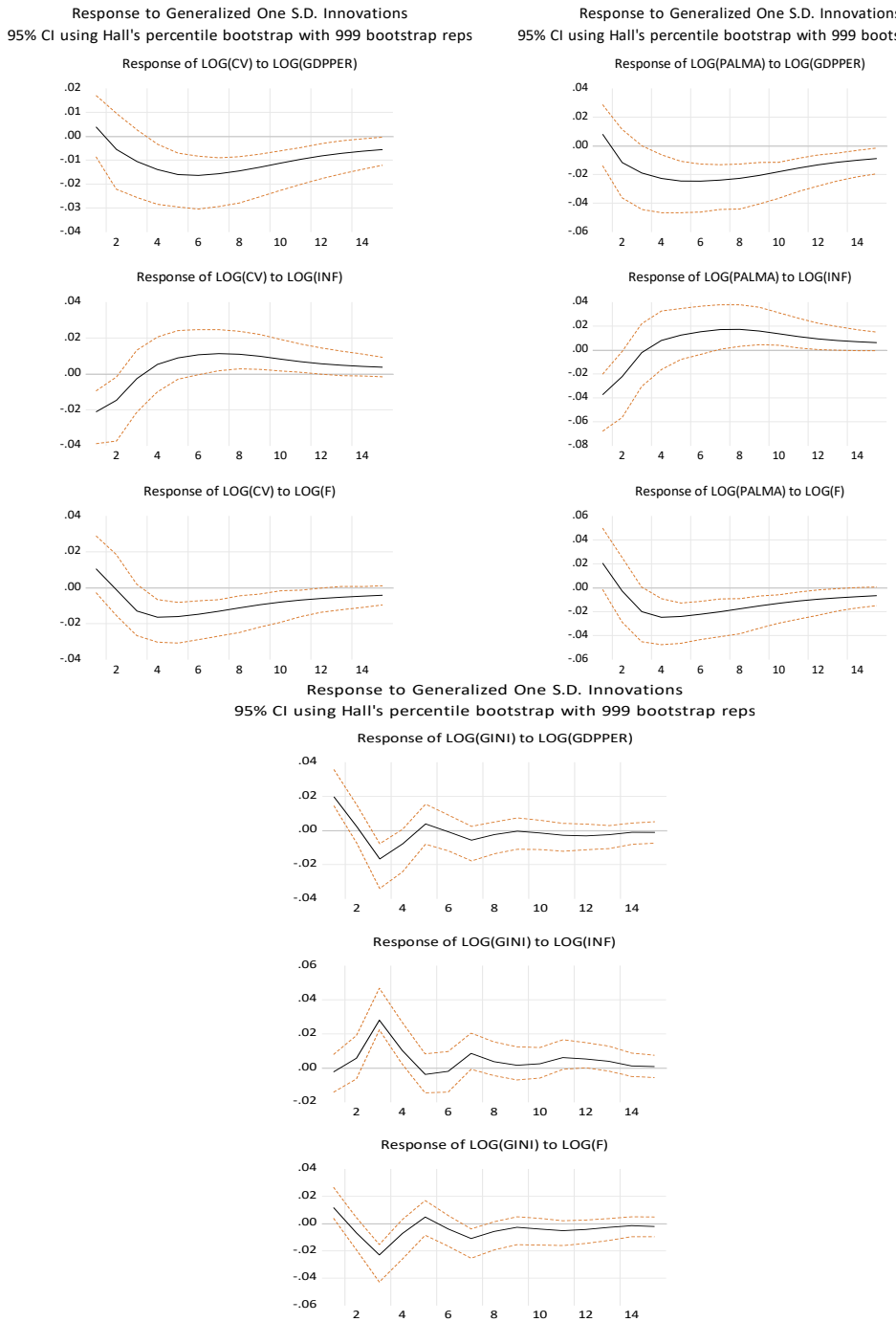

Figure 3. Response Functions of Inequality Indices to One Standard Deviation Innovation to Variables

Source: Research finding.

All the responses are significant in 95 percent confidence intervals. The figure shows that an increase in GDP per capita will smoothly decrease consumption inequality in Iran. Unlike consumption inequality, the response of income inequality (GINI) to an increase in GDP per capita is variable. The Response of consumption inequality to inflationary shocks is negative in the initial years, but it is reverse in subsequent years. It confirms that inflationary shocks in the medium to long run increases consumption inequality. Like the response of income inequality, the response of the income Gini index to inflationary shocks is variable and differs from that of consumption inequality indices, but overall, it shows that inflationary shocks will increase income inequality.

To better compare the impacts of sanctions on income and consumption inequality, Figure 4 indicates the three responses of inequality indices to one standard deviation innovation to economic conditions ($\hat{F}$). Remember that sanctions ruin economic conditions, so an increase in the level of sanctions causes a decrease in the economic condition index. In other words, sanctions have a negative relationship with the economic condition index, $\hat{F}$, as their effects reflect on dimensions of $\hat{F}$. Figures 3 and 4 show that all responses are significant in a 95 percent confidence interval, so we can say that improvement of economic conditions, as expected, has a meaningful impact on income and consumption inequality. Responses of consumption inequality to an economic condition shock are smooth. Moreover, it confirms that better economic conditions lead to more consumption equality in the Iranian economy. The response of income inequality is more variable, but it is in general in the same direction. Therefore, we can say that the effects of sanctions on the Iranian economy were followed by increases in economic inequality, but the effects on consumption inequality are smoother.

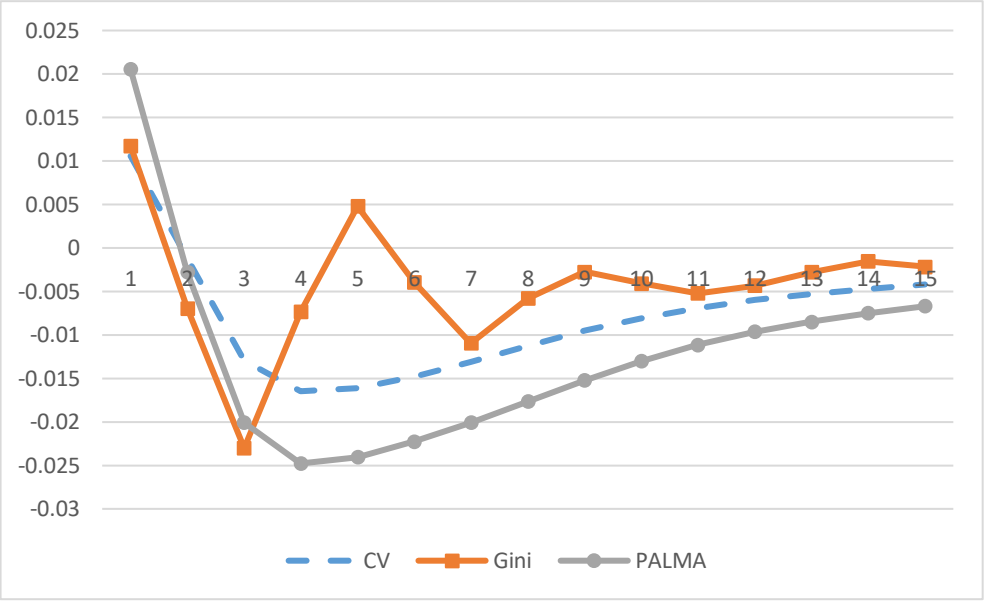

Figure 4. Responses of Inequality Indices to One Standard Deviation Innovation to Economic Conditions ($\hat{F}$)
Source: Research finding.

Table 6 contains variance decompositions of the three inequality variables. As results show, the economic condition index explains a significant share of the variances of three inequality variables between 5 to 10 years. This finding indicates that sanctions have a prominent share of inequality in the Iranian economy.

Table 6. Variance Decompositions of the three VAR Models

Part 1: Variance decomposition of log (CV)

Period	S.E.	LOG(CV)	LOG(GDPPER)	LOG(INF)	LOG(F)
1	0.041634	100.0000	0.000000	0.000000	0.000000
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
5	0.060773	74.06496	17.74482	1.134690	7.055535
		(14.7906)	(12.4026)	(7.72886)	(11.7123)
10	0.069286	59.31539	33.78670	1.252384	5.645529
		(15.1241)	(15.0854)	(9.27983)	(12.1595)
15	0.071378	56.12535	37.20484	1.318026	5.351781
		(16.1375)	(16.4928)	(9.98865)	(12.8090)
Cholesky Ordering: LOG(CV) LOG(GDPPER) LOG(INF) LOG(F)					
Standard Errors: Monte Carlo (100 repetitions)					

Part 1: Variance decomposition of log (Gini)

Period	S.E.	LOG(GINI)	LOG(GDPPER)	LOG(INF)	LOG(F)
1	0.041105	100.0000	0.000000	0.000000	0.000000

		(0.00000)	(0.00000)	(0.00000)	(0.00000)
5	0.058171	61.35757	11.66795	19.64710	7.327377
		(12.0801)	(8.07393)	(8.73604)	(7.02286)
10	0.062138	56.07439	12.32102	18.97392	12.63068
		(13.1555)	(9.13862)	(9.57058)	(7.31689)
15	0.063341	54.71167	13.02868	19.64367	12.61599
		(13.9369)	(10.0792)	(10.4581)	(7.78195)
Cholesky Ordering: LOG(GINI) LOG(GDPPER) LOG(INF) LOG(F)					
Standard Errors: Monte Carlo (100 repetitions)					
Part 1: Variance decomposition of log (Palma)					
Period	S.E.	LOG(PALMA)	LOG(GDPPER)	LOG(INF)	LOG(F)
1	0.067499	100.0000	0.000000	0.000000	0.000000
		(0.00000)	(0.00000)	(0.00000)	(0.00000)
5	0.096950	74.17515	19.83141	0.728844	5.264599
		(14.2647)	(13.3700)	(6.34649)	(8.56859)
10	0.109845	60.50891	34.29082	0.913233	4.287038
		(15.5793)	(16.0907)	(5.88849)	(8.87341)
15	0.113294	57.28542	37.63906	1.001675	4.073846
		(16.7486)	(17.5962)	(6.14833)	(9.90416)
Cholesky Ordering: LOG(PALMA) LOG(GDPPER) LOG(INF) LOG(F)					
Standard Errors: Monte Carlo (100 repetitions)					

Source: Research finding.

The difference in responses of income inequality and consumption inequality to shocks shows that selection of the inequality indexes among various variables such as income, consumption, and wages is a crucial step in the inequality analysis. As explained in the theoretical background, there is more emphasis on consumption because it better reflects consumer's utilities than income. Therefore, differences in the response of income inequality relative to consumption inequality show that there is a different mechanism between income and consumption. The information problems of income indices, the existence of consumption smoothing behavior, different dynamics in relative prices of goods consumed by different income levels of society, the possibility of saving and borrowing for consumers, the existence of transfers from governments, and higher consumption of leisure are possible explanations for different trends in income and consumption responses to an economic shock. We have shown that consumption inequality responded to economic shocks, and economic sanctions have a meaningful impact on consumption inequality in Iranian society.

Drawn on the literature of the consumption theory and following the life-cycle hypothesis of Modigliani and Brumberg (1955) and the Permanent Income

Hypothesis of Friedman (1957), we recognize that risk-averse consumers prefer to have a smooth consumption flow. Therefore, consumers base their consumption decisions on the permanent part of their income, rather than the current income. Thus, changes in income distribution will not map exactly onto consumption distribution. Our results confirm the idea that the responses of consumption inequality to the shocks in economic volatilities are smoother than income inequality.

Our results showed that the sanctions do not have similar effects on the Iranian economy, as Figure 2 shows, which confirms that the structure of sanctions against Iran was not the same over time. As it was said in the theoretical part of the paper, the sanction arrangement and its various restriction types could affect income and consumption distribution (Brooks, 2002; Jeong, 2020). So, our results support the idea and show that the sanctions of the Obama administration and the maximum pressure campaign of Trump have had effects on the Iranian economy, as they turned the economic conditions index (see Figure 2). In general, we can conclude that the sanctions of the 2010s have had significant distributional impacts on Iranian society and have hit the poor people more than the rich people.

5. Conclusion

This paper aimed to model the effects of economic sanctions on economic inequality. We constructed an index of economic conditions that could reveal information about economic sanctions and other events that degrade economic prosperity. Our idea was that the sanction trend as a variable is not visible and measurable in statistics, but its economic impacts can be measured. The results showed that in the Iranian economy, economic sanctions (especially recent sanctions by the US, EU, and UN) have had effects on economic prosperity. Our results showed that inflationary shocks have had impacts on consumption equality in the Iranian economy. Furthermore, we can say that the effects of sanctions on the Iranian economy were followed by increasing in economic inequality, but the consumption inequality increased more obviously. The results showed that improvement of economic conditions, as expected, will have significant effects on income and consumption inequality, but responses of consumption inequality to shocks to economic condition is smooth and, in general, our findings indicate that better economic conditions are followed by more consumption equality in Iranian economy. The response of income inequality is more variable, but, overall, it is in the same direction. The difference in responses of income inequality and consumption inequality to shocks shows that it is important to focus on inequality

index. We have indicated that consumption inequality significantly responds to inflationary shocks and per-capita income shocks. Also, economic sanctions have had significant and continuous impacts on consumption inequality in Iranian society.

Our results support the idea and show that the sanctions of the Obama administration and the maximum pressure campaign of Trump have had effects on the Iranian economy. Therefore, we can conclude that the sanctions of the 2010s have had significant distributional effects on Iranian society and have hit the poor people more than the rich people.

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