Iranian Economic Review 2021, 25(1), 57-68
DOI: 10.22059/ier.2019.70879

RESEARCH PAPER

The Population Aging Effect on Pattern of Export (Case of Major Trade Partners of Iran)

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Received: 29 December 2018, Revised: 2 February 2019, Accepted: 14 March 2019

Abstract

The purpose of this paper is to examine the effect of population aging effect on trade in major trade partners of Iran during the period 2000-2015. In this paper, we show that demographic differences between countries are a source of comparative advantage in international trade. Since many skills are age-dependent, population aging decreases the relative supply and increases the relative price of skills which depreciate with age. Thus, industries relying on skills in which younger workers are relatively more efficient will be more productive in countries with a younger labor force and less productive in countries with an older population. The results indicated that the secondary education group and the average age of people between the ages of 20-40 and 41-65 years had a positive and significant effect on the exports compared to the elementary and excellent education groups. The results showed that human capital in more experienced age groups by improving job skills leads to comparative advantage and increases in exports of countries.

Keywords: Trade Patterns, Comparative Advantage, Population Aging, Labor Skills, Panel Data.
JEL Classification: B17, P23, E24, C23.

Introduction

Many countries observe major changes in the demographics of their populations as aging leads to a shift in the age structure of the labor force towards older workers. These changes are likely to have a profound influence on the structure of economic activity within countries and on the pattern of trade between them through a change in the relative supply of age-dependent skills. Recent research on aging suggests that there is a negative relationship between age and some cognitive abilities, with a number of studies showing that cognitive decline begins as early as the age of 25. This implies that aging societies experience a more rapid decline in the quality and the stock of certain cognitive skills and may thus lose comparative advantage in industries which use those skills intensively (Caia and Stoyanov, 2016).

Factors such as public health improvement, better nutritional status, more awareness about the right lifestyle and medical equipment have reduced mortality rates in these countries and increased the world population. A group of economists sees population growth as a factor in the development and supply of labor for productive, inventive and innovative activities and production. They see the rise of the population as the main motive for the dynamics and work of the people. The theory of this group of economists also boosted the world population and expanded the population to an explosion, prompting opponents of population growth to state

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that economic and social problems, constraints on food supplies and habitations are major barriers to population growth and population growth also causes a significant portion of government revenue to be expended on providing essential economic, social and health services to the additional population, which in turn prevents the improvement of living standards.

This article links economics, with its focus on skills and productivity, and psychology, where the idea of different skills changing differently with age first originated. A series of studies on cognitive abilities and aging consistently report that speech and language abilities improve with age, while memory, multitasking, and the speed of information processing decline with age. Furthermore, a decline in physical strength with age is well documented in the medical literature. Knowing the importance of those skills for various occupations and the composition of occupations across industries, we are able to pin down industry-level demand for each age-dependent skill. For instance, among the occupations which rely heavily on age depreciating cognitive skills are various types of machine operators, where coordination, divided attention, and perceptual speed are very important. As a result, in industries where most workers enter as machine setters and operators, such as yarn mills or wood product manufacturing, age-depreciating skills are used intensively. Other industries, such as printing or beverages and tobacco, employ many workers in occupations which require good written and/or oral communication skills (e.g. technical writers or sales representatives) and use age-appreciating cognitive skills intensively.

One such mechanism operates through the effect of population aging on the stocks of age-dependent skills. If individuals are endowed with certain stocks of age-dependent skills which they supply to the market, then a country with an older labor force, all else being equal, will have lower endowments and higher relative prices of age-depreciating skills and thus specialize in the production of goods which utilize age-appreciating skills intensively. The second mechanism through which demographics operate is the effect on labor productivity. If aging affects the quality rather than the quantity of age-dependent skills, then older workers become less productive in tasks which require age-depreciating skills, and the age composition of the labor force would determine the relative productivity of an industry. In the presence of labor market frictions which prevent perfect sorting of workers into industries based on their age, industries would inherit the national age distribution, in which case population aging would shift the age distribution of employees in all sectors and increase (decrease) labor productivity in industries which rely on age-appreciating (age-depreciating) skills.

Availability of historical demographic data allows us to test the dynamic predictions of the model. Specifically, we would expect fast(slow)-aging countries to observe a decrease in the relative price of age-appreciating (age-depreciating) skills and an increase in the relative productivity of industries which use those skills intensively, thus making them more competitive in the global market. Analyzing the effect of population aging on changes in comparative advantage allows us to address many omitted variable concerns in the estimation, and in particular the effect of institutional factors which do not vary over time. We also pay close attention to other potential sources of endogeneity in the empirical model, and explore the robustness of our results using an instrumental variable approach and alternative measures of countries' effective endowment in age-dependent skills.

This paper contributes to the fast-growing literature that formally tests the relationship between factor proportions and trade flows. Specifically, it is related to the classical works documenting the important role of physical and human capital endowments in comparative advantage. More recent developments in this literature emphasize non-traditional sources of comparative advantage, such as the cross-country variations in contract enforcement (Levchenko, 2007; Nunn, 2007), the quality of financial systems (Beck, 2003; Manova,

2008), the extent of labor market frictions (Helpman and Itskhoki, 2010; Cunat and Melitz, 2012; Tang, 2012), skill dispersion (Bombardini et al., 2012), and water resources (Debaere, 2014). Our study contributes to this literature by proposing a factor of comparative advantage stemming from the differences in endowments of cognitive and physical skills between countries. Using the variation in demographic composition across countries and the variation in age-dependence of different cognitive skills, we are able to construct a reliable proxy for a country's effective endowment in unobservable cognitive and physical skills. We thus demonstrate that demographics can affect cross-country differences in effective endowments of cognitive and physical skills and is an equally important determinant of comparative advantage as are the differences in physical and human capitals.

This paper seeks to examine the effect of the difference in age pyramid on international trade. Countries with a young population seem to have different products from countries with a relatively old population. The statistical population of the present study includes major trade partners of Iran data for the period 2000-2015. The paper is organized as follows. Section 2 discusses the theoretical Literature. Section 3 describes the data and Sections 4 presents the baseline empirical results. Section 5 concludes.

Theoretical Literature

Population structure and its evolution over time as one of the important issues affecting various sections of societies are of great significance. At present, the population of OPEC countries, like many developing countries, seeking to continuously reduce fertility and increase life expectancy, undergo significant changes in their age structure, which merit important economic, social considerations in terms of policy and planning. In fact, population size and growth are the factors that have received the most attention in the discussion of the relationship between demographic characteristics and the environment. In the environmental economics debate, the population is also an environmental pollutant. Because as population increases, demand for agricultural land, energy resources, water resources, and so on increases. This can lead to the destruction of forests and pastures, reduced fertility of agricultural land and environmental pollution (Fatras and Ghorban Seresht, 2012).

The shift in time allocation for human capital accumulation is another topic that is heavily influenced by the changing age structure and demographics. Given the declining supply of labor that results from aging in the economy, various factors are being considered to compensate for this. Increasing proportion of the elderly population puts pressure on the labor market, which will lead to higher wages. Since the return on human capital is determined by people's discounted future earnings, wage increases will encourage the younger generation to invest in education (Fougere et al., 2009). Therefore, it can be seen that changing population structure will also affect the way people allocate time in different generations for education, work and leisure.

Changing the structure of the population, on the one hand, changes the share of education in human capital, and, on the other hand, transforms experience into one of the factors of human capital due to changing the age of the population, and thus the net effect of changing the structure of the population on human capital will be ambiguous. Sadahiro and Shimasawa (2003) examined the long-term effects of population restructuring in the Japanese economy, which showed that the decline in population growth has led to an increase in the motivation of younger people to allocate their time to education, which has led to an increase in human capital. Fougere et al. (2009) also demonstrated in the Canadian economy that population restructuring has increased the motivation of young people to invest in human capital.

The level of trade impact on the overall factors of production and, consequently, on economic growth will be stronger when combined with the accumulation of human capital in

one country. In other words, the benefits of trading for countries with higher skills are far more than low-skilled countries. The combination of human capital and trade actually represents a higher degree of efficiency of the trading sectors of the countries and it has a stronger effect on the economic growth of the countries (Soderbom and Teal, 2003). The ability to absorb transmitted technologies in the course of trade depends on various factors, such as the social capacity of an economy, and the social capacity of an economy is in fact determined through the variable of human capital of that society (Abramovitz, 1986). In truth, human capital determines the capacity of the economy to innovate, adapt, and accept technology from the borders. Capital goods and intermediate goods contain a certain level of technology, and therefore the import of these commodities is one of the ways of technology transfer. A country that is free to import such goods can use international innovations and thus increase the productivity of production factors and, as a result, economic growth. But the usability and applying these technologies depend on the level of education, skills and abilities of the workforce of that society (Badinger and Tondl, 2002).

Jalaie and Sabagh Pourfard (2008), in their research, investigated the relationship between differences in gender and developmental level with the help of the Human Development Index in Iran using VEC, VECM models. The results indicate that women's political participation can have a definite impact on economic development, which will affect how decisions are made in the Iranian economy. Vaez Barzani and Hatami (2010) examined the effect of educational gender equality on economic growth in selected developing countries. In this study, the direct and indirect effects of educational gender equality on economic growth have been examined using synchronous system model and seemingly unrelated regression (SUR) method. The results of the model's estimation show that the gender equality in education had a positive and significant effect on economic growth. Based on the results, improving gender equality in education has accelerated economic growth, which was directly due to its impact on human capital accumulation and indirectly through adjusting population growth and investment development. Therefore, it is imperative that developing countries, by adopting appropriate policies and taking into account the role of women in economic development, prepare the ground for promoting gender equality for economic growth. Boozhmehrani (1392) examines the impact of the decline in fertility and the aging of the Iranian population composition on the category of social capital using Garch model. The results indicate that Iran's population is currently moving rapidly in age, and as fertility declines and life expectancy rises, the number and percentage of middle-aged and elderly people increases, and the youth population declines. Sharepour and Arman (1393) have analyzed the various levels of social capital of women and men in Tehran. The sample size of this study is 20,670 citizens over 18 years of age living in Tehran. The results indicate that there is no significant difference between the average social capital of family and relatives among women and men, while there is a significant difference between the average social capital of friends, neighborhood and total social capital between men and women. That is, the average social capital of friends, neighborhood and the total was more for men than women.

Do, Levchenko and Raddatz (2012) have studied the effect of fertility on competitive advantage and international trade using Ricardo's theory and the 2SLS method. The study suggests that countries with a comparative advantage in low-calorie products have lower fertility rate because women's wages in these countries are lower and they need more work to earn a living, so the cost of raising children is higher in these countries. Cuberes and Tamura (2014), in a research using optimization method, measured the optimal fertility and birth rate in order to improve the human capital status and increase the welfare through international trade, and reached an optimal solution. In this study, panel data is used. The results indicate a growth rate of 1.9 for fertility index in order to achieve maximum. Cai and Stoyanov (2016) have studied the demographic differences between countries according to their competitive

advantage in international trade. In this study, the degree of industrialization of countries has been addressed according to their age distribution using two Ricardo and Heckscher–Ohlin and a cross-sectional pattern. The results indicate that industries that rely on younger workers are more efficient. Population aging also leads to specialization in industries that need higher skills.

Methodology of Research

In this study, an empirical model based on gender and age-related skills is presented concerning the relative advantage of Ricardian and Heckscher-Ohlin models. We introduce age-dependent skills into the theoretical model of Ricardian and Heckscher–Ohlin comparative advantage by Chor (2010). In that extension, population aging affects country's comparative advantage both through a reduction in relative supply and an increase in relative price of agedepreciating skills (Heckscher–Ohlin channel) and through a direct effect on labor productivity in tasks that rely on age-dependent skills (Ricardian channel) (Caia and Stoyanov, 2016). The empirical specification implied by the model is similar to Chor (2010) and Bombardini et al. (2012):

$$lnX_{cpi} = \sum_{k=K} \beta_k I_i^k \times Age_c + \sum_{f \in F} \phi_f I_i^f \times F_c^f + \delta'_{cp}\lambda + \gamma_c + \gamma_{pi} + \varepsilon_{cpi} \quad (1)$$

where X_{cpi} is exports from country *c* to country *p* in industry *i*, *K* is the set of age dependent skills and *F* is the set of other factors of production, I_i^k is the intensity of industry *i* in factor of production *k*, Age_c is the demographic structure in country *c* assumed to be increasing as population is getting older, F_c^f is endowment of country *c* in factor *f*, and δ'_{cp} is bilateral trade costs. Coefficients ϕ_f reflect the importance of conventional determinants of comparative advantage, such as human and physical capital endowments (Caia and Stoyanov, 2016).

In Equation (1), the coefficients β_k on interactions $I_i^k \times Age_c$ capture both the Ricardian and the Heckscher–Ohlin channels. Separating the two effects is neither critical nor feasible for this study. In either case, the estimates of model (1) are valid for the purpose of evaluating the effect of population aging on trade flows and comparative advantage. Whether this effect operates through changes in skill premia or labor productivity is irrelevant for the main finding of this paper that aging countries experience structural changes in their production and trade patterns away from industries which rely on age-depreciating skills. Isolating one effect from the other would require micro data and a good measure of individual productivity to evaluate the relationship between aging, skill premia and labor productivity, which is outside the scope of this paper. Thus, we leave these questions for future research.

The interaction $I_i^k \times Age_c$ is the main variable of interest and the sign of β_k allows us to test the key theoretical prediction that younger countries have a comparative advantage in industries which intensively use age-depreciating skills. The theoretical model predicts that $\beta_k < 0$ for skills that worsen with age and $\beta_k > 0$ for skills that improve with age. Furthermore, Equation (1) implies that for any pair of countries c_1 and c_2 exporting goods *i* and *j* to a third country *p* the following holds:

$$E\left[\ln\left(\frac{X_{c1pi}}{X_{c2pi}}\right) - ln\left(\frac{X_{c1pj}}{X_{c2pj}}\right)\right] = \sum_{k=K} \beta_k \left(I_i^k - I_j^k\right) \times (Age_{c1} - Age_{c2}) \quad (2)$$

If country c_1 has a younger population than country c_2, $Age_{c1} - Age_{c2} < 0$, and industry *i* is more intensive in skill *k* than industry *j*, $I_i^k - I_j^k > 0$, then we would expect country c_1 to export relatively more (less) of good *i* than *j* if skill *k* depreciates (appreciates) with age, which would be the case when $\beta_k < 0$ ($\beta_k > 0$).

In our baseline specifications we control for two standard Heckscher–Ohlin factors of comparative advantage — the cross country differences in physical capital and skilled labor.

Given that countries export more in industries which use their abundant factors intensively, we expect $\phi_f > 0$ for all standard factors of production. The vector δ'_{cp} in Equation (1) captures bilateral trade frictions between countries *c* and *p*. Exporter fixed effects γ_c control for exporter's aggregate productivity level, size, remoteness from other countries, and other characteristics that do not vary across industries. Importer-industry fixed effects γ_{pi} control for product prices in the importing country and all other demand shifters, including those which may be driven by cross-country demographic differences.

There are two potential endogeneity concerns with $I_i^k \times Age_c$ variables in Equation (1). The first one relates to the demographic composition of a country's population. A country's median age is predetermined relative to industry-level trade flows, and it is difficult to think of other reasons why the median age could affect the export structure other than through the effect on either supply or demand. However, it may be related to other unobservable countries' determinants of comparative advantage which may have differential impact on productivities in industries with different skill intensities.

The model accommodates both productivity and factor endowment differences in a setting with multiple countries, industries, and factors of production. In this setup, for any pair of countries c_1 and c_2, their relative exports of product i to country p is given by:

$$\frac{X_{c1pi}}{X_{c2pi}} = \frac{(\varphi_{c1}^i / mc_{c1}^i d_{c1p}^i)^\theta}{(\varphi_{c2}^i / mc_{c2}^i d_{c2p}^i)^\theta} \quad (3)$$

where X_{c1pi} is the value of exports of good i from c1 to country p, d_{cp}^i is the iceberg trade cost for shipping one unit of i from c to p, and θ is the inverse of productivity shock variance. The term mc_c^i is the unit production costs of country c in industry i which captures the Heckscher–Ohlin forces and φ_c^i is the Ricardian productivity of country c in industry i. Following Chor (2010), we parametrize the productivity term and the unit cost function as follows, distinguishing coefficients that relate to demographics with stars:

$$ln\varphi_c^i = \mu_c + \mu_i + \sum_{k=K} \rho_k^* I_i^k \times Age_c + \sum_{(n.m)} \rho_{nm} L_i^n \times M_c^m \quad (4)$$

$$mc_c^i = \prod_{k\in K} (W_{ck})^{s_{ki}} \prod_{f\in F} (W_{ck})^{s_{fi}} \quad (5)$$

μ_c and μ_i are country and industry productivity parameters, L_i^n and M_c^m are country and industry characteristics, such as institutional factors, which determine country's productivity edge in that industry, and coefficients ρ_{nm} reflect the strength of the effect of interactions $L_i^n \times M_c^m$ on productivity. If senior workers become less productive in tasks that require age-depreciating skills, productivity will also depend on the interaction of industry's intensity in age-dependent skill k, I_i^k, and a measure of a country's demographic composition, Age_c, which we assume is increasing as a country's population becomes older. To the extent that industries inherit age distribution of a country, older population would imply productivity advantage for industries which require age-appreciating skills ($\rho_k^* > 0$) and disadvantage for industries which use age-depreciating skills intensively ($\rho_k^* < 0$).

The unit cost function is a Cobb–Douglas aggregator of factor prices in country c, where K is a set of age-dependent skills, F is a set of other factors of production, such as human and physical capital, and s_{ji} is the share of factor j∈{K,F} in total costs of industry i. If the Heckscher–Ohlin channel plays a role, then, as in, relative factor prices are inversely related to relative factor endowments and the log unit costs becomes:

$$\ln mc_c^i = -\sum_{k\in K} \phi_k^* s_{ki} \ln(F_c^k) \quad (6)$$

where F_c^k is the endowment of factor j∈{K, F} in country c measured relative to some reference factor, and $\phi_k^* > 0$, $\phi_f > 0$. Substituting Equation (6) into Equation (5) we obtain:

$$\frac{1}{\theta} ln\left(\frac{X_{c1pi}}{X_{c2pi}}\right) = \sum_{k=K} \rho_k^* I_i^k \times (Age_{c1} - Age_{c2}) + \sum_{k\in K} \phi_k^* s_{ki}\, ln\left(\frac{F_{c1}^k}{F_{c2}^k}\right) + \sum_{(n.m)} \rho_{nm} L_i^n \times$$
$$(M_{c1}^{nm} - M_{c2}^{nm}) + \sum_{f\in F} \phi_f s_{fi}\, ln\left(\frac{F_{c1}^f}{F_{c2}^f}\right) + (\mu_{c1} - \mu_{c2}) + (d_{c1p}^i - d_{c2p}^i) \quad (7)$$

The relative exports are determined by combination of six factors: Ricardian forces, as captured by the differential effect of age composition and institutional factors on productivity (the first and the third terms); the Heckscher–Ohlin forces, operating through the difference in factor endowments (the second and the fourth terms); productivity shifters (fifth term) and trade costs (sixth term). On one hand, if there are no Ricardian forces in the model and population aging affects only the stock of age-dependent skills but not the quality, then the first and the third terms disappear from Equation (7), which becomes similar to the prediction of the Heckscher–Ohlin model by Romalis (2004). On the other hand, if population aging does not affect relative premia of different age-dependent skills, then the second term vanishes and demographic composition would affect trade only through variation in labor productivity across industries.

$$X_{cpi} = \sum_{k=K} \beta_k I_i^k \times Age_c + \sum_{f\in F} \phi_f I_i^f \times F_c^f + \delta_{cp}'\lambda + \gamma_c + \gamma_{pi} + \varepsilon_{cpi} \quad (8)$$

In Equation (8), β_k combines both ρ_k^* and ϕ_k^*, and the interactions $I_i^k \times Age_c$ capture both the Ricardian and the Heckscher–Ohlin channels. The model predicts that $\beta_k < 0$ for skills which worsen with age and $\beta_k > 0$ for skills that improve with age. This follows from the fact that for age-depreciating skills $\rho_k^* < 0$ and $\sigma_1^k < 0$, which implies that $\beta_k < 0$ since ϕ_k^* is positive for all k. For age-appreciating skills both ρ_k^* and ϕ_k^* are positive, and so is β_k.

Estimation of Empirical Research Model

The purpose of this paper is to examine the effect of gender and demographic differences on international trade in major trade partners of Iran during the period 2000-2015. Our primary measure of a country's age structure is the median age, obtained from the United Nations. As an alternative, we also use the share of young workers in the labor force, constructed as a fraction of 20–40 year-olds in the 20-to-65 age group. The information on the age structure of population comes from the World Development Indicators database, maintained by the World Bank. Industry-level measures of intensities in skilled labor and physical capital are derived from the WDI. Capital-intensity is constructed as the ratio of capital stock over total employment, and skill intensity as the share of nonproduction workers in total employment. Data on a country's stock of physical capital, measured in 2005 prices, is retrieved from the Penn World Table. Human capital stock for the year 2000 is obtained from Barro and Lee (2013) and is measured as a share of population with secondary and tertiary education. The full sample includes 12 countries of trade partners of Iran.

Unit Root Test of the Variables of the Research

To investigate the effect of gender and demographic differences on international trade, it is first necessary to determine the existence of unit roots in the data series. Panel unit root tests are similar, but not identical to unit root tests carried out on a single series. The literature suggests that a panel-based unit root test enhances the power of the unit root test as it allows for greater efficiency by providing more degrees of freedom and for heterogeneity across individual series. For this study, we have chosen the Im, Pesaran and Shin (1997, IPS), which is based on the well-known Dickey–Fuller procedure. Investigations into the unit root in panel data have recently attracted a lot of attention.

Data used in the analysis are annual time series during the period 2000-2015 on exports volume, GDP, Inflation Rate, Exchange Rate, Interest Rate, Physical Capital, Elementary education, Secondary Education, Higher Education, The Ratio of Female Employees to the Total Working Population, The Ratio of Male Employees to the Total Working Population. The unit is expressed in US dollars. All variables used are in natural logarithms.

Table 1 presents the panel unit root tests. At a 5 per cent significance level, all statistic of the level model confirm that none of series has a panel unit root. Based on the results from the panel unit roots, we conclude for all variables; the null of a unit root can be rejected in their levels. We conclude that all series are stationary in level with the constant plus time trend of the panel unit root regression.

Table 1. Unit Root Test of Variables

Variable	**(IPS)**	
	Test Statistic	**Prob**
Exports Volume	-3.65	0.00
Economic Growth	-2.76	0.00
Inflation Rate	-3.02	0.00
Exchange Rate	-2.54	0.00
Interest Rate	-2.88	0.00
Physical Capital	-3.01	0.00
Elementary Education	-2.94	0.02
Secondary Education	-3.45	0.00
Higher Education	-2.03	0.03
The Ratio of Female Employees to the Total Working Population	-2.76	0.00
The Ratio of Male Employees to the Total Working Population	-4.29	0.01
Elementary Education Multiplied by Average Age	-2.34	0.00
Secondary Education Multiplied by Average Age	-3.18	0.00
Higher Education Multiplied by Average Age	-3.54	0.00
The Average Human Capital Multiplied by the Ratio of Female Employees	-2.87	0.00
The Average Human Capital Multiplied by the Ratio of Male Employees	-4.39	0.01
The Average Physical Capital Multiplied by the Ratio of Female Employees	-2.44	0.00
The Average Physical Capital Multiplied by the Ratio of Male Employees	-3.18	0.00

Source: Research findings.

Model Specification and Hypothesis Examination

In order to examine the effect of gender and demographic differences on international trade, Table 2-4 reports estimation results for Equation (1) with the country's median age used as a proxy for the stock of age-depreciating skills. The first column confirms the main prediction of the Heckscher–Ohlin model for capital and skilled labor: countries that are abundant in capital and skilled labor export more in industries which use those factors intensively. Adding $I_i^k \times Age_c$ interactions to the main specification in columns (2) to (4), we find that all coefficients are consistent with the theoretical model and are statistically significant, thus supporting the hypothesis that age differences across countries are the source of comparative advantage in international trade. The estimates in columns (2)–(4) reveal that older countries

export more in industries which use age-appreciating cognitive skills intensively and less in industries which are intensive in physical and age-depreciating cognitive skills.

With this explanation, it is first assumed that the effects of different variables of the countries considered in this study have the same effect on exports. In other words, the impact of the demographic structure of the *i* th country or the *j* th country on exports and trade of the *i* th country or the *j* th country will be the same. The intercept in the model is also the same across different sections (countries).

To find out whether a pool method is used or a panel data method, we will refer to the F test. If the F test allows for panel data, then through the Hausman test we recognize that the random effects method must be used, or the model with constant effects.

According to the statistic F, the zero hypothesis of intercept and same coefficient for all units will be tested in the panel model. The results are presented in Table 2 for the research model.

Table 2. Diagnostic Test for Model Estimation in the Form of Pooled or Panel Data with Fixed Effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	5.311	(12,172)	0.0000
Cross-section Chi-square	98.85	12	0.0000

Source: Research findings.

Based on these tables, the F test and the Prob value do not rule out the existence of fixed effects against the Pooled state. In other words, since the significance level (Prob) obtained in both F and χ_2 tests is less than 0.05, the zero hypothesis based on the fact that the effects of the regression model are redundant at 5% (and 10%) level can be rejected. So the model estimation in the form of panel data with fixed effects is preferred to estimate the model in the form of Pooled data.

In this section, one of the two methods of fixed effects and random effects should be selected to estimate panel data. The Hausman test is used to determine the estimation method in panel data. Based on this test, the rejection of the zero hypotheses suggests using the fixed effects method. Therefore, the Hausman test was performed for different models with different explanatory variables. The results of the Husmon test, which is reported in Table 4 regarding the export equation, indicates the rejection of the zero hypothesis and the choice of fixed effects method for the export equation.

Table 3. Diagnostic Test for Model Estimation in the Form of Panel Data with Fixed Effects versus Panel Data with Random Effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	28.394	8	0.0001

Source: Research findings.

In order to investigate the effect of demographic and age structure on exports and volume of trade of countries, panel data with fixed effects has been used whose results are shown in the following table. In this study, the average age of individuals was used as an indicator for increasing or decreasing age-related skills.

Table 4. Estimating the Impact of Demographic and Age Structure on the Volume of Trade of Countries

Dependent Variable / Independent Variable	Model 1	Model 2	Model 3	Model 4
Intercept	(0.00) 1.44	(0.00) 2.54	(0.00) 1.76	(0.00) 3.09
Elementary Education Multiplied by Average Age	(0.02) 0.12	(0.01) 0.25	(0.03) 0.13	(0.01) 0.19
Secondary Education Multiplied by Average Age	(0.03) 0.56	(0.00) 0.62	(0.02) 0.43	(0.00) 0.52
Higher Education Multiplied by Average Age	(0.01) 0.46	(0.01) 0.59	(0.01) 0.39	(0.03) 0.48
The Average Human Capital Multiplied by the Ratio of Female Employees	(0.00) 0.12	-	-	(0.00) 0.22
The Average Human Capital Multiplied by the Ratio of Male Employees	-	(0.03) 0.27	-	(0.02) 0.28
The Average Physical Capital Multiplied by the Ratio of Female Employees	(0.02) 0.09	-	-	(0.03) 0.14
The Average Physical Capital Multiplied by the Ratio of Male Employees	-	(0.00) 0.16	-	(0.03) 0.21
Economic Growth	(0.03) 0.32	(0.00) 0.25	(0.00) 0.21	(0.00) 0.18
Inflation Rate	(0.00) 0.18	(0.00) 0.29	(0.03) 0.22	(0.00) 0.28
Exchange Rate	(0.01) 0.22	(0.04) 0.18	(0.02) 0.28	(0.00) 0.18
Interest rate	-0.19 (0.04)	(0.02) -0.23	(0.00) -0.17	(0.03) -0.22
The Coefficient of Determination	(0.00) 1.44	(0.00) 2.54	(0.00) 1.76	(0.00) 3.09
The F Statistic	0.67	0.83	0.77	0.72
The Durbin-Watson Statistic	12.43 (0.00) 1.88	(0.00) 45.34 1.79	(0.00) 26.67 1.94	(0.00) 31.09 1.97

Source: Research findings.
Note: the numbers in the parentheses indicate the Prob value.

Goodness of fit statistics such as R^2 or coefficient of determination in the fitted model are 0.67, 0.83, 0.77 and 0.72, which indicates that the explanatory power of the model is appropriate. Also, considering the high F statistic and the probability value, the total fitted regression is meaningful. The durbin-watson statistic in fitted models is 1.88, 1.79, 1.94, and 1.97, which indicates that there is no significant correlation in the model.

All estimated coefficients are consistent with theory and previous literature. According to the results of Table 4, all estimated coefficients at the significance level of 5% have a significant difference from zero.

The results indicate that economic growth, inflation rate and exchange rate have a positive and significant effect on these countries. Interest rate has a significant negative effect on the export of the countries.

The variables in this study for human capital include primary, secondary and higher education. Combined variables including the product of education and the average age of the population, indicate that increasing population age and increasing education in individuals lead to an increase in the productivity of this group and, consequently, create a comparative advantage in producing products and increase exports.

In addition, the difference of average human capital between men and women suggests that with the average level of education as an indicator for human capital, the impact of female workers compared to male employees was lower. In other words, the productivity of male workers due to human capital has had a positive and significant impact on the export of countries.

The average age in the labor force is based on the age range of 20-40 years and 41- 65. It is observed that the younger age group have less age-related skills than more experienced people and have increased their work experience by increasing their Job skills experience.

The product variable of multiplication of human capital in the ratio of male and female employees showed that the male group had higher efficiency in using physical capital than female group and also had higher skill learning.

The remarkable results in this study are that in the secondary education group, using human capital, physical and mean age, they have higher efficiency and higher production skills than other groups, and the benefit of this group is higher than that of elementary and higher education.

Based on the results obtained, the research hypotheses suggest that the difference in the age structure of the two countries can be a factor in the creation of trade between them. The youth population in the countries will lead to a relative advantage in the production of consumer goods. It has also been confirmed that the difference in the gender structure of the two countries can be a factor in the creation of trade between them.

Conclusions

The purpose of this paper is to examine the effect of population aging effect on trade in major trade partners of Iran during the period 2000-2015. For this purpose, panel data has been used. The variables used in this study include age and demographic composition of the labor force, education level and human capital, economic growth, interest rates and volume of countries exports and imports. The results of this study indicate that the product of the human and physical capital index in the male and female working age group has had a significant and different effect on exports of these countries. The variables for human capital in this study include primary, secondary and higher education. Combined variables, including the product of education and the average age of the population, indicate that increasing population age and education in individuals leads to an increase in the efficiency of this group and, consequently, creates a comparative advantage in producing products and it increases the exports. In addition, the difference of average human capital between men and women suggests that with the average level of education as an indicator for human capital, female employees have been less effective than male workers. In other words, the productivity of male workers due to human capital has had a positive and significant impact on the export of countries. The remarkable results in this study are that the secondary education group using human capital, physical and mean age, has higher productivity and higher production skills than other groups, and the benefit of this group is higher than that of elementary and higher education. According to the results, it is suggested that educational and demographic policies of the country should be in keeping the average population growth in a range that the society does not face a shortage of work experience. The political, administrative, and legal measures needed to establish a proper private sector and increase the level of private confidence can lead to the use of expert forces and increased productivity, which in fact leads to boom in exports.

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