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Developing a commodity trading strategy for Iran By applying a Gravity Model among D-8 Countries

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Abstract

Globalization is an inevitable process with two approaches including: the globalization of the economy and the expansion of global trade. There are two paradoxical consequences of the creation of trade (social welfare) and the deviation of trade (decreased welfare) which elicits the countries' reactions. This dialectic move is represented in the countries' attitudes toward blocs, associations, and economic and commercial arrangements among countries. The literature indicates the inapplicability of the human-based indexes in the estimated model of the commercial potential of the countries in forming economic and commercial associations. Accordingly, the present study aims at developing a strategic framework of Iran's commodity trading with the D-8 countries based on the GM theory. The generalized GM theory turns into an expanded GM theory using variables expressing human attitudes. The findings indicated that as the classical variables of GDP and openness economy, and per capita production increase, Iran's trading potential increases. Distance and population increase, however, decrease this potential. Human variables including the human development index, the share of research in GDP, the share of public trainings, and the ratio of labor force in the industry to the total labor force show that as these variable grow, Iran's goods trade potential will increase. In fact, the innovative part of the process of developing the Iranian goods trade model involves proving the effect of the human-based variables in the Gravity model. The study demonstrated that the Linder variable and direct foreign investments do not influence commercial trades among the D-8 countries.

Keywords: Commodity trading strategy, Gravity Model, D-8 Countries, Iran, GM theory.

Introduction

Economic integration and economic, commercial, and regional arrangements are among the reactions of countries to resist globalization. According to the reports by World Trade Organization (WTO), until July 2010, 474 preferential trade agreements were reported to the organization, 283 of which are being implemented, which shows a growth in trading treaties by 28%, compared to the 2007 statistics showing 193 implemented cases out of 371 reported ones[1], while they are implemented at a 47% rate faster than contracting the treaties.

The present study attempts to identify and develop a strategic model of the Iranian commodity trading and the influence of human factors in the Iranian economy on the integration of Iran with 8 developing countries known as the D-8, namely, Iran, Indonesia, Bangladesh, Pakistan, Turkey, Egypt, Malaysia, and Nigeria. The goals pursued by the D-8 group include promoting the status of the member countries in the global economy, giving variety to and creating new opportunities in trading ties, boosting the decision-making potential of the members at the global level, and promoting their nations' standards of living. Relying on relative advantages and various economic potentials and gaining experiences in various regional and economic convergences, Iran can develop potentials to cope with the globalization trends and trigger economic growth, foreign trades and economic welfare by better identifying relative advantages [2]

The factors which have the capability of accelerating the goal realization process include two sets of classis variables (those commonly investigated in the literature) and human-based ones (adopted in the present study). The study is arranged in six sections. In the second section, problem statement is presented. Section three presents a literature review and the fourth section describes the methodology. Section 5 includes accounts of the type of the study, the conceptual model, the variables, modeling, validation, data analysis, fitting the model, and testing the hypotheses, and the final section discusses the findings and suggestions.

Problem statement: The presence of Iran in ECO (Economic Cooperation Organization) and D-8 has not been of considerable outcomes for the country. This failure has been greater in the D-8 group, which has hindered Iran from achieving its goals and has deprived it of the great advantages this presence could have otherwise offered. Although the economic advantages of this economic cooperation have not been achieved, the presence of Iran in these integrations implies the country's willingness to achieve the features of free trade and triggers the country's potential to actively engage in foreign trade[2].

An investigation of Iran's commodity trading in the D-8 reveals

a 7% to 14%range of exports and imports over two decades until 2000. In fact, during this period, D-8 did not have a considerable role in Iran's goods trade strategies, which might be the result of Iran's trading policies or the international job distribution, which need to be investigated independently. However, the question is: what is the role of Iran's trading policy regarding forming economic and commercial blocs with the D-8 in boosting Iran's trading potentials and what factors can form the pattern of this strategic policy?

The purpose of the present study is to identify and develop a strategic model of Iran's goods trade potentials with the D-8 countries based on the GM theory. The model was developed by making a number of changes to the Gravity model and using 4 new variables of human development, foreign investment, the share of research in GDP, and the share of human labor in the industrial sector relative to the total human labor along with commonly investigated variables, in this study referred to as classical factors (GDP, distance, population, per capita income), and the influence of virtual variables (membership in WTO) as well as the influence of this convergence on Iran's trading potentials with the D-8 countries based on the GM theory. To this end, the following hypotheses were rested:

There is a significant correlation between the influential trading factors (distance, human labor, GDP, etc.) and Iran's trading potentials with the D-8 countries. The virtual influential factor (membership in WTO) and Iran's trading potential with the D-8 countries are significantly correlated. Iran's trading potential and forming an economic commercial bloc with the D-8 countries are significantly correlated.

Literature review in Iran and the world: The Gravity model has been widely used in estimating commercial trends among countries and economic blocs. GM model has historical based in 60 decade. But they are mentioned from 2000 to present.

Lee investigated the best regional commercial agreement for Eastern Asia[3] and Bunt[4] investigated the influence of Euro on trades between the European Union and Norway, Switzerland, Canada, Japan, and the U.S. Grant and Lambert[5], Siliverstoves[6], Henderson[7], Bousiere[8] , Sunchan Park[9], and Lampe[10] studied the trade flows among economic blocs using the GM. Kepaptsoglou[11], Baier and Bergstrand [12], Kaur and Nanda[13], and Roy and Rayhan[14] adopted the GM to estimate trade flows. Gust[15] investigated and approved the positive influence of the real exchange rate on trades between countries. Chisik[16] explored the negative influence of the tariff rate on bilateral exchanges between countries using the GM. Bahmani[17] investigated the commercial convergence between Canada and Mexico and concluded that the trade flow between the two countries is influenced by the real exchange rate and the free trading agreement, and that the largest Mexican export industries respond to decreased exchange rates more than the Canadian ones.

Rahmani and Abedin[18], NajarZadeh and Rasekh[19], Tayebi[20], Shekibaee[21], Toosi[22] investigated GDP, population, the Linder similarity variable, physical distance, and Iran's trade potential in economic convergence. Akbari[23], ShihakiTash[24] used the GM to estimate Iran's trade flows and economic blocs. Razzaghi[25] investigated the technological gap in D-8 using the GM and concluded that the gap increases capital commodity trading.

What these studies have in common is the estimation of trade flows among countries using the ordinary least square method and variables including GDP, population, distance, and virtual ones (shared borders, common languages, cultures, religions, etc.). They all emphasize economic variables.

Methodology

A large number of studies have been conducted to estimate the trade potential, i.e. exports and imports, or only export potential among economic blocs including the G-8, using the GM. These studies focused on three kinds of factors that called classical, humanity, and dummy indexes. Classical factors like as: the GDP, per capita income or production, population, distance, custom tariff, technology, and exchange rate fluctuations. Humanity factors such as: the share of research in the GDP, public education costs, the human labor in the industry, and humanity development index. Dummy factors such as: member of WTO.

Type of the study: This study is an applied one since it investigates the economic integration of the G-8 countries using the GM and identifying the influence of these integrations and proper trade arrangements for Iran. It is a correlation type investigating the correlations among the independent and dependent variables. It is an expose-facto type, which is the base of econometrics and fitting the goods trade potential of Iran using the extended gravity model.

Domain of study: The topic domain of the study is: investigating factors influencing Iran's trade potentials**.** The time domain of the study is: the period of 2000-2010

The place domain of the study is: the D-8 member countries including Iran, Bangladesh, Malaysia, Egypt, Pakistan, Nigeria, and Indonesia

Population and sample: The population included the D-8 member countries in the first decade of the 21st century. The economic and demographic statistics as well as the share of research in the GDP, public educations costs, human development index, the labor force in the industry relative to the total one, and direct foreign investment during 2000 to 2010 in the D-8 member countries are gathered from official global references.

Conceptual model and variables: In terms of goals, this is a theoretical method based on the GM and in terms of effectiveness and innovation, it can be placed in a developmental continuum and since it seeks to present a new model, it is an exploratory type. It focuses on the bases of the theories justifying foreign trade according to the GM and the

real and objective data of the countries. A conceptual model of this study is shown in figure-1.

Modeling and variables: A proposed of Gravity Model was developed through the applied changes made in the original model. Therefore, the proposed model is presented in figure-2. The previous studies did not use human-based variables in the GM. The present study focuses on such variables as Public education cost, the share of research in the GDP, and humanity indexes ,and Share of labor force in industry which are considered as the innovative part contributing to the relative advantage of a country and is investigated for the first time in Iran

Variables: the dependent variable is Iran's trade potential including the total exports and imports. The dependent variables include the GDP, population, foreign investment, human force share, distance between countries, membership in WTO, public education cost, labor force in the industry relative to the total one, research and development costs, openness of the economy calculated through:

Op= Export + Import/GDP

And Linder's similarity variables calculated through

$$\text{Linder}_{ijt} = \text{In}[(Y_{Pit} - Y_{Pjt})]^2$$

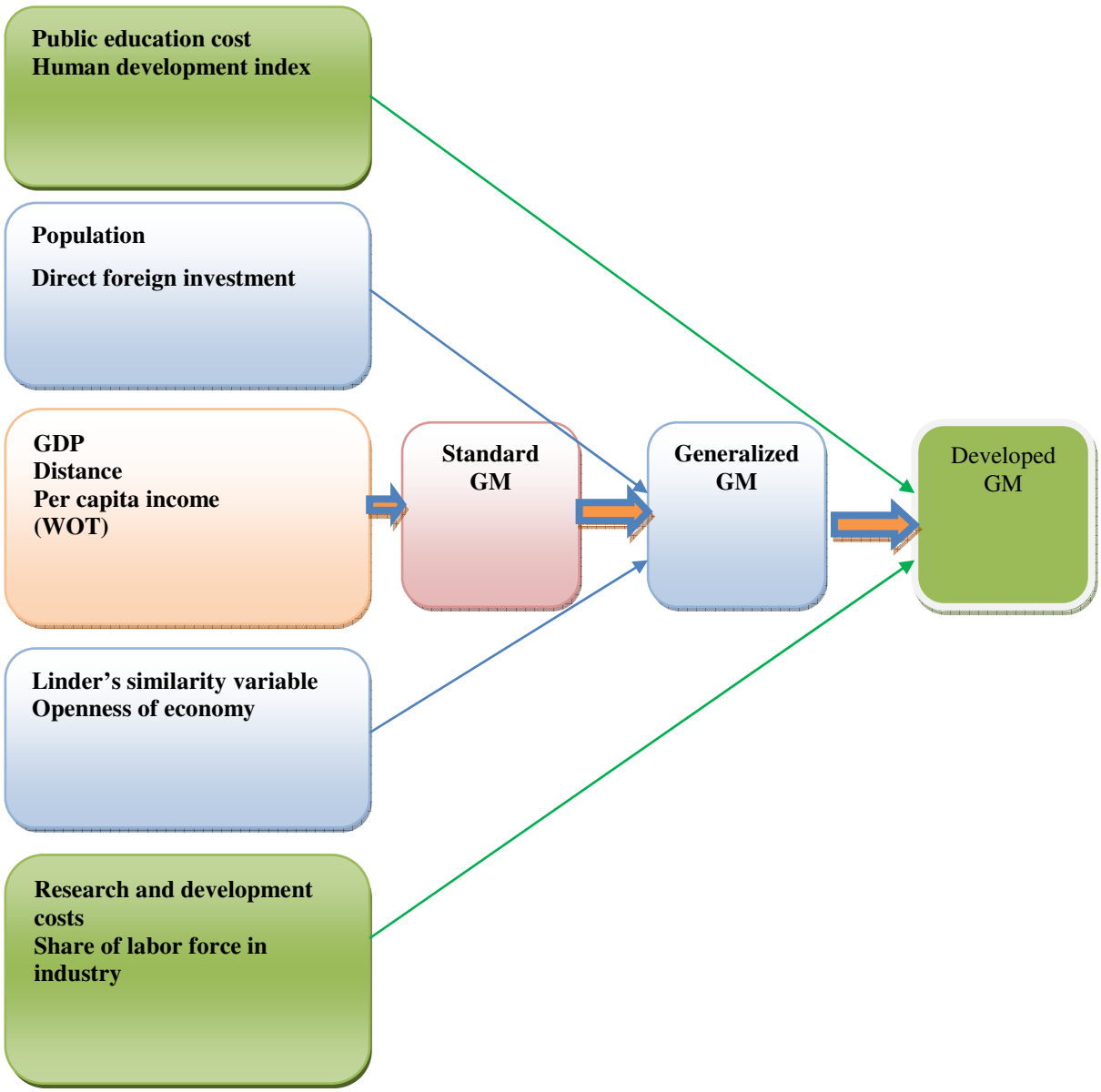

Figure-1
A conceptual model of the study

Where, Y_{pjt} and Y_{pit}stand for the real per capita GDP in countries j and i, respectively. Based on Linder's trade theory, this coefficient is expected to be negative. The theory entails that countries with more similarities tend to trade with one another more than dissimilar countries and since one of the most important factors indicating similarity is the similarity of their per capita incomes, the closer their per capita GDPs, the more their bilateral trades. Per capita production is calculated through:
GDPs = GDP/pop

Tools and techniques: data regarding three D-8 member countries over the period of 2000 to 2010 were collected from the World Bank, the International Monetary Fund, WTO, the Islamic Conference Organization, and the International Trade Statistic Yearbook, and included GDP, import and export, population, distance, direct foreign investment, the share of research in the GDP, the human development index, the share of labor force in the industry, the share of public education in the GDP.

Data gathering: data were gathered by using the official statistics provided by the World Bank, the International Monetary Fund, WTO, the Iranian Central Bank, the Iranian Center of Statistics, and Iran's Customs Data.
As stated in the previous section, through the gravity models, the bilateral trade flows for Iran in the D-8 group could be predicted and the effect of an economic cooperation agreement among these countries could be investigated. To do so, the explanatory variables were calculated and the results of the estimation of the extended GM using the Ordinary Least Square method and the Eviews and software were derived. The extended GM in this study is represented through:

$$LnT_{ij} = a + \beta_1 \ln GDP_{ij} + \beta_2 \ln POP_{ij} + \beta_3 \ln FDI_{ij} + \beta_4 \ln OP_{ij} + \beta_5 \ln LIN_{ij} + \beta_6 \ln DIS_{ij}$$
$$+\beta_7 \ln WOT_{ij} + \beta_8 \ln EDU_{ij} + \beta_9 \ln HUM_{ij} + \beta_{10} \ln EMP_{ij} + \beta_{11} \ln R\&D_{ij} + \beta_{12} \ln GDPs_{ij} + \ell_{ij}$$

Where: T_{ij}: Iran's trade potential, GDP_{ij}: the gross domestic product, POP_{ij}: the size of the population, FDI_{ij}: foreign investment, OP_{ij}; openness of economy, EDU_{ij}: public education costs, $HUMAN_{ij}$: human force, EMP_{ij}: the share of labor force in the industry relative to the total one, RES_{ij}: research and development cost, LIN_{ij}: Linder's similarity variable, DIS_{ij}: the distance between two countries, WTO_{ij}: membership in the WTO, GDPs: the per capita production, S_{ij}: the error statement of the model.

Validation: the model was compared with other models and the precision of the calculated coefficients was tested and proved. All variables were excluded from the model and the calculations were performed in the absence of the variables. The results indicated the absence of disturbing variable (s), which proves the validity of the model.

Data analysis, model fit, and testing hypotheses: Using a mathematical model, Iran's potential in trading with the D-8 member countries based on the gravity model is measured. The gravity equation coefficients are calculated through regression, based on 11 years of observations conducted of Iran's commercial ties with the D-8 member countries. Moreover, the effects of foreign investment and the share of human force on trading potential are explored. Two sets of processing and analysis are normally conducted in the literature. They include descriptive and inferential statistics.

Testing the model: at this stage, the panel data were tested to see whether they are stationary, using the unit square IPS. Since they were stationary with one or two pauses, using the Pedroni cointegration test was inevitable. Then, in order to select among panel data and pooled data, the Lamer statistic was used. Then, the Hausman test was conducted to clarify the discrepancies between the estimators of the fixed effects and the random effects. Finally, the estimation of the model with the fixed effects and based on the results of the Hausman test was conducted.

Accordingly, in order to test the hypotheses, the pooled data were used. Doing this, F statistic was used to select among pooled and panel data. If the panel data approach is selected, the Hausman test is conducted to select between fixed effects and random effects. Moreover, the data were tested for stability using the IPS. Then, homoscedasticity is examined. The mathematical calculations are conducted using the EXCEL, Eviews, and SPSS. In the following sections, these approaches are investigated theoretically and mathematically.

IPS unit root test in panel data If the time series variables are not stationary, it is highly probable that the regression is spurious, which makes using t and F statistics misleading. Therefore, in order to prevent from spurious regression, data are tested to see whether they are stationary. In this test, what is most important is the power of the unit root test. Most scholars have consensus that the greater the sample size, the more powerful, and therefore more reliable, the tests. In order to measure the power of the tests, it is better to use panel data derived from combining the time series data from various groups, rather than focus on the time series. Panel data outweigh cross sectional or time series ones in various regards. More reliable estimations, explaining more advanced models, and lowered linearity among variables are the advantages of this approach. In this study, the Im, Pesaran and Shin (IPS) approach is used to test whether data are stationary. Compared to Levin and Lin ( ), and Harris and Tzavalis ( ) tests, this approach is less restricted. It is based on mean of the Augmented Dickey-Fuller test for cross sectional samples. Consider the following generalized Dickey-Fuller ( ) regression:

$$y_{it} = \rho_i y_{i,t-\backslash} + \sum_{j=\backslash}^{p_i} \varphi_{ij} \Delta y_{i,t-j} + z'_{it}\gamma + \varepsilon_{it}$$

The stationary test entails investigating H_0: $p_i = 1$, for all i's and

H_1: $p_i<1$ for at least one i. with the null hypothesis, the stationary state of the variable is to be investigated[26].

The IPS test can be conducted in two states: cross sectional data with a constant value, and cross sectional data with a constant value and a round variable. The results of the unit root test are demonstrated in table-1.

Considering t_{pi} as the t statistic of the generalized Dickey- Fuller regression, the average t statistic is:

$$\bar{t} = \frac{1}{N}\sum_{i=1}^{N} t_{\rho i}$$

$$t_{IPS} = \frac{\sqrt{N}\left(\bar{t} - \frac{1}{N}\sum_{i=1}^{N} E\left[t_{iT} / \rho_i = 1\right]\right)}{\sqrt{\frac{i}{N}\sum_{i=1}^{N} \mathrm{var}\left[t_{iT} / \rho_i = 1\right]}} \Rightarrow N(0,1)$$

In the above equation, $\bar{t}$ has a standard normal distribution[27]. Each variable is smaller than 0.05 at the first or second difference of the IPS statistic, therefore, all variables are reliable at the first or second differences.

Pedroni cointegration test: According to the stationary test, some variables including Iran's trading potential, population size, foreign investment, human force, and the share of labor force in the industry relative to the total one are not stationary. However, according to the first and second level differences, the null hypothesis is rejected and the variables are significant. Accordingly, all variables of the model have a unit root. Based on the results of the test, since the variables are not stationary, the cointegration tests are used because when variables are non-stationary, the results can be trusted provided the variables are cointegrated.

Results of cointegration test: In this study, Pedroni's cointegration test was conducted to see whether the variables are cointegrated. Two parameter statistics Group-t and Panel-t were used. Having been standardized, they are represented as Group ADF-stat and Panel ADF-stat. according to the results, the significance level of the test is below 0.01 (prob.=0.000) and the null hypothesis stating a lack of cointegration among the variables is rejected. Therefore, there are long-term relationships among the variables.

Table 2 shows that the results indicate cointegration among the variables. Therefore, the results can be trusted.

Table-1
Results of reliability tests for time series data

Variable	Prob*	IPS statistic	Result	Degree
LGDP	0.0109	-2.29529	reliable	I(0)
LPOP	0.3935	-0.27024	unreliable	I(0)
LPOP	0.0313	-1.86140	reliable	I(1)
LFDI	0.3607	-0.35650	unreliable	I(0)
LFDI	0.0033	-2.71294	reliable	I(1)
LOP	0.0000	-5.11099	reliable	I(0)
LEDU	0.0063	-2.49756	reliable	I(0)
LHUMAN	0.2031	-0.83057	unreliable	I(0)
LHUMAN	0.2338	-0.72635	unreliable	I(1)
LHUMAN	0.0473	-1.67189	reliable	I(2)
LEMPLOY	0.1087	-1.23366	unreliable	I(0)
LEMPLOY	0.0351	-1.81108	reliable	I(1)
LRESEARCH	0.0007	-3.17643	reliable	I(0)
LLINDER	0.0444	-1.70199	reliable	I(0)
LDIS	0.0053	-2.55471	reliable	I(0)
LWOT	0.0000	-78.9670	reliable	I(0)
LGDP per Capita	0.0246	-1.96687	reliable	I(0)
LT	0.9552	1.69797	unreliable	I(0)
LT	0.0004	-3.38594	reliable	I(1)

Table-2
Results of Pedroni test for developed GM

Pedroni Residual Cointegration Test	**Statistic**	**Prob**
Panel ADF-Statistic	-3.956055	0.0000
Group ADF-Statistic	-2.615393	0.0045

Lamer F test- To select between panel and pooled data, the F statistic was used.As indicated by table-3, prob. >0.05 and the hypothesis of equal intercepts is not rejected. It implies that the pooled model is preferable.

Table-3
Results of F test

Redundant Fixed Effects Tests			
Test period fixed effects			
Effects Test	Statistic	d.f.	Prob.
Period F	1.232953	(8,30)	0.3145

Hausman test: According to the Hausman test, the null hypothesis assumes discrepancies between the fixed effects and random effects estimators. If it is rejected, the fixed effects approach is preferred. In this test, the null hypothesis is based on the assumption that individual effects and explanatory variables are not correlated.

As indicated by table-4, prob. = 0.0361<0.05, rejecting the null hypothesis. Therefore, the fixed effects approach is to be used.

Table-4
Results of Hausman test

Correlated Random Effects - Hausman Test			
Test period random effects			
	Statistic	d.f.	Prob.
Period random	2.963983	8	0.0361

Goodness of fit with fixed effects: The overall model with fixed effects is described in table-5.

Table-5
Goodness of fit with fixed effects

Dependent Variable: LY?				
Method: Pooled EGLS (Period weights)				
Sample: 2000 2010				
Included observations: 11				
Cross-sections included: 8				
Total pool (unbalanced) observations: 88				
Linear estimation after one-step weighting matrix				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LGDP	5.321615	2.617900	2.032780	0.0489
LPOP	-4.451423	2.087272	-2.132651	0.0393
LFDI	0.019728	0.025648	0.769192	0.4464
LOP	0.842222	0.065536	12.85127	0.0000
LEDU	0.677971	0.112802	6.010294	0.0000
LHUMAN	1.911115	0.243502	7.848450	0.0000
LEMPLOY	1.115386	0.092157	12.10308	0.0000
LRESEARCH	0.093435	0.039047	2.392909	0.0216
LLINDER	0.131864	1.558938	0.084586	0.9330
LDIS	-0.077985	0.030838	-2.528818	0.0156
LWOT	0.152122	0.032355	4.701593	0.0000
LGDPs	4.307497	1.757838	2.450452	0.0189
	Weighted Statistics			
R-squared	0.999950	Mean dependent var		5.280251
Adjusted R-squared	0.999926	S.D. dependent var		1.388919
S.E. of regression	0.003786	Sum squared resid		0.000487
F-statistic	42328.27	Durbin-Watson stat		2.104700
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R-squared	0.999925	Mean dependent var		4.808824
Sum squared resid	0.000592	Durbin-Watson stat		2.064558

Results of coefficients fit with fixed effects and testing hypotheses: t statistic and its associate probability (prob.) indicate a significant correlation between GDP, population, openness of the economy, public education costs, the share of human force, the share of labor force in the industry relative to the total one, research and development costs, distance, membership in WTO, and Linder's similarity index and the countries' trade potentials at 95% confidence (absolute value of t is greater than 1.96).

R^2 statistic indicates that 68% of the changes in the dependent variable, trading potential, can be explained by GDP, population, openness of the economy, public education costs, the share of human force, the share of labor force in the industry relative to the total one, research and development costs, distance, and membership in WTO.

First hypothesis: The GDP coefficient indicates that it is positively correlated with trading potentials. In fact, with a one-unit increase in GDP, the trading potential grows for 5.32 units. Therefore, this hypothesis, stating the correlation between the GDP and trading potential is approved.

Second hypothesis: The population coefficient indicates that it is negatively correlated with trading potentials. In fact, with a one-unit increase in population, the trading potential falls for 4.45 units.

Third hypothesis: The openness of the economy coefficient indicates that it is positively correlated with trading potentials. In fact, with a one-unit increase in openness of the economy, the trading potential grows for 0.84 units.

Forth hypothesis: The public education costs coefficient indicates that it is positively correlated with trading potentials. In fact, with a one-unit increase in public education costs, the trading potential grows for 6.8 units.

Fifth hypothesis: The human development coefficient indicates that it is positively correlated with trading potentials. In fact, with a one-unit increase in human development, the trading potential grows for 1.91 units.

Sixth hypothesis: The coefficient of labor force in the industry relative to the total one indicates that it is positively correlated with trading potentials. In fact, with a one-unit increase in the share of labor force in the industry relative to the total one, the trading potential grows for 1.11 units.

Seventh hypothesis: The coefficient of research and development costs indicates that they are negatively correlated with trading potentials. In fact, with a one-unit increase in research and development costs, the trading potential falls for 9 percent.

8th hypothesis: The coefficient of distance between countries indicates that it is negatively correlated with trading potentials. In fact, with a one-unit increase in distance, the trading potential reduces for 8 percent.

9th hypothesis: The coefficient of membership in WTO indicates that it is positively correlated with trading potentials. In fact, with a one-unit increase membership in WTO, the trading potential grows for 15 units.

10th hypothesis: With a one-unit increase in the per capita production, trading potentials rise for 2.5%.

11th and 12th hypotheses: Foreign investment and Linder's similarity variable did not significantly affect the sample in the model. Therefore these hypotheses are rejected. This could be explained by the fact that the D-8 member countries use these capitals in oil and non-export industries.

Result and Discussion

The results of testing the hypotheses reveal that forming economic blocs among the D-8 member countries can remarkably raise their trading potentials and provide a solution to their single-product economy. The results of the extended model are represented in figure-2. The expansion of exports especially non-oil exports is highly important in Iran[28].

As discussed in literature review, most studies conducted on the GM emphasize classic variables or economic development and take account of economic development as well as the World Bank suggestions, while this study incorporated the human development factors into the model. It conducted the investigations with real quantities and demonstrated that developing human factors can influence trading potentials.

Conclusion

As indicated by the tested hypotheses, GDP, population, openness of the economy, public education costs, the share of human force, the share of labor force in the industry relative to the total one, research and development costs, distance, and membership in WTO, all influence Iran's trading potentials with the D-8 member countries. Population and distance are negatively correlated with trading potentials. Direct foreign investment and Linder's similarity variable do not influence the D-8 trade function. To sum it up, the convergence among the D-8 member countries is beneficial to the Iranian economy and society. Also, the results of the extended Gravity Model demonstrated in graph 3 indicate that classic and human-based variables are influential.

The study was based on the combination of economic and human factors influencing trading potentials and the perspective of forming an economic bloc and proved the influence of these factors in boosting the potentials. This is the first study to demonstrate that research and human development index are not unproductive and their productivity can improve Iran's presence in the D-8 markets.

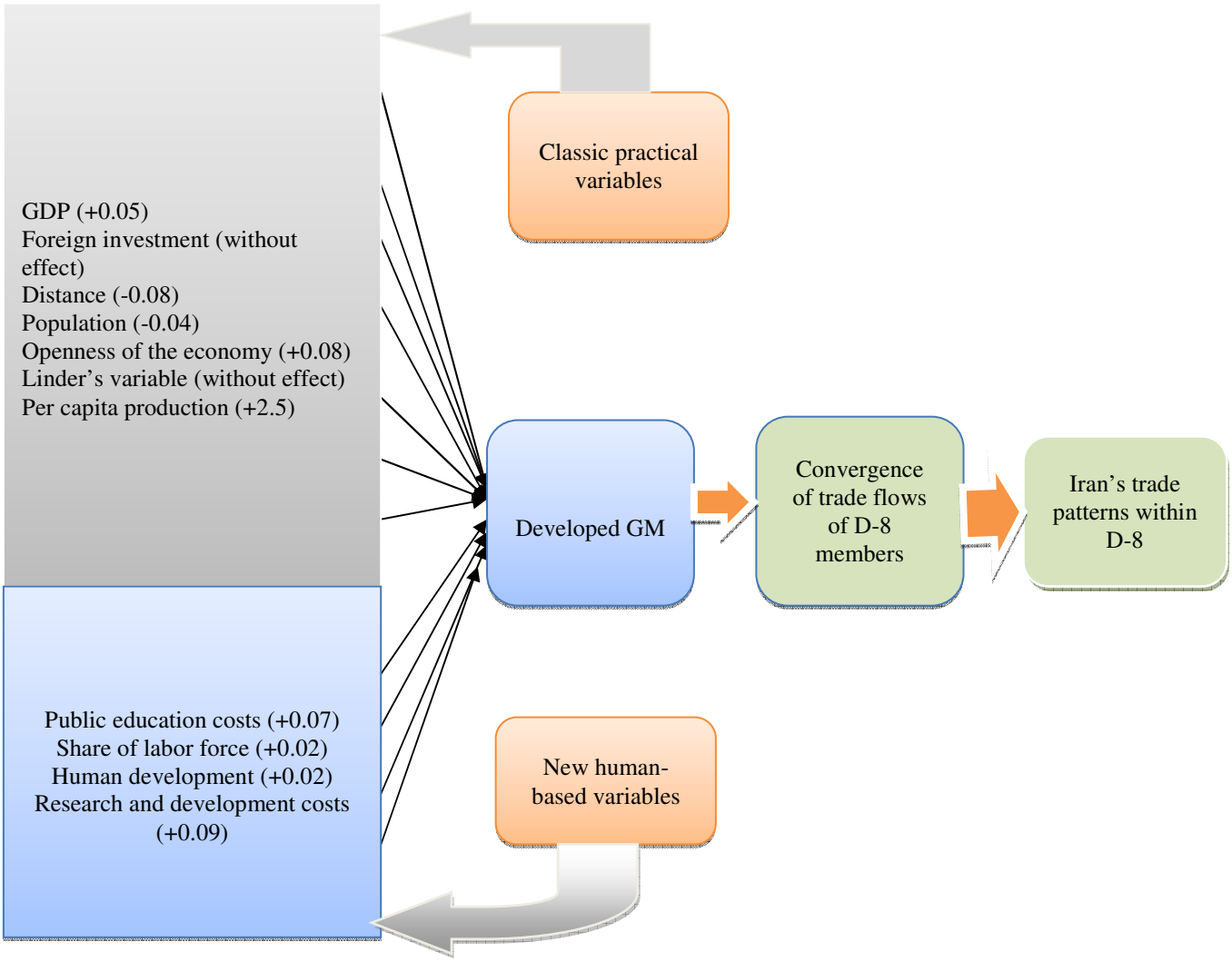

Figure-2
Iran's strategic trade model based on the extended GM

Suggestions for future studies: Future researchers are advised to change the mathematical foundations of the model and incorporate other variables such as democracy, women, and political stability into the study. It is suggested that future researchers investigate how forming a trading bloc can reverse the process of the accumulated capitals escaping from the country and how the country can attract its own and other countries' accumulated capitals.

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