The Analysis of the Impact of Exchange Rate on Investment and Employment in Iran by Using GTAP Model

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Abstract: In the present study, the analysis of the increase of exchange rate on investment and employment in Iran by using a multiregional computable general equilibrium model is conducted. The results confirm the accordance of price with changes of exchange rate. The increase of exchange rate has been accompanied with the decrease of production and employment in agriculture, industry and mineral sectors and it has been accompanied with the increase of production and employment in services, oil and gas sectors. Furthermore, total investment in Iran is in accordance with the changes of exchange rate. Therefore, according to the objective of the study, positive shocks to exchange rate generally can increase employment. This change is important since the part of employment is higher in services, oil and gas sectors than agriculture and industry and mineral ones. Moreover, positive shock of exchange rate increases investment according to the export and import structure Classification JEL: D58, E24, E22 and E23

Key words: Exchange Rate · Investment · Employment · GTAP model

INTRODUCTION

Exchange rate is one of the key variables in every economic system and its importance is definitely higher in countries like Iran that its major income of the government is exchange revenues from the oil expert. The importance of exchange rate as an important key variable includes the effects of changes and relationships out of economy is of particular importance [1].

The shock of exchange rate affects total demand of economy through import, export and money demand as well as total supply of economy through the costs of imported intermediate goods. Therefore, the changes of this variable easily affect the economic structure of countries. The new theoretical discussions and empirical analyses indicate that the impulses of exchange rate have different effects on the macroeconomic variables in different economies in such a manner that circumstances and size of this effect on the variables are different and depend on the initial circumstance of every economy. For the same reason, most of countries stabilize their monetary value against exchanges, which are the most important for forestalling the impulse of exchange rate. It is still observed that some of the other countries accept

the impulses of exchange rate by refraining from stabilizing the exchange rate and the acceptance of floating exchange rate system [2].

General equilibrium model is among models in which the impact of exchange rate changes can be analyzed. With the consistency of global economy, demand for quantitative analyses resulted from types of shocks at worldwide level would be higher day by day. General equilibrium models are used widely as the political-analytical models from the late 1970s. The mentioned models that are greatly flexible have great capacity for including different economic issues with the consideration of Walras' law in markets. The use of the mentioned models is observed in a wide range of political issues such as the selection of development strategies, income distribution, trade policies, foreign shocks and long-term development in the developed and developing countries.

The changes of exchange rate in a country indicate the economic performance of that country that it is necessary to evaluate the effects of its changes on the macro variables for analyzing the effects of impulses of this variable in an economy. The exchange rate in Iran has been affected by various impulses that the impact of these

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impulses on the different variables in economy is undeniable. For this reason, in addition to the importance that exchange rate is gaining in the macro variables of economy day by day, it has particular importance in the present period in the Iran's economy. Thus, having the necessary knowledge regarding the circumstance of the effects of these impulses in the present period can be highly effective in decisions and prevention. Therefore, the main question of the paper is whether the increase of exchange rate affects investment and employment in Iran in the framework of general equilibrium models. To answer the question of the framework, the paper is arranged in a way that after introduction, the review of the literature in the second chapter, theoretical principles in the third chapter, the estimation of the model in the fourth chapter and conclusion in the fifth chapter are included.

Review of the Literature: Many studies have been conducted concerning the discussion of changes of exchange rate. Most of these studies have been in a way that the impact of exchange impulse on one, two or three economic variables is examined in the framework of general equilibrium and econometric models. Therefore, attempt has been made to mention the studies in the literature.

Empirical Studies: Ping [3] evaluated the impact of impulses of exchange rate on the employment of production line using 29 states of China from 1993 to 2002. The econometric results indicated that the impulses of exchange rate on the total employment may be different from its impact on the different sections. Hildegunn (2008) investigated the relationship between the bullishness of resources of productivity growth and dynamism of real exchange rate with an analysis of South Africa. This study has been conducted in the framework of a dynamic general equilibrium analysis. The numeral simulation in this paper showed that the increase of general consumption has been after the bullishness resulted from the increase of real exchange rate. Roberto and colleagues (2012) in a paper titled "the mechanism of general equilibrium and real exchange rate in the model of Global Trade Analysis Project (GTAP) mentioned that the impact of shock in a section of economy can be seen in other sections because different sections of economy are interrelated. Thus, the shocks of exchange rate in the other section are seen through creating scenario. According to the results of this paper, the initial increase of exchange rate increase export and changes trade equilibrium. Firat (2013) evaluated growth under the

impulses of exchange rate using one estimation technique of dynamic panel. The results of this research show that the impulses of exchange rate have had a significant and negative impact on the growth of companies.

Theoretical Background: In economy, macro communication shows that change in a section can affect a wide area of economy, because one variable is connected with many variables and all the sections are interrelated simultaneously, directly or indirectly. Thus, in the general equilibrium model of GTAP, general equilibrium is decomposed into internal equilibrium and external equilibrium for simplifying the analysis. In the mentioned model, internal equilibrium (FE) and external equilibrium (BP) are discussed through the relationship between the real total consumption (c) and the relative yield of factors (w). The relative yield of factors (pfactor) and the index of the price of the initial factors in the region are studied. The function of relative price is mentioned as the real exchange rate in the model. The BP and FE curves make general equilibrium at macro level. In the confluence point of FE and BP curves, the combination (w, c) makes general equilibrium. The concept of real exchange rate can be analyzed by the three following definitions:

- The price of non-tradable goods in relation to tradable ones.
- The price of export in relation to import.
- The price of internal factors in relation to the external factors.

In this study, the third definition is confirmed considering the real exchange rate and change in the real exchange rate is made through change in the price of factors. For example, the reduction of agricultural goods tariff decreases the price of imported agricultural goods. Therefore, domestic consumers substitute domestic goods with foreign ones. Consequently, domestic imbalance would be made in the economy. On the one hand, the increase of demand for import results in fraction of the trade equilibrium and consequently foreign imbalance in the economy. The decrease of demand for agricultural products results in the limitation of this sector in the country. Therefore, low production decreases demand for the production factors in this sector that employing lower production factors results in the yield of internal factors in relation to the yield of external factors and consequently the reduction of real exchange rate would occur. On the other hand, due to the existence of the complete employment condition in these models, the

reduction in the demand of workforce by a sector should be compensated by the other sectors. In the mentioned example, this reduction would be compensated by the increase of demand in the services sectors. Consequently, the internal equilibrium is established again. The reduction of real exchange rate increases export. This reduction decreases also the price of export goods in relation to the import goods and as a result, it decreases the demand for import. Therefore, the trade fraction would be compensated by the decrease of import and increase of export in which the reduction of real exchange rate occurs and the external equilibrium would be established again. Thus, in the general equilibrium, w is the exchange rate that establishes balance between net trade and capital flow by affecting economic variables and it establishes general equilibrium (M° Dougall *et al.,* 2012).

The Gtap Model: One of the types of general equilibrium models is the multiregional model of Global Trade Analysis Project (GTAP) is used in this research. The mentioned model is an appropriate tool for conducting quantitative analyses of the effects of exchange impulses due to its world-wideness [4]. Furthermore, one of the most important reasons, which necessitate the use of types of computable general equilibrium models, is the reliability of its results. The GTAP is employed by many researchers in all across the globe and the accuracy of its results has been tested [5].

Moreover, along with the mentioned model, data compatible with the framework of one model of standard general equilibrium is presented and updated once in several years that is anther advantage of using the mentioned model. The possibility of separation and generalization of different regions and sections for different simulations is the third advantage of using the data of the mentioned model. Furthermore, the mentioned model has a great flexibility degree for necessary expansion and modifications in a way that there are possibilities for some changes and modifications such as release effects, changes in tax and the other cases in the model. The GTAP is a static model and does not include any dynamic effect of technological changes, population growth and capital balance. Behavioral activities and its intersection and interregional interchanges are consisted of two components of the main equations including accounting relations and behavioral equations. Accounting relations include available data in the Social Accounting Matrix (SAM) and input-output and behavioral equations indicate the behavior of economic factors in the model which are concerned with production,

consumption, saving and regional investment. Its math model includes a series of nonlinear equations that is extracted from the maximizing micro-economy theory by Dogan method along with the extracted accounting relations. Each region is consisted of four economic factors such as Representative Regional Household, Private Household, government and enterprises. Regional household is the owner of the used initial factors in the production of enterprises. The income of the regional household is the total of the value of selling the production factors and types of tax and tariff that the assignment of the income to the saving, private household and government is conducted according to Cobb-Douglas function. Government and private household with the purchase their needed goods and services from domestic and foreign markets by receiving income from the regional household. The consumption demand of private household is evaluated based on the functional form of "Difference constant elasticity" that first was presented by Chinook. Therefore, the demand of private household would have nonhomothetic form that along with the changes of income, the cost part of different goods would not fixed in the budget of household. Functions of the consumption demand of the government is extracted by one function of the desirability of Cobb-Douglas that the cost part of different goods is fixed. Enterprises employ intermediate goods and initial inputs such as workforce, capital, land and natural sources for producing their goods and services and with the combination of these factors produce types of goods and services. There are five factors of production such as land, skilled workforce, unskilled workforce, capital and natural sources. The all factors except land and natural sources are completely mobile in different sectors, but none of production factors is tradable. In other words, they have not international mobility. Selling goods are done in the inside or outside of each region. Based on the standard closure of the GTAP model, production of all sectors, land, workforce, capital and natural sources as well as all the prices are determined in the framework of the model. In other words, they are endogenous. The calculator in the GTAP model is the world price index of the production factors that are usually created exogenously and the weight average of the price of production factors in the all regions. It is necessary to note that different macro closures can be assumed according to the type of research. Finally, the solution of the model which is in the form of the percentage of changes is conducted using General Equilibrium Modeling Package (GEMPACK) [6].

Table 1: the aggregation of the GTAP Data

Set	Subset
Sectors	Agriculture, Industry and Mine, Services, Oil and Gas
Regions	Iran, Country members of Shanghai, EU country members, countries that have the highest part in trading with Iran, the rest of the world
Factors	Workforce, Capital, Land and Natural sources

Source: Authors

Aggregation of Gtap Data: The data in GTAP are 5 production factors, 57 sectors and 113 regions. The five production factors are skilled and unskilled workforce, capital, land and natural sources. In this study, four production factors namely workforce, capital, land and natural sources are taken into consideration. In this research, information is in the form of social accounting matrix that used GTAP.7. In Table 1, the details of sectors, regions and production factors are mentioned in the present paper.

The Model and Closure: The user in the closure of each model is obliged to select endogenous and exogenous variables for closing the model. In this closure, there are math solutions for solving the model that are compatible with accounting relations while, it allows the user to implement his. Her views regarding the circumstance of the mechanism of economy in the model. From math standpoint, the role of closure is distinguishing between endogenous and exogenous variables in the model in a way that the number of functions is equal with the number of unknown ones to make the system soluble [7]. The classification of variables in the closure of the model depends on the intended economic issue in a way that this classification should have economic logic in accordance with the objective and the policy. The standard closure of the GTAP is neoclassic in a way that all the markets are in equilibrium; the activity of all enterprises is under the assumption of zero income and regional household is put on the line of budget, however, users are free to select closure.

The first new function that shows the effect of internal equilibrium on the changes of products is the function of initial factors.

$$qo(i, r) = qocom(i) + qoreg(r) + qoall(i, r) \qquad (1)$$

In function 1, qo (i, r) is the percentage of change in the quantity of product related to the initial goods i in region r that are determined by the three initial factors which are endogenous normally in standard GTAP. Adding this new function and initial shifters makes the separation of the effect of internal equilibrium easier. These three initial factors are qocom(r), the percentage of change in the quantity of product related to the initial

factor i, qreg(r), the percentage of change in the quantity of product related to the initial factor in region r and qoall is the percentage of change in the quantity of initial factor i in region r.

The second new function introduces a new closure variable that this variable is the real total per capita consumption (uc) as the total of government and private sector's costs. Adding a new variable (uc) and one function for defining this variable indicate the endogenous of this variable in the closure of GTAP standard.

$$AGGEXPAND(r).uc(r) = PRIVEXP(r). up(r) + GOVEXP(r). ug(r) \qquad (2)$$

In function 2, three indices of uc(r), up(r) and ug(r). uc(r) is the per capita desirability that government and private sector obtain from the consumption in the region r that is decomposed into up(r) as the per capita desirability from the expenses of private sector and ug(r) the per capita desirability from the expenses of the government in the region r. uc variable is used to separate curves of FE and BP.

The two remained variables that are effective in the closure are dpsave and pfactr(r) ones. Dpsave indicates the growth rate of part of income that based on the saving function affects the distribution of saving in the region r. Furthermore, change in dpsave affects the investment-saving balance.

$$Psave(r) + qsave(r) - y(r) = uelas(r) + dpsave(r) \qquad 3)$$

In function 3, psave is the change percentage of saving in the region r, qsave(r) is the change percentage of regional demand for net savings, y(r) is the change percentage of the income of household in the region r, uels is the traction of cost in relation to the changes of desirability, dpsave(r) is the parameter of saving distribution.

Pfactor is a variable that refers to the real exchange rate. In this study, with consideration of equations (4), (5) and (6) in the standard closure, the intended modifications are conducted. The intended shock is applied by the quantity change of pfactor that has included all the prices in itself.

$$VENDWWLD \cdot pfactor(r) = \sum_{i \in END-COM} (VOM(i,r) \cdot pm(i,r)) \qquad (4)$$

Function 4 calculates the percentage of changes in the price index of initial factors in each region. In this function, pfactor(r) is the index of market price of initial factors in the region r (weight average from the received of types of production factors) VENDWWLD(r), the value of initial factors in all across the world, VOM(i, r) is the value of the product i based on the market price in the region, pm(i, r) is the is the market price of i in the region r.

Function (5) specifies the real yield rate of initial factor i, in the region r.

$$Pfactorreal(i, s) = pm(i, s) - ppriv(s) \qquad (5)$$

In function (5), pfactorreal(i, r) is the difference of yield rate of initial factor I from the growth rate CPI (the index of consumer's price), pm(i,s) is the market price of factor i, in the region s, ppriv(s) is the price index for consuming expenses of private sector.

Function 6 calculates the percentage of changes in the index of global price f initial factors.

$$VENDWWLD \cdot pfactwld = \sum_{r \in REG} (VENDWREG(r) \cdot pfactor(r)) \qquad (6)$$

In function 6, pfacwld is the change percentage of the index f global price of initial factors.

VENDWWLD is obtained through function (7).

$$VENDWWLD = \sum_{i \in END-COMM} VENDWREG(r) \qquad (7)$$

In function (7), VENDWREG(r) which is the value of initial factors to the market price in each region is obtained endogenously through function (8).

$$VENDWREG = \sum_{i \in ENDW-COMM} VOM(i,r) \qquad (8)$$

In the standard closure of the GTAP, qoreg and dpsave are endogenous, while pfactr and uc(r) are endogenously defined. The curve of FE and BP is analyzed through the relationship between consumption and real exchange rate. Therefore, the endogenousness of consumption and real exchange rate are indispensible in the model.

The reduction of tariff shifts the curves of FE and BP and makes internal and external imbalance in the initial place of consumption and real exchange rate. Imbalance would be eliminated by the two variables of qreg(r) and dpsave(r). The variable of qoreg(r) is employed in order to modify the closure in the design of FE curve. If change would be made in the initial factors, FE curve shifts the internal equilibrium roughly in relation to the initial combination of consumption and real exchange rate, which would be stopped by the parameter of initial change of qoreg. If the level of initial factor would be fixed, economy moves along FE curve. On the other hand, the variable of dpsave would be used for the modification of closure in the design of BP curve and imbalance in the level of payments in the initial combination of consumption and real exchange rate, which would be stepped by the distributive parameters of saving. If the total saving would be fixed, economy moves along BP curve. To apply the modifications, there is need to change the closure of the model in a way that transferrable parameters would be endogenous. Particularly qoreg and dpsave would be endogenous. The substitutive function makes uc exogenous and dpsave endogenous in way that makes model able to change the total saving, the second substitutive function makes pfactor exogenous, while makes qoreg endogenous in such a manner that makes change possible at the level of initial factors (Mc Dougall et.al, 2012)[8].

The Empirical Results: The increase of exchange rate increases the price level of imported goods in the domestic market. Therefore, it is expected that demand for this group of goods would be decreased and demand for the domestic goods would be increased. Furthermore, with the increase of exchange rate, the relative price of exported goods in foreign markets would be decreased and consequently it is expected that the demand for such goods would be increased. Consequently, it is possible that domestic products are inclined to the foreign markets and lower part in the domestic market would be sold[9].

Thus, generally it is expected that the rate of import would be decreased and the rate of export would be increased, the level of domestic price would be increased and domestic products would be increased. Consequently, employment and investment would be increased. Furthermore, with the increase of exchange rate, the price of imported intermediate goods also would be increased. Therefore, in sectors and industries which products are dependent on the imported intermediate inputs, the expectation of the increase of final price f the goods is existed and this increase might decrease the increase of competition of goods in the foreign markets and intensify the increase of domestic prices [10].

Table 2: Results of 10% increase of exchange rate(percentage change)

	Agriculture Sector	Industry and Mine Sector	Services Sector	Oil and Gas Sector
Price Index	6.22	7.72	8.10	12.34
Production	-3.65	-9.55	1.71	1.42
Private Consumption	2.14	3.25	3.61	1.76
State Consumption	7.08	6.62	2.82	-1.17
Net export and import	-153.18	-7531.75	-696.76	6728.14

Source: Authors

Table 3: Results of 10% increase of exchange rate (percentage change)

	Agriculture Sector	Industry and Mine Sector	Services Sector	Oil and Gas Sector
Employment	-4.01	-8.81	2.65	2.22

Source: Authors

Table 4: Results of 10% increase of exchange rate(percentage change)

	Iran	Country members of Shanghai	EU	Countries with the highest trade part with Iran	Rest of the world
Welfare Index	5343.01	22997.12	75925.83	16356.33	166874
Investment	6.92	4.29	10.39	16.08	9.81

Source: Authors

The important point in the analysis of changes of exchange rate refers to the substitution traction of imported goods with domestic goods as well as the substitution traction of exported gods with the supplied goods in the domestic market. Thus, theoretically the increase of exchange rate brings about the reduction of demand for imported goods. If the substitution traction in this group of goods and domestic goods were low, the level of domestic prices would be affected by the increase of exchange rate.

In the present paper, the scenario of 10%increase of exchange rate is taken into consideration. In the mentioned scenario, the impact of the increase of exchange rate on the investment employment, GNP and the components are examined.

10% Increase of Exchange Rate: As stated in Table (2), 10% increase of exchange rate has increased the price index of the domestic products in all economic sectors. The sector of oil and gas with the price increase of 12.34 is at first level, services sector with the price increase of 8.10 is at the second level and the sector of industry and mine with the price increase of 7.72 is at the third level. The price of agricultural products with the 6.22 increase, has been lower than the other sectors from the viewpoint of price increase. The increase of price has reduced production 3.65 in the agricultural sector and 9.55 in the industry and mine sector. On the contrary, in the services sector, the increase of price has increased production 1.71 and I the oil and gas sector it has increased 1.42. Net export and import in the agriculture sector increased 153.81, in the industry and mine sector increased 7531.75

and in the services sector decreased 696.76, while it increased 6728.14 in oil and gas sector. This point indicates that oil and gas sector has provided the necessary exchange rate for the increase of import in the other sectors by increase of export.

As shown in Table (3), the employment has decreased 4.01 in the agriculture sector and in the industry and mine sector 8.81, while, in the services sector it has increased 2.65 and in oil and gas sector it has increased 2.22.

As shown in Table (4), regional household welfare has increased in the all study regions in this research that in Iran it has the final grade with 5343.01 dollars. Investment has increased in the all study regions in the GTAP that countries which have the highest trade part with Iran are at first position with 16.08 increase and Iran is at third position with 6.92 increase. Countries in Shanghai are at the final position with 4.29 increase. In the rest of the world, investment has increased 9.81 [11].

CONCLUSION

This paper aimed to determine the impact of exchange rate on the investment and employment in the framework of one computable multiregional systematic model. To investigate this impact, a scenario of 10% increase of exchange rate is taken into consideration. The results confirm the accordance of price with the changes of exchange rate in a way that the increase of exchange rate has increased price in the all sectors. The increase of exchange rate has decreased production in agriculture, industry and mine sectors and it increased production in

services, oil and gas sectors. Thus, the reaction of employment has been different sectors against the increase of exchange rate in a way that the increase of exchange rate has been along with the decrease of production in agriculture, industry and mine sectors and it has decreased employment and it increased employment in the sectors of services, oil and gas along with the increase of production. Total investment in the all study regions in the present study is in accordance with the increase of exchange rate. Therefore, according to the objective of the study, the positive impulses of exchange rate generally can increase employment. This issue is important because the part of employment is higher in the sectors of services, oil and gas than agriculture, industry and mine sectors. Furthermore, the positive impulse of exchange rate increases investment according to the structure of export and import. According to the results of this study, the management of exchange arte and consequently the determination of optimum path of exchange rate are highly important according to the widespread and different consequences of change of exchange rate in Iran's economy for achieving employment and optimum investment which are two vital variables in the economy.

REFERENCES

1. Ghafari, H., M. Jalai and A. Changi Ashtiani, 2012. The analysis and prediction of effects of increase of exchange rate on the economic growth f Iran's major economy sectors (1976 to 2014), Journal of Science and Research, Economic Growth and Development Research, pp: 7.

2. Samti, M., A. Khanzadi and M. Yazdani, 2010. The analysis of assumption the existence of symmetrical effects of shocks of exchange rate the production level and price (case study: Iran)". Journal of Money and Economy, pp: 4.

3. Ping, HUA, 2007. Real Exchange Rate and Manufacturing Employment in china, China Economic Review, 18: 335-353.

4. Narayanan, G.B., A. Angel and R. McDougall, 2012. Global Trade, Assistance and Production: The GTAP 8 Data Base. Center for Global Trade Analysis, Purdue University.

5. Hertel, T.W., D.K. Lanclos, K.R. Pearson and P.V. Swaminathan, 1997. Aggregation and Computation of Equilibrium Elasticities, in T.W. Hertel (e.d.), Global Trade Analysis; Modeling and Applications. Cambridge: Cambridge University Press.

6. Harrison, W.J. and K.R. Pearson, 1994. Computing Solutions for Large General Equilibrium Models Using GEMPACK. Monash University, Australia, Impact Project, Preliminary Working Paper, pp: 64.

7. Hertel, T.W. and M.E. Tsigas, 1997. Structre of GTAP, In: T.W. Hertel, (ed.), Global Trade Analysis. Modeling and Applications, Cambridge: Cambridge University Press.

8. Dougal, M.C., R.Z. Akgul, T. Walmsley, T. Hertel and V. Nelson, 2012. General Equilibrium Mechanisms and Real Exchange Rate in the GTAP Model, Third Draft of a Technical Document November, pp: 1-40.

9. Demir, F., 2013. Growth under Exchange Rate Volatility: Does Access to Foreign or Domestic Equity Markets Matter?, Journal of Development Economics, 100: 74-88.

10. E.stokke, H., 2008. Resource Boom, Productivity Growth and Real Exchange Rate Dynamics-A Dynamic General Equilibrium Analysis of South Africa, Economic Modeling, 25: 148-160.

11. Shoven, J. and J. Whalley, 1984. Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey, Journal of Economic Literature, 22: 1007-1051.