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Research Paper

Effects of Changing Agricultural Subsidies on Production and Exports in Iran

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Abstract

Subsidy is a tool used by governments as a form of financial aid to support specific economic sectors. Today subsidy is common in several countries such as Iran due to different political and economic reasons. This study has examined the effects of changing agricultural subsidies on, production and exports. For this purpose, a computable general equilibrium model (CGE) for the year 2012 was used in social accounting matrix form in 2001 as the statistical basis. For the extraction and transportation of nonlinear programming model "mixed complementary problem" (MCP) was used. Social Accounting Matrix was divided into main sectors: agriculture, oil and gas, textiles, energy, industry and services. Then, the effect of agricultural subsidies and its effect on endogenous variables were investigated. Results showed that reducing agricultural subsidies, decreases the level of agricultural production by 21.3 percent and increases prices which in turn causes deviation of real exchange rate from equilibrium that prevents the exports in this sector. Moreover, by reducing subsidies the unemployment rate increases and welfare decreases.

Keywords:
Accounting matrix, computational general equilibrium, effect of reducing subsidies Social

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INTRODUCTION

Generally, subsidy is a financial aid that governments pay to contribute to delivering goods and services to consumers at cheaper prices and supporting the competitiveness of manufacturers (Meyer, 2011). In fact, subsidy is a tool used by governments as a form of financial aid to support a specific economic sector. Subsidy is the most common, albeit the most controversial, economic concept that is closely related to the welfare of a large portion of the population. Generally, subsidies are classified into five categories: economic subsidies, development subsidies, social subsidies, political subsidies, and cultural subsidies. Based on payment steps, subsidies are divided into consumer subsidies, production subsidies, distribution subsidies, service subsidies, export subsidies, and foreign exchange subsidies (Jansooz, 2009). It seems that Iran currently has an inefficient subsidization system (Abassi Shavazi, 2011). In this system, subsidies are distributed equally among high-income groups, medium groups, and vulnerable groups of society. One consequence of this situation is the increase in waste products. In addition, distributing subsidies in this manner has resulted in the expansion of trafficking markets and has created differences between free rates and governmental rates. So, one can say that a major issue that should be considered by policymakers and macroeconomic planners is to change the current public subsidization system (Najafi & Shooshtarian, 2004). The relative prices of goods that tax is levied on are increased and the relative prices of subsidized goods are decreased. So, by creating a deficit on social costs, subsidies have substantial effects on the national economy. Although in some countries, consumers that pay lower prices for subsidized goods benefit from these subsidies, this ultimately creates social discontent because subsidizing increases public costs, slows economic growth, creates budget deficit and thus leads to inflation (Qin et al., 2012; Karimi, 2007).

Riafard (2010) examined the effect of reducing tariff rates on the economy of Iran using a computable general equilibrium model in his master's thesis. The results showed that the reduction or elimination of customs tariffs in the textile industry sector by the government would not be too concerning because inflation as an indicator of welfare would remain unchanged. The unemployment rate would decrease and welfare would increase. In addition, production would be bolstered in important sectors such as agriculture and horticulture, oil and gas, textile, and chemical industries.

Tayeb Nia and Foladi (2009) examined the effects of increasing world prices on domestic prices, trade balance, and exchange rate using a computable general equilibrium model. They provided a general equilibrium model for Iran and examined the effects of varying world prices of agricultural, industrial and service goods on domestic price levels, trade balance, and exchange rate separately and simultaneously. The results showed that an increase in the prices of industrial goods would have the greatest impact on the domestic price levels and an increase in the prices of services goods would have a minimal impact on the domestic price levels.

Mabugu and Margaret (2008) addressed the effects of further support for agriculture on the productivity and welfare of poor households in South Africa. They used a top-down simulation model of general equilibrium. Their model predicted that supporting agricultural production would have a minor impact on GDP.

Supportive policies of developed countries aim to grant subsidies to producers instead of consumers, but the policy is applied in such a way that it eventually benefits the consumers. But, the policy is usually quite the opposite in non-developed. Since two decades ago, and mainly due to the rise of population, the reduction of industrial aids from developed countries, and the ongoing economic problems encountered by Iran, the government has launched the scheme of tar-

geted subsidization across the entire economy. Many studies have been since carried out in this regard. However, a few studies have considered the role of the agricultural sector. Therefore, the present study aimed to explore the effects of changing agricultural subsidies on agricultural production and exportation. The study investigated the effects of agriculture subsidies on other economic sectors, the rate of transportation, exportation and importation of agricultural commodities, and social welfare.

Based on the theory of production in microeconomics, capital and labor can be substituted for each other, and a fixed combination of these two factors is required for the production of goods. In other words, the value of materials and the value-added are combined with a Leontief function. Domestic goods can be issued or combined with imported goods to create the final product. In other words, firms provide domestic goods to domestic markets or export them to maximize their revenues. Firms perform this operation by using a transfer function. This function and the production function with constant elasticity have a similar characteristic. But, it is called here the transfer function with a constant elasticity (Akbari Moghaddam, 2008). Figure 1 and 2 shows general equilibrium model various stages of production and supply in the market.

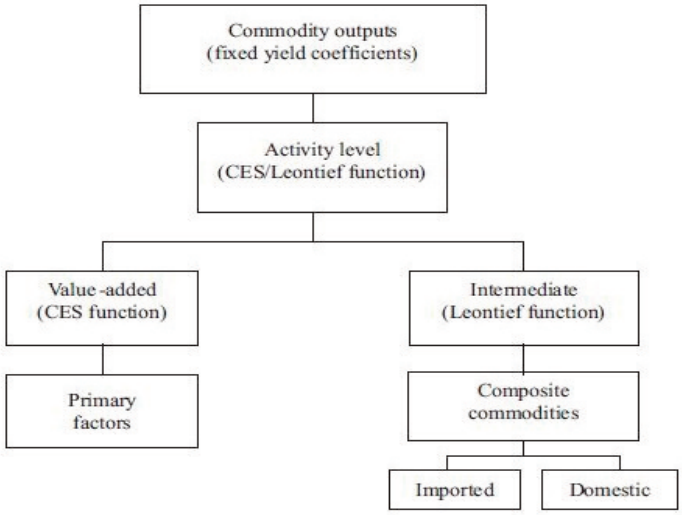

Figure 1. Structure and Overall Process of Production in General Equilibrium Models (Lofgren et al., 2002)

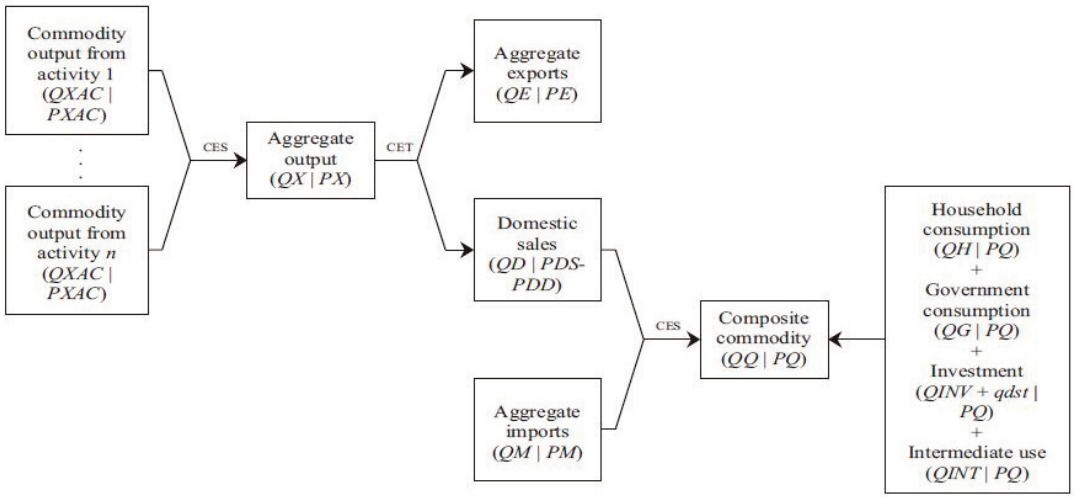

Figure 2. The Flow of Marketed Commodities in General Equilibrium Models (Lofgren et al., 2002)

The following model that consists of *n* commodities and m factors is considered to introduce the general equilibrium of the economy. If P_j is the j-th commodity price, the price vector is written as follows (Abassi Shavazi, 2011):

$$(P = P_1, P_2, \ldots, P_n) \quad (1)$$

If W_i is assumed as the *i-th* wage, the vector of wages (w) can be written as follows:

$$(\mathrm{W} = \mathrm{W}_1, \mathrm{W}_2, \ldots, \mathrm{W}_m) \quad (2)$$

It is assumed that the economy is in competitive conditions so households and firms are the price-maker. In economics, there are *f* firms that buy each of the factors of production (data) from the factor market and sell products in the commodity market. If is the amount of the factor *i* purchased by the firm *f*, and is the amount of production (output) *j* of the firm, profit functionis obtained from the difference between income and expense as follows:

$$-\sum_{i=1}^{m} Wi\, r_i^f \qquad \mathrm{F} = 1, 2, \ldots, \mathrm{F}$$

$$\pi^f = \sum_{j=1}^{n} P_j C_j^f \quad (3)$$

If $C^f = (C_1^f C_2^f \ldots, C_n^f)$ and $r^f = (r_1^f r_2^f \ldots, r_m^f)$ are the vectors of goods and factors of production of the firm, respectively, the profit function can be written as follows:

$$\pi^f = Pc^f - Wr^f \quad (4)$$

This will be followed by each firm that maximizes its profit by considering the constraints of the production function. Production function in the general case can be written as follows (Abassi Shavazi, 2011):

$$Q^f = (C_1^f C_2^f, \ldots, C_n^f r_1^f, r_2^f, \ldots, r_m^f) = Q^f(C^f, r^f) \quad (5)$$

$$\left\{ \begin{array}{l} Max\ \pi^f = PC^f - Wr^f \\ s.t Q^f = Q^f(c^f, r^f) \end{array} \right\} \quad (6)$$

The Lagrange function for this problem is as follows:

$$L^f = Pc^f - Wr^f + Y^f\left(Q^f(c^f, r^f)\right) \quad (7)$$

where y^f is the Lagrange coefficient for the firm. If it is assumed that manufacturers produce each product to some extent and use each factor of production, then the necessary condition for maximum profit is that the production function is obtained as follows

$$\frac{\partial L^f}{\partial C^f} = p + y^f \cdot \frac{\partial Q^f}{\partial C^f} = 0 \quad (8)$$

in other words, the n + m +1 unknowns, r^f, y^f and c^f from the above equations that are n+m+1 are obtained as follows (Abassi Shavazi, 2011):

$$y^f \cdot \frac{\partial Q^f}{\partial C^f} = -p$$

$$y^f \cdot \frac{\partial Q^f}{\partial r^f} = w$$

$$Q^f(c^f, r^f) = 0 \quad (9)$$

These equations must be solved for *f* firms, so the total number of *f* equations would be (n + m +1). There are *h* households in the economy that have a certain amount of factors such as labor that can be traded as capital incomes. Each household may also have a number of shares provided by firms. So, they can make a profit from these shares, which provides the other part of the household income. The total income of the household is spent on selling commodities by the means of (is the amount of the factor *i* sold by the household *h*). In this case, the utility function of the household *h* is as follows (Abassi Shavazi, 2011):

$$u^h = u^h(C_1^h, C_2^h, \ldots, C_n^h, r_1^h, r_2^h, \ldots, r_m^h) = u^h(C^h, r^h) \quad (10)$$

where is a vector of goods consumed by the household *h* and is a vector of production factors supplied by the household *h*. Budget con-

straint due to income from work and dividend is written as follows (Abassi Shavazi, 2011):

$$\sum_{i=1}^{m} w_i r_i^h + \sum_{f=1}^{F} S^{hf} \pi^f = \sum_{j=1}^{n} p_j c_j^h \quad (11)$$

where s^{hf} represents the share of the household h of the firm f. If the vectors s^h and π are considered, then we can write the budget constraint as follows:

$$wr^h + s^h \pi = pc^h \quad (12)$$

So the issue that the consumer is facing will be as follows:

$$\begin{Bmatrix} \max u^h = u_x^h (c^h r^h) \\ s.t\, wr^h + s^h \pi - pc^h \end{Bmatrix} \quad (13)$$

in general equilibrium, the sum of all demands for each commodity or factor of production is equal to its total supply. The balance on commodities and factors will be created with the following equations (Qin et al, 2012).

$$\sum_{h=1}^{H} C_j^h = \sum_{f=1}^{F} C_f^f \quad j = 1, 2, \ldots, n$$
$$\sum_{h=1}^{H} r_i^h = \sum_{f=1}^{F} r_i^f \quad I = 1,2, \ldots, m \quad (14)$$

Equations of budget constraint for the total household are as follows:

$$\sum_{i=1}^{m} w_i r_i^h + \sum_{f=1}^{F} S^{hf} \pi^f = \sum_{j=1}^{n} p_j c_j^h \quad (15)$$

$$\sum_{h=1}^{H} \sum_{i=1}^{m} w_i r_i^h + \sum_{f=1}^{F} \pi^f = \sum_{h=1}^{H} \sum_{j=1}^{n} p_j c_j^h \quad (16)$$

Eq. (15) and (16) show that the total income from the wages of all households plus the total profit of all firms must be equal to the total value of productions. If instead of π^f, we use its expression, we have:

$$\sum_{h=1}^{H} \sum_{i=1}^{m} w_i r_i^h + \sum_{f=1}^{F} \left(\sum_{j=1}^{n} p_j c_f^f - \sum_{i=1}^{m} w_i r_i^f \right) = \sum_{h=1}^{H} \sum_{j=1}^{n} p_j c_j^h \quad (17)$$

Eq. (17) shows that general equilibrium equations are not independent of one another. For example, assume that all markets except the last market of production factors are in equilibrium. In this case, we have:

$$\sum_{h=1}^{H} C_j^h = \sum_{f=1}^{F} C_f^f \quad j = 1, 2, \ldots, n \;\; i = 1,2, \ldots, m$$
$$\sum_{h=1}^{H} r_i^h = \sum_{j=1}^{F} r_i^f \quad (18)$$

Standard social accounting matrix

The standard social accounting matrix is similar to the matrix presented in Table 1, except that in the standard matrix, taxes must be paid to the tax account. In fact, taxes are included in the government account where they create government revenue but in the standard social accounting matrix, taxes can be separated statistic wise and also total revenue for the government must show its impact (Akbari Moghaddam, 2008). The social matrix in this study provides a comprehensive picture of economic activity and economic exchanges that take place between various inputs. The unit of each account in the matrix is based on billion IRR which means the value obtained by multiplying the price in the quantity. To separate prices from quantities, the conventional solution is that all prices for commodities and factors of production are assumed unity. Prices and base quantities with exogenous elasticities (elasticity of substitution) set up the size of the free parameters of the model. In fact, we have used the Cobb-Douglas function in that the elasticity of substitution is equal to unity in these types of functions. Now, we use the matrix that is dependent on the social accounting matrix and is called McM (a small consistent matrix). Table 1 shows in this matrix, the sectors are placed in columns and the markets in the rows. In fact, the prices as complementary variables are in rows. This matrix is rectangular with 17 columns and 12 rows. There are both positive and negative items in McM. The positive item is the sale or production of each sector in a particular mar-

Table 1

Social Accounting Matrix (Akbari Moghaddam, (2008)

The total	Expenditures								
	Rest of the world (ROW)	**Savings -Investment**	**Government**	**Enterprise**	**Households**	**Factors**	**Commodities**	**Activities**	**Receipts**
Activity income (gross output)	-	-	-	-	Household products	-	Market outputs	-	Activities
Demand	Exports	Investment	Government consumption	-	Private consumption	-	Transaction costs	Intermediariesinput	Commodities
Factor income	Factor income from ROW	-	-	-	-	-	-	value-added	Factors
Household Income	TransfersTo households from ROW	-	Transfer to households	Surplus to households	Interhousehold transfers	Payments to households	-	-	Households
Enterprise income	Transfersto Enterprisesfrom ROW	-	Transfer to Enterprises	-	-	Factors income to Enterprises	-	-	Enterprises
Government income	Transfer to Government from ROW	-	-	Surplus to government direct enterprise taxes	Transfers to government direct	Factor income to government factor taxes	Sales tax, tariffs, export taxes	Producer taxes, valued-added	Government
Savings	Foreign savings	-	Government savings	Enterprise savings	Household savings	-	-	-	Savings -Investments
Foreign exchange rate	-	-	Government transfers to ROW	Surplus to ROW	-	Factor income to ROW	-	-	Rest of the world (ROW)
-	Foreign exchange inflow	Investment	Government expenditure	Enterprise expenditure	Households expenditure	Factors expenditures	Supply expenditure	Activity	Total

ket, which is basically the output. The negative item is the cost that is, in fact, data or input, e.g. the use of production factors (demand factors) or the use of raw materials by each manufacturing sector. McM is aligned when the sum of rows and columns is equal to zero. When the input and output of the economy are equal, the sum of rows is zero, which expresses the equality of supply and demand. Also, when the sum of columns is zero, it represents the value and cost of entry and exit are equal, which implies zero profits and eventually the sum of the consumer column becomes zero when the final demand is equal to the sum of sale factors. In the social accounting matrix of the present research, we have split the activities into six main sectors including agriculture, oil and gas, textiles, energy (electricity and water), industry, and services.

The model used in this study is an interpretation of the Rutherford findings and the Johansen-Euler approximation that shows the impact of changes in agricultural subsidies on the production and export of the agricultural sector.

Endogenous variables

Endogenous variables of the model can be divided into three main categories:

A) The price index: prices of commodities and non-negative factors.

B) The amount index: activity of all manufacturing sectors that is non-negative.

C) The income index: that is non-negative.

Table 2 lists the definition of each variable along with its denoted symbol.

RESULTS AND DISCUSSION

The study was carried out in 2011 using the input-output table of Iran's economy in 2001 (Abbassi, 2011). The scenarios are based on research studies carried out in the agricultural sector including Hosseini et al. (2016), Sabouhi and Ahmadpour (2015). Based on a social accounting matrix, this research study is written in the GAMS software. The social accounting matrix was divided into six main sections: agriculture, oil and gas, textiles, energy, industry, and services (Abassi Shavazi, 2011). Table 3 shows in the Division of Social Accounting Matrix form in 2001 as the statistical basis. Table 4 shows the amount of exports and imports in each sector. In the agricultural sector, imports outweigh exports by about 36 percent.

Table 2
The Variables in the Model

Parts	*(X1, X2,..., X6)*
The export of each sector	*(E1, E2,...,E6)*
Imports of goods per unit	*(M1, M2,..., M6)*
Commodity price index for each sector	*(P1, P2,..., P6)*
The price index for imported goods per unit	*(PF1, PF2,..., PF6)*
Investment price index	*P1*
Investment index	*I1*
Wage Index	P_L
Price index of capital	P_R
Price index for welfare	P_W
Welfare index	*W*
Rate of exchange	*PFX*

Table 3
Division of Social Accounting Matrix

	Sectors	Agriculture	Oil and gas	Textiles	Energy electricity and water	Industry	Services
Intermediate materials	Agriculture	165680197	6772	2212258	1213947	43150633	889599
	Oil and gas	668088	145865436	42102	322778	3282749	8966745
	Textiles	398057	23353	18516490	353721	1226124	970408
	Energy electricity and water	1644592	312778	351721	19681719	3361161	4764755
	Industry	14998252	1556964	5599817	856658	385425131	30675234
	Services	19332345	3446529	2960662	5662779	59354230	385425131
Value added	Work	66640425	3399518	4683983	3766938	42335825	174951503
	Capital	61998438	137119522	2665947	7504898	85512926	164206887

Table 4
Exports and Imports in Each Sector

	Agriculture	Oil and gas	Textiles	Energy electricity and water	Industry	Services
Exports	7088433	109810696	5862348	78263	12486898	18356742
Imports	11884756	4371633	8261759	55672	93436611	13345718

The effect of reducing agricultural subsidies on Iran's economy was examined in the context of four scenarios. Table 5 shows effect of reducing subsidies in each sector at different levels, for example at the 5 percent level, it is as follows: the production agriculture used 0.17 percent of the commodity of oil and gas sector, 0.11.6 percent of commodity of textiles sector, 0.44.30 percent commodity of the power sector, 10.8 percent of the commodity of industry and 9.4 percent of the commodity of the services sector as intermediary inputs. Also, 11.50 percent of the workforce,

Table 6 shows the effect of reducing agricultural subsidies on price levels. As can be seen, agricultural subsidies, which have been applied as a shock to the economy, have reduced the value of agricultural prices, which can be attributed to a decline in production in this sector. A 5 percent reduction in subsidies causes a 4.8 percent increase in the price of the agricultural sector. With a further reduction in subsidies, prices in this sector would increase. With a 20 percent reduction in agricultural subsidies, the price in this sector would reach 21.35 percent. Furthermore, the use of this policy in the oil and gas sector would lead to a decrease in prices. With a 5% and 10 percent reduction in the agricultural subsidies, the prices for oil and gas would decrease by 1.6 percent and 3.3 percent, respectively.

Table 6
Effect of Reducing the Rate of Agricultural Subsidies on the Prices of Various Sectors

Percent of reducing subsidies	Changes in the production of different sectors					
	Agriculture	Oil and gas %	Textiles %	Energy electricity and water%	Industry%	Services %
5	4.80	-1.62	0.2	-0.7	0.0	-0.9
10	9.70	-3.23	0.3	-1.6	0.1	-1.5
15	14.65	-432	0.5	-1.9	0.2	-2.3
20	21.35	-6.76	1.0	-2.3	0.5	-3.2

Table 5
Effect of Reducing Subsidies in Each Sector

Percent of reducing subsidies	Change of production in each sector					
	Agriculture %	Oil and gas %	Textiles %	Energy electricity %	Industry %	Services %
5	-17	11.60	-44.30	-10.80	-9.40	-11.50
10	-20.70	12.40	-36.20	-12.10	-10.80	-12.50
15	-22.60	13.40	-40.60	-13.40	-11.80	-13.60
20	-26.40	16.80	-41.80	-14.90	-13	-14.40

Sectors production

According to the results of Sabouhi and Ahmadpur (2015), in the agricultural sector, the subsidies that involved surges in the price of inputs (water, fertilizer, use of pesticides and machineries), the price of energy carriers in poultry and dairy farms, and the transportation costs, have reduced the social surplus of the agricultural sector (social welfare), reduced the level of a large number of annual and livestock activities in different areas, increased prices, reduced consumption, reduced exports, and increased imports of agricultural commodities, which is consistent with our finding in this study. Table 7 shows the effect of reducing subsidies to the real exchange rate. The trends in effect of reducing subsidies to the real exchange rate are shown in Figure. 3.

Table 8 shows the effect of reducing subsidies on oil and gas.

Table 9 shows the effect of this policy on the level of well-being and the unemployment rate. Overall, the four-step reduction of the agricultural subsidy has led to a decline in welfare. A 5 percent reduction in agricultural subsidies reduces the welfare level by 7.5 percent. This trend continues to increase. For example with a 20 percent reduction in agricultural subsidies, the welfare level would decrease by 11.9 percent. The decline in agricultural subsidies would increase the unemployment rate. With a change in the subsidy rate from 5 to 20 percent, the unemployment rate would continually increase from 10.8 to 17.6 percent. The trends in welfare and unemployment rates are shown in Figure. 4.

The results of Sabouhi and Ahmadpur (2015) on targeted subsidies and the effect of reducing agricultural subsidies showed a decrease in the social welfare and the unemployment rates which are in line with the results of this study.

Table 7

Effect of Reducing Subsidies on the Real Exchange Rate

Change of the real exchange rate (%)	Percent of reducing subsidies (%)
-1.62	5
-3.23	10
-4.32	15
-6.76	20

Table 8

Effect of Reducing Subsidies on Oil and Gas Exports

Change of oil and gas exports (%)	Reducing subsidies (%)
11.60	5
12.40	10
13.40	15
16.80	20

Table 9

Effect of Reducing the Agricultural Subsidies on Social Welfare and the Unemployment Rate

Change of welfare (%)	Change of unemployment rate (%)	Reducing subsidies (%)
-7.5	10.8	5
-9.7	12.4	10
-11.2	14.3	15
-11.9	17.6	20

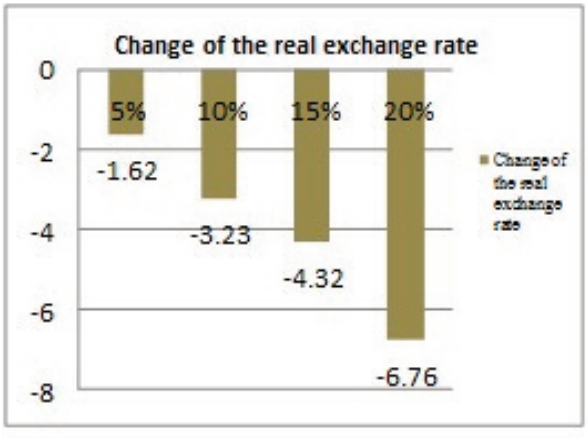

Figure 3. Effect of Reducing Subsidies on the Real Exchange Rate

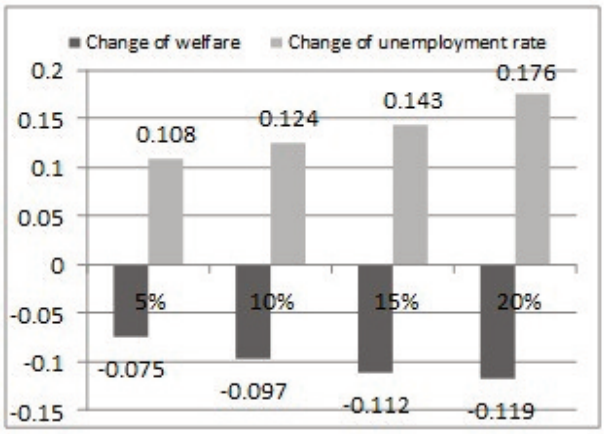

Figure 4. Effect of Reducing the Agricultural Subsidies on Social Welfare and the Unemployment Rate

CONCLUSION AND RECOMMENDATION

Using the input-output in 2001, the required data were collected, and they were then included in the table of a social accounting matrix to achieve the initial equilibrium. Next, after a policy shock, that is the reduction of agricultural subsidies here, was applied, a new equilibrium was established and the data were updated. The shock and its effect on the endogenous variables of the model, e.g. production, prices, exports, imports, welfare, and unemployment, were examined. The shock in the four scenarios, 5, 10, 15, and 20 percent was imposed on the model.

Finally, the four-step reductions in agricultural subsidies led to a decline in welfare. Reducing subsidies in the agricultural sector, which has been applied as a shock to the economy, resulted in a rise in agriculture prices, which could be due to a decline in the productivity of this sector. In Hosseini et al. (2016), analyzed the effects of targeted subsidies on Iran's agricultural sector (Computable General Equilibrium Model). The results show that the reduction of agricultural water subsidies would significantly decrease the use of rural households and, on the other hand, it would increase the price index and production costs in the agricultural sector, The results of the decline in agricultural subsidies have led to an increase in unemployment and a decrease in social welfare as well as in real exchange rates at various levels. According to the results of this study and given the importance of the policy in the country, the following recommendations can be drawn:

The deviation of the real exchange rate might prevent agricultural production and exports. Therefore, to expand exports in this sector, it is necessary to eliminate deviations from the real exchange rate.

The rise in domestic prices leads to a rise in domestic sales and a fall in exports. So, it is important to control domestic prices in order to improve exportation.

According to the results, the reduction of agricultural subsidies would decrease production in this sector. It is necessary for the government to adopt appropriate policies to control the volatility of agricultural production.

Policies to reduce agricultural subsidies alone would increase the unemployment rate. Therefore, governments have to implement appropriate policies to prevent a rise in unemployment while reducing subsidies.

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