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Investigating the Effect of Green Subsidies on Employment, Investment and Value added of Iran's Agricultural Sector Using the CGE Model

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Abstract

One of the most important economic policies in most countries is to support producers or consumers through subsidies. The category of green subsidies has been proposed in the direction of agricultural development, which is in line with the law on targeted subsidies, but in a real way. Green subsidies belong to farmers and are used to boost business and industry in the agricultural sector. The purpose of this study is to investigate the effects of Iran's accession to the World Trade Organization by applying a simulated green subsidy policy on the variables of employment, investment, and value added in the agricultural sector, which is designed in the form of 20%, 50% and 100% scenarios. The model was calibrated using the social accounting matrix of 2011 and the baseline scenario (0% of green subsidies). GAMS software was used to analyze the data in this research. The results show an increase in employment in the agricultural sector during the effects of Iran's accession to the World Trade Organization and by applying the green subsidy simulation policy, in 20, 50 and 100% scenarios. Also, the implementation of green subsidy policy has led to an increase in investment in the agricultural sector.This is due to the increased production in this sector and as a result, increase in the use of intermediate inputs. The results obtained from the mentioned shocks show that value added in the agricultural sector has an upward trend, which is due to the increase in the use of factors of production in this sector.

Keywords: Agriculture section, CGE model, Green Subsidy, World Trade Organization

Introduction

Based on the market economy system, the extent of government presence and intervention in the economy is analyzed based on its advantages and disadvantages (Barton, 2011). One of the most important economic policies in most countries is to support producers or consumers through subsidies. Agricultural subsidies have long been a constant feature of government policies to influence their use (Bellmann, 2019). Supporting theagricultural products has been accepted due to its role in establishing food security and high risk in agricultural production. This is even more important in developing countries where the agricultural sector plays a key role in their economic and social development.Even the World Trade Organization has authorized the use of certain supportive methods by

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governments (Jalali, 2010). In the WTO, all measures and assistance provided by the government or public institutions to agricultural producers so that they can produce and supply agricultural products at more reasonable prices are classified as "internal support". Public services and related support; such as research, pest and disease control, education services, marketing services, infrastructure services, etc. or public storage support to ensure food security, support for farmers' incomes subject to their separation from production, disaster compensation payments. The government has no advantage over farmers in disadvantaged areas. The developments of the last decade in the field of world economy and trade have had a wide reflection on the domestic economies of countries, especially developing countries. One of the most important consequences of these developments is the need to link the process of economic development of countries with the forces and factors of the global economy. The WTO today is one of the foundations of globalization, especially in the field of economics. Countries that are not one of the members of this organization, also try to become a member to achieve economic and industrial development by using the privileges of membership in this international organization (World Trade Organization, 2007). Paying green subsidies to farmers in the agricultural sector is very important in the country's economy. Green subsidies will be paid to support farmers, villagers, and nomads. Green subsidies are given to farmers in three stages before, during, and after production. In this regard pre-production green subsidies include insurance for agricultural products, facilities, and agricultural machinery, and subsidy facilities will be paid to them. Also, subsidies to agricultural inputs and support machinery, including payment of green subsidies during and after production, in the form of conversion and complementary industries, guaranteed purchases, transportation systems, distribution, and export incentives. Iran is now one of the applicants for accession. In Iran, on the one hand, various subsidies are paid directly and indirectly to individuals, firms, and companies, privately and publicly. On the other hand, according to Article 104 of the Fifth Economic, Social and Cultural Development Plan of the Islamic Republic of Iran, the government is obliged to align the laws and regulations of the country's business sector with the laws and regulations of regional and international unions, including the World Trade Organization. Prepare and empower the economic pillars of the country for membership in the World Trade Organization to take legal action (Zare, 2009). The purpose of this study is to investigate the effects of applying a simulated green subsidy policy on the variables of employment, investment, and value added in the agricultural sector. This is the first innovation in Iran. In the world, in this field, because in most countries this policy has been implemented and data is available, econometric methods are applicable in this case. Given that few studies have been performed with the computable general equilibrium model, some of the similar articles will be discussed in the following. Jackson *et al*. (2020) examined the value of the Agriculture Committee in the WTO trade process and found that at least $ 778 billion of WTO trade belongs to the agricultural sector. Ahangari *et al*. (2018) studied the effects of green tax on economic growth and welfare in Iran with a dynamic stochastic general equilibrium approach. The results showed that the application of green tax in the above four scenarios has a little negative impact on economic growth. Lambie (2017) examines the effects of tax reforms, including VAT, in Uruguay using a computable general equilibrium method. The result is that in order to maintain budget neutrality after tax reform, the VAT rate must be reduced. The results of empirical studies showed that participation in normal agricultural policy (CAP) causes positive changes.

Charnowitz (2016) in a study on green subsidies and the WTO, looking at renewable energy, concluded that under the framework of domestic law, international law and world trade law, along with the implementation of the WTO law, a good design of green subsidies can be. Banga (2014) examined the effects of green subsidies on productivity, production and international agricultural trade and used the Agricultural Trade Policy Simulation (ATPSM) model. The results have shown that between 1995 and 2007, green box subsidies increased about 60 percent in the European Union and 40 percent in the United States in agricultural production, leading to substantial gains in developing countries and increasing their export earnings by 55 percent. Lim and Kim (2012) with a CGE model, introduced subsidies to industry R&D as a means of internalizing technological advances in the Korean economy. They found that subsidies (for all groups) to R&D expenditures might increase carbon intensity and real GDP for the Korean economy. Lapka, Kadelinova, Ricon and Lapka (2011) examined the reaction of Czech farmers in a study of rural development in the form of green agricultural subsidies:. Using a computable general equilibrium model, Kling examined the effect of Vietnam's accession to the WTO on income distribution and showed that joining the WTO has been effective on income distribution through job creation. Morley and Poniro (2004) used a general equilibrium model to examine the effect of market access within the framework of the World Trade Organization and the Latin American Rural Free Trade Agreement. Their findings suggest that both the WTO and the Free Trade Agreement will have positive effects on the studied countries in terms of employment and production, and that the WTO has had more positive effects on the agricultural sector. Piri (2016) In a study, the World Trade Organization and Third World countries: A case study examined the process of accession of the Islamic Republic of Iran to the WTO. The results showed that the membership of the World Trade Organization has not been a cure for all political, economic and cultural diseases of any country, but it could be said that it is a big step towards improving the economic structure and economic growth of countries.

Theoretical Foundations and Research Methods

It is well established in the theoretical literature that the channels through which green subsidy payments can affect agricultural production include: (A) The effects of risk were first highlighted by Hennessy (1998) when he argued that green subsidy payments could reduce farmers advancing risks by increasing wealth (wealth effect) and creating less risk-taking. Empirical evidence on the risk effects of green subsidy payments has been provided by many studies including Chavas and Holt (1990), Young and Westcott (2000), Anton (2004), Morrow and Skokai (2006), and Just (2011). Although most studies show that green subsidy payments make farmers production less risky, many believe that the impact may not be very large and can be minimized.

B) Land price effects occur when green subsidy payments become land value. Many studies have modeled this effect and its implications for agricultural production and investment. Debre, Anton and Thompson (2001), Roe, Samuro and Diao (2003), Roberts, Kirvan and Hopkins (2003), Goodwin, Mishra and Ortalo Magne (2003), Kirvan (2009) have have developed models in this area. Hendrix, Johnson, and Deutter (2012) also use a panel data set from Kansas farmers to estimate the dynamic rent equation using the GMM system and show that short-term subsidy capital in agricultural rents increases to 12 cents and the long run to subsidies increase by 37 cents per dollar. C) Credit effects reduce the cost of accessing debt in the event of internal support measures in the Green Fund. Studies have shown that with the presence of incomplete capital markets, including a significant gap between borrowing and lending rates, any agricultural policy, given the availability of credit, will affect farmers' willingness to invest in overproduction in the future. Potentially increases farmers' creditworthiness and liquidity (Roe *et al.*, 2003). D) The effects of labor force participation occur and can affect employment studies show that green subsidy payments make farm families spend more time on the farm, thus increasing employment and agricultural production. These studies include L-Sta, Moshra, and Aharan (2004), Aharan, L-Sta, and Dobre (2006). E) Expectations of green subsidies can affect employment, investment, and value-added production, as farmers may change their production decisions to maximize their future maximum payments from expected policy changes. Banga (2014) also says that green subsidies in agriculture have a significant impact on production and trade. Although in developed countries there has been an attempt for years to separate domestic support from green subsidies in production, the net and natural volume of subsidies provided in some developed countries has led to significant production and trade. These subsidies exist with the decision of the top producer with current production volumes and sales with low production costs, increase their health, reduce their investment risk and create domestic demand for their products. In other words, expectations of subsidies under the green box can affect production, as farmers may change production decisions to maximize their future payments by changing expected policies.

Today, general equilibrium models are widely used in both developed and developing countries and are used in the analysis of various dimensions resulting from the implementation of various economic policies. Among the general equilibrium models, the general equilibrium model can be calculated according to its special advantages and has more practical cases. The most important feature of these models is having micro-principles and optimizing the behavior of households and enterprises, paying attention to the relationships between different economic sectors and the need for low data. On the other hand, considering the specific characteristics of the Iranian economy,enough data is not available or the accuracy of the data is minimum, the use of computable general equilibrium models will be very useful.

In this paper, a computable general equilibrium method is used to investigate the economic effects of the green subsidy simulation policy in Iran agricultural sector. This method is one of the methods of quantitative analysis of policy issues and can provide a comprehensive framework for examining the comprehensive effects of policies. Indeed, one of the greatest advantages of the computable general equilibrium model is its ability to explain the consequences of changes in a particular policy parameter or the characteristics of a sector as a whole (Cardente *et al.*, 2016). Another advantage of the general equilibrium models over econometric models is that they do not dependent on time series data. In addition, the robust microeconomic framework of general equilibrium models fully describes the optimization behavior of economic agents and enables these models to have a stronger analytical basis.In addition to econometric models, these models are preferred over data-output models.. In a computable general equilibrium model, each policy in the model is applied by changing the exogenous parameters. In these patterns, a change in some of the parameters in the model indicates a policy or shock (Naderan and Fooladi, 2005).

Computable general equilibrium models based on Wallace general equilibrium theory are a major general tool for numerical analysis of global public and economic policies. These models are based on the belief that change in one sector of the economy has affected other sectors as well, and that successive effects on other sectors have a significant return on the primary sector. Thus, given the constraints of the economy, the full feedback from all sectors reflects the full effects of policy change or external shocks. As a result, the framework of general equilibrium models describes the complexity of micro-macro two-way interaction more accurately. The CGE model, as an economic model, includes a complete description of the economy and connects the market for goods and factors of production (Muller and Ferrari, 2011). Since CGE general equilibrium models have a more comprehensive view of the components and economic indicators of countries than other theoretical frameworks. They better illustrate the liberalization experience in the form of simulated scenarios (Banooei *et al.*, 2016).

In this model, the equations are generally divided into three parts: zero profit in all sectors, balance in the market of goods and inputs, the balance of the income and costs. Computable general equilibrium models formulate the cyclical flow of income and expenditure of an economy in which producers, factors of production, and consumers are considered. In these models, exchanges are based on the optimization behavior of economic agents, so that consumers maximize their utility function according to the budget level, and thus, the demand side of the model is determined. Manufacturers also seek to maximize their profits, which determines the supply side of the model. Equilibrium market prices provide the necessary conditions for equilibrium. For all goods and services, supply will be equal to demand, and if returns to the scale are constant, the zero profit condition applies to all activities.

In this way, a clear theoretical framework of the implementation of the general equilibrium model will be formed, (Fig. 1). Using the above analytical framework, it is possible to consider various types of economic subsidies; On the factors of production, intermediate inputs and production will be provided for each specific field of activity.

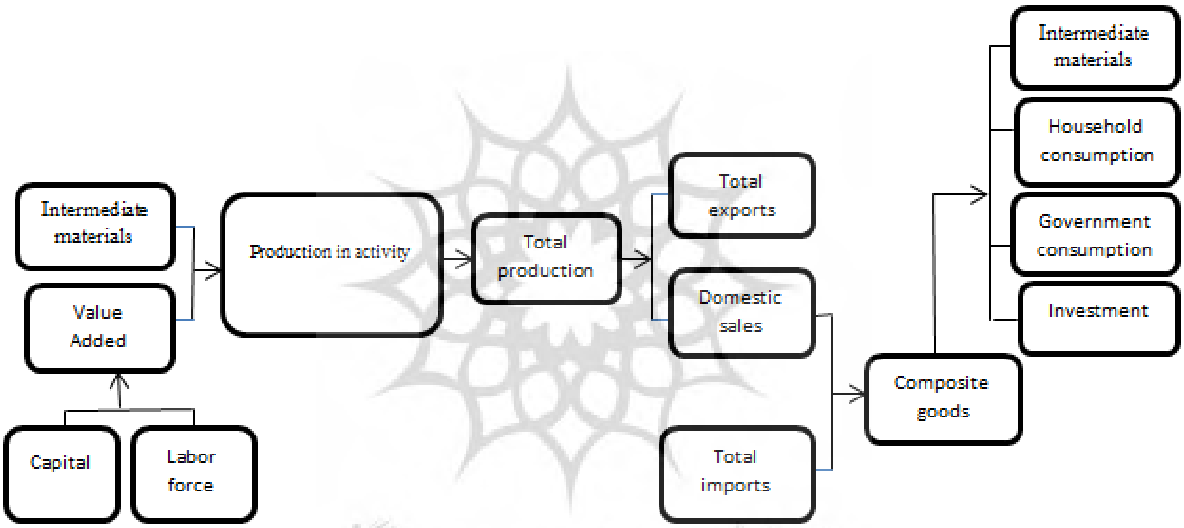

Fig. 1- Computable General Equilibrium Model (CGE) components
Source:(Lafgren *et al.*, 2002)

The model used includes equations related to production, household and government consumption, savings, investment, and foreign trade (Hosoe, 2004). In this model, it is assumed that economic sectors use labor and capital as primary inputs for production. In the reality part of the model, in addition to the primary inputs, it is assumed that the segments also use intermediate inputs for production. For convenience, the production stages are divided into upper and lower stages. At the lower stage, value added (or primary composite factor) is assumed to be obtained by combining labor and capital with Cobb-Douglas production function technology.

$$VA_j = b_j \pi \, FD_{hj}^{\beta_{hj}} \quad (1)$$

In the upper stage, gross output is generated from a combination of value-added and intermediate inputs with Leontief production technology.

$$Y_j = min\left(\frac{X_{ij}}{ax_{ij}}, \frac{VA_j}{ay_j}\right) \quad (2)$$

According to these two steps, each sector maximizes its profit function relative to its production. So finally the following equations are obtained.

$$X_{ij} = ax_{ij}.Y_j \quad (3)$$

$$VA_j = ay_j.Y_j \quad (4)$$

$$FD_{hj} = \frac{\beta_{hj} PN_j}{w_h} VA_j \quad (5)$$

$$PS_j = ay_j.PN_j + \sum ax_{ij}.PQ_i \quad (6)$$

It is assumed that consumers choose their shopping cart in a way that maximizes their usefulness. Their income comes from the supply of labor and capital. The utility of households depends on the amount of consumption of the goods produced in each sector. Here, the utility function is a Cobb-Douglas function, which, given the budget constraint, is equal to the net household income (household income equal to the income derived from the supply of factors of production, from which the direct tax and household savings are deducted). , Net income or available income), will be maximized. Given this, the following equation will be obtained.

$$C_i PQ_i = \lambda_{ci}\left(\sum W_h FS_h - TAX_{dir} - SAV_{hoh}\right) \quad (7)$$

In the case of public sector consumption, it is assumed that the government earns revenue by imposing sales taxes, and direct taxes on household income, import taxes (import tariffs), and oil exports. Government revenue will be spent on expenditures and savings.

$$TAX_{ind,j} = tx_j.PS_j.Y_j \quad (8)$$

$$TAX_{dir} = td.\sum_h W_h\, FS_h \quad (9)$$

$$\text{TARIFF}_j = tx_j.PM_j.M_j \quad (10)$$

$$G_i.PQ_i = \lambda_{gi}\left(TAX_{dir} + \sum TAX_{ind,j} + \sum TARIFF_j + E_{oil} - SAV_g\right) \quad (11)$$

The investment in each sector will be a function of the total investment, which is equal to the total savings (totally private, government, and foreign savings). External savings are assumed to be exogenous variables and therefore the exchange rate establishes the trade balance.

$$SAV_{hoh} = s_{hoh}\sum_h W_h.FS_h \quad (12)$$

$$SAV_g = s_g\left(\sum_i TAX_{ind,i} + \sum_i TARIFF_i + TAX_{dir} + E_{oil}\right) \quad (13)$$

$$SAVING = \left(SAV_h + SAV_{Gov} + SAV_f\right) \quad (14)$$

$$SAVING = INVES \quad (15)$$

$$ID_i.PQ_i = \mu_i.INVEST \quad (16)$$

In the foreign trade sector, it is assumed that there is a small country assumption that the country does not influence international market prices. Therefore, world import and export prices are stable.

$$PE_i = pwe_i.EXR \quad (17)$$

$$PM_i = pwm_i.EXR \quad (18)$$

When considering a model for an open economy, it requires some consideration of substitution between imported, exported and domestically offered goods. In general equilibrium models, there is a difference between imported and domestic goods, as well as between goods produced for export and goods produced for domestic sale. It is assumed that the sum of goods imported and supplied domestically constitutes composite goods (Armington goods). These composite goods are used as intermediate inputs and final uses. Imports are assumed to be an incomplete substitute for domestic production. This means that one unit of imported goods can be replaced by more than one unit of domestic goods. This is known as the Armington hypothesis. The relationship between imports and domestic production is represented as a Constant Elasticity of Substitution (CES).

$$Q_i = \gamma_i\left(\alpha_{mi}.M_i^{\rho mi} + \alpha_{di}.D_i^{\rho mi}\right)^{1/\rho im} \quad (19)$$

Here, Q_i,, D_i, γ_i, α_{di} and α_{mi} represent a composite product, a domestically produced product, ithe efficiency parameter in the composite product function, and the share parameters in the Armington function, respectively. Therefore, $\alpha_{di} + \alpha_{mi} = 1$ and $\alpha_{mi}, \alpha_{di} \geq 0$ and ρ_{mi} The power of the Armington function or the parameter related to the substitution tensile such that and, is the tensile strength of the Armington function, which can be calculated in the form of Equation (20).

$$h_i = \frac{\dfrac{-d\left(\frac{M_i}{D_i}\right)}{M_i/D_i}}{\dfrac{d\left(\frac{PM_i}{PD_i}\right)}{PM_i/PD_i}} \quad (20)$$

According to the problem of maximizing the problem, the demand functions for imports and domestic products will be obtained in the form of equations (21) and (22).

$$M_i = \left(\frac{\gamma_i^{\rho mi}\,\alpha_{mi}PQ_i}{(1+tm_i)PM_i}\right)^{1/1-\rho_{mi}}.Q_i \quad (21)$$

$$D_i = \left(\frac{\gamma_i^{\rho mi}\,\alpha_{di}PQ_i}{PD_i}\right)^{1/1-\rho_{mi}}.Q_i \quad (22)$$

PD_i is the price of domestically produced goods.

It is also assumed that exports can be incompletely converted into domestic production. The relationship between exports and domestic production is also expressed in terms of a transient Constant Elasticity of Transformation (CET).

$$Y_i = \theta_i\left(\beta_{ei}.E_i^{\rho ei} + \beta_{di}.D_i^{\rho ei}\right)^{1/\rho ei} \quad (23)$$

Where E_i is the export value, θ_i is the efficiency parameter of the transfer function, β_{di} and β_{ei} are the share parameters in the transfer function so that $\beta_{ei} + \beta_{di} = 1$ and ρ_{ei} ,β_{di}, $\beta_{ei} \geq 0$ are the transfer functions.

According to the problem of maximization, the supply functions of exports and domestic goods will be obtained in the following relations, respectively:

$$E_i = \left(\frac{\theta_i^{\rho ei}\,\beta_{ei}(tx_i + PS_i)}{PD_i}\right)^{1/1-\rho_{ei}}.Y_i \quad (24)$$

$$D_i = \left(\frac{\theta_i^{\rho ei}\,\beta_{di}(tx_i + PS_i)}{PD_i}\right)^{1/1-\rho_{ei}}.Y_i \quad (25)$$

In order to balance the four markets of labor, capital, composite goods, and foreign currency, the moderating factor for equal supply and demand in each market is the relevant price. Exchange rates are the moderating factors in the following items: the labor market, the wage rates, the capital market, the interest or rent of capital, the composite market, the price of composite goods, and the foreign exchange market,.

$$\sum_j FD_{hj} = FS_h \quad (26)$$

$$Q_i = C_i + G_i + ID_i + \sum_j X_{ij} \quad (27)$$

$$\sum_i pwe_i . E_I + SAV_f = \sum_i pwm_i . M_i \quad (28)$$

There are so many solutions with similar relative prices. The price normalization equation is used to ensure that the equilibrium is the only solution. In this equation, the price index is fixed and changes in other prices relative to this price are measured.

$$PINDEX = \sum_i \omega_i PQ_i \quad (29)$$

Policy variables in these models can also be considered in various forms such as tax rates, subsidy system selection, pricing rules, development strategy selection, trade policies, economic adjustment and stabilization, revenue distribution, government expenditure components, and external shocks. In this study, the policy of paying green subsidies in the part of subsidies paid to farmers has been applied directly and indirectly. Organizing data for use with general equilibrium models is one of the most important first steps in building these models. The social accounting matrix is a good starting point for introducing the basic equations of the general equilibrium model. CGE models establish the relationships between SAM accounts and a set of nonlinear equations simultaneously using modern general equilibrium theory (Can, 2011).

The social accounting matrix is the best setting in which most of the required statistics and data are collected and categorized. This matrix depicts the structural features of the countries economy and clearly shows the channels of transmission of the policies effect from the source to destination. The accounts of this matrix include groups of goods and services, productive activities, factors of production, economic institutions, government tax revenues, and savings and investments.

The SAM matrix somehow describes the resources and uses of society. SAM is technically a square matrix in which each array is linked to a row and a column. Each cell of this matrix represents a payment from column to row. Social accounting matrix includes accounts of activities (agriculture, industry, electricity, transportation and services), goods and services (agriculture, industry, electricity, transportation and services), factors of production (labor and capital) and institutions (households , goverment and the outside world). In this matrix, the last row and column contain the sum of the corresponding items (Zoghipour and Zibaei, 2009).

The method used in this research is that first the relationships between different economic variables are designed in the form of a set of mathematical equations and then to ensure the proper functioning of the model, the accuracy of its production in creating real world data is examined. This is usually done with matrix information for a base year. In this way, based on the information of the social accounting matrix of the economy exogenous variables , the endogenous variables of the model are reproduced and compared with the real world information.

Relying on this information is done to ensure the validity of the model. Model calibration is the process of calculating the transfer and contribution parameters used in the utility and production functions of the CGE model so that solving the equation regains the same original balance of the model data. Then the solution of the calibrated model is used as the basis equilibrium with which the results of the experimental test of the model are compared. The inputs to the calibration process are the CGE model databases, which explain the economy at its initial equilibrium (Berfisher, 2014). Also, one of the main goals in using general equilibrium models is simulation or scenario building. By scenario-making in general equilibrium models, the effects of different policies can be quantified. After ensuring the proper performance of the model, different scenarios are modeled and the results of different policies are predicted based on the designed model.

Results and Discussion

The latest matrix of social accounting in Iran is in 2011, which has been prepared by the Islamic Parliament Research Center (IPRC).In this paper, this matrix has been used as a source of information.This matrix is based on a symmetric data-output table, which has been compiled with a whole-except approach. (Banooei, 2016).

Given that the data used is the social accounting matrix of the year 1990, data were calibrated and updated using the ras method based on 2018 data using the model (Miller and Blair, 2009). The model was used to calculate the initial equilibrium point (Robinson, Kilkenny and Hanson, 1990). GAMS software was used to analyze the data in this research.

From the numerical solution of the computable general equilibrium model, all the reproduced baseline year data , indicate the robustness of the model calibration. The calibrated parameters and the substitution and conversion tensions, respectively, are given in Table 2 of the Armington and Conversion functions, respectively.

The share of intermediate inputs shows the ratio of the amounts of intermediate inputs and factors of production in each unit of product. The share of agricultural intermediate inputs shows that 0.21, 0.38 and 0.01 units of agricultural, industrial and service inputs are required to produce each product unit, respectively.

Table 1- Matrix of macro-social accounting in Iran in 2011 (Million Rial)

	Activities	Factors of production	Institutions	Investment	The outside world	Total
Activities	3744722627		15423275859	2110793327	13599093535	11495605243
Factors of production	6209271377				23802886.8	6233074264
Institutions		6233074264	799316040.9		495245.4071	7431735199
saving			2543162960			26997734860
The outside world	1412387674	20267641.8	4188335.834	496792564		1935093400
Total	11366381679	6233074264	7431735199	2699734860	1935093400	29795242966

Source: (Islamic Consultative Assembly, 2011)

According to Table 2, the share of capital is 0.711, which is larger than the share of labor by 0.289.This indicates that the agricultural sector is capital-intensive, which meansthe amount of share of capital is more than labor for each unit of product,.

The backlink index is the column sum of the share of intermediate inputs for productive activity. This index shows that the agricultural sector needs 0.28 units of intermediate products per unit of the final product. The latter index of industry and services is 0.12 and 0.11, respectively. Comparing the value of indicators shows that increasing agricultural production has a greater impact on the economy than increasing industrial and service production.

Table 2- Parameters and elasticity model

Function name			Agriculture	Industry	Services
Consumption function		Commodity share	0.6129	0.1224	0.2569
		Marginal propensity to consume of households	0.376	0.060	0.384
Value-added production function (Cobb-Douglas(		Transfer or performance	1.826	1.423	1.903
	Labor force	The share of factors	0.289	0.113	0.343
	Capital		0.711	0.887	0.657
Marginal production function	Agriculture	The share of intermediate inputs	0.211	0.386	0.016
	Industry		0.072	0.283	0.0313
	Services		0.017	0.595	0.076
		The share of value added	0.3014	1.0716	0.606
Armington function)Composite goods(		Elasticity of substitution	1.4	1.4	1.4
		The share of imports	0.032	0.161	0.252
		The transfer	1.642	1.976	1.515
Conversion function		Elasticity of conversion	1.2	1.2	1.2
		The share of exports	0.919	0.479	0.895
		The transfer	3.824	2.002	3.656

Source: Research Findings

One of the main goals in applying general equilibrium models is simulating or scenario building. By scenario-making in general equilibrium models, the effects of different policies can be quantified. Therefore, in order to study the effects of Iran's accession to the World Trade Organization (WTO), the effect of green subsidies in the agricultural sector on the variables of employment, investment and value added has been studied in three scenarios, which are in the form of (base, 20%, 50% and% 100) Designed. The amount of observed change indicates the impact on employment, investment and value added of the agricultural sector in different scenarios in case of the occurrence of a shock or sudden change in the form of green subsidies in the economic system.

Employment Changes

One of the variables that is affected by the application of green subsidies in the agricultural sector is the factors of production. Changes in production typically change the demand for labor and capital stock, and thus affect the application of green employment subsidies.

During the effects of Iran's accession to the World Trade Organization and by applying the green subsidy simulation policy, employment in the agricultural sector is affected. According to the results of Table 3, applying a 20% green subsidy in the agricultural sector will increase employment by 0.19%, and by applying a 50% green subsidy in the agricultural sector, it will be increased by 0.47%. Also, in the 100% scenario, there will be a 0.95% increase in employment. This result contradicts the findings of cling *et al*. (2009). In a study using a computable general equilibrium model, they examined the effect of Vietnam's accession to the World Trade Organization on the income distribution. The results showed that joining this organization was through job creation, especially in the industrial sector.

Since the total amount of capital and labor in the studied model is assumed to be constant, this increase means the transfer of these inputs from other sectors of production to the agricultural sector, and therefore employment in other sectors has decreased.

Table 3- Employment changes

Scenarios	Scenario 1	Scenario 2	Scenario 3
	20%	50%	100%
Sections			
Agriculture	0.1911	0.4774	0.9529
Industry	- 0.0256	- 0.0640	- 0.1277
Services	- 0.0936	- 0.2339	- 0.4670

Source: Research Findings

Investment Changes

In the Social Accounting Matrix, the Investment Column Account reports investors purchases of goods and services used (domestic intermediate inputs, imported intermediate inputs) in the future manufacturing activities and the sales tax.

Table 4- Investment changes

Scenarios	Scenario 1	Scenario 2	Scenario 3
Sections	20%	50%	100%
Agriculture	2.3294	2.5902	2.9788
Industry	- 2.162	- 2.2719	- 2.4061
Services	- 1.5133	- 1.5602	- 1.5713

Source: Research Findings

According to Table 4, the amount of investment in the agricultural sector in Scenario 1 has increased by 2.33% compared to the baseline scenario. In the second and third scenarios, it has increased by 2.59 and 2.98 percent, respectively.

In the industrial sector, in the 20% scenario 2.16, in the 50% scenario 2.27% and in the 100% scenario, 2.41% decrease is observed in investment compared to the basic scenario. Also in the services sector, in scenarios of 20, 50, and 100 percent, there was a decrease of 3.65, 3.84 and 4.04 percent in the amount of investment, respectively. The results of examining the model in the investment sector showed that due to the implementation of green subsidy policy, investment in the agricultural sector will increase. On the other hand, the total investment investment in industry and services is decreasing

Given that the standard model of calculable general equilibrium is a static model (one-period) and the factors of production (labor and capital) are assumed to be constant. As a result, with the application of green subsidy policy in the agricultural sector, the transfer of factors of production from other sectors to the agricultural sector to increase production is observed that this increase in production requires increased use of intermediate inputs, also this transfer reduces production in other sectors and thus Reduction of the use of intermediate inputs in the industry and services sector. As mentioned above, investing in the social accounting matrix is the total payment of the departments for the purchase of intermediate inputs and sales tax. If the full employment of production factors is not established and there is unemployed labor and capital, the increase of production factors in the agricultural sector will be compensated by using the unemployed capacity of production factors. Furthermore, the transfer of production factors from other sectors to this sector will not be observed. The results were consistent with the study of the sun (26). He designed a model for Egypt with an optimization method. His model was used to assess the economic impact of several medium-term scenarios that were dependent on subsidy policies and domestic energy pricing. The results of the model show that in the absence of appropriate policy measures, a reduction effect has been observed in production and investment.

Value-Added Changes

In the social accounting matrix, the total column of payments to labor, capital and tax expenditures constitutes the added value of the economic activity. Value added is a direct function of gross output and demand for factors of production and also directly related to the wages of factors of production.

Table 5- Value added changes

Sourc

Scenarios / Sections	Scenario 1	Scenario 2	Scenario 3
	20%	50%	100%
Agriculture	3.2369	3.6622	4.3176
Industry	-3.0215	-3.1519	-3.2753
Services	-4.3765	-4.5791	-4.7853
Total	-2.3099	-2.3492	-2.3341

Source: Research Findings

Given that the standard model of calculable general equilibrium is static (one-period), the factors of production (labor and capital) are assumed to be constant. As a result, with the implementation of a green subsidy policy in the agricultural sector, the transfer of labor and capital from other sectors to the agricultural sector is observed.

In Table 5, the rate of value added increases in the agricultural sector by applying green subsidies with scenarios 1, 2, and 3 by 3.23, 3.66 and 4.31 percent, respectively.

Considering the application of shocks in the form of different rates of green subsidies that entered the general system of the economy in the basic state and the results obtained from these shocks, show an increase in value added in the agricultural sector. Also, the rate of value-added decreases in the industrial sector and is equal to 3.02, 3.15, 3.27.In the service sector, it is equal to 4.38, 4.58 and 4.78, which is higher than the rate of increase in the agricultural sector. Finally, the total changes in value added in scenarios 1, 2, and 3 have been reduced by 2.31, 2.35 and 2.33 percent, respectively.

Due to the transfer of factors of production in agricultural sector from other sectors, the rate of value added in this sector is positive compared to other sectors, Total production and income of the agricultural sector have also increased. In other sectors, the trend of declining income of the factors of production has been achieved, which ultimately reduced the value added of other sectors.

Also, based on the obtained results and the value added changes observed in different production sectors in total, it indicates negative changes in the total value added. The rate of increase in value added in the agricultural sector has been lower than the rate of decrease in other sectors.In general, the total value added variable has been negative compared to the baseline scenario. This negative result is due to the assumption of full employment in the CGE model, and in the absence of this assumption and the transfer of factors of production from other sectors to the agricultural sector and instead attract capital and unemployed labor in this sector, the total value added variable is positive. It becomes.

It is consistent with the findings of Lapka *et al.* (2011). In a study of rural development in the form of green agricultural subsidies, they examined the reaction of Czech farmers. The results of experimental studies showed that participation in normal agricultural policy causes positive changes in the value added of the agricultural sector.

Conclusions and Suggestions

The category of green subsidies has been proposed in the direction of agricultural development, which is in line with the law on targeted subsidies, but in a real way. Green subsidies are for farmers in order to boost business and industry in the agricultural sector and the goals of green subsidies are to mechanize agriculture, improve seeds and soil, insure crops and agriculture, as well as strengthen the manufacturing industry to increase farmers' incomes. In a new classification, green subsidies for developing countries were proposed to develop programs on poverty alleviation, rural development, food security, and diversified agriculture (Banga, 2014).

Green subsidies include subsidies that are exempt from the reduction requirements. These subsidies have minimal effect on production and trade. Funds must be provided by the government, and it is forbidden to ask consumers for higher prices to finance the subsidies. The subsidies in this box do not have any restrictions and can be paid in the required amount in the allowed cases. Other characteristics of this subsidy include the provision of educational, extension, research, pest and disease inspection services, investment in rural and agricultural development infrastructure, food aid, natural disaster compensation aid, and the like, in addition to these protections are considered.

Given the accession of most countries to the World Trade Organization, Iran, as a developing country whose non-oil economy has not played a significant role in the global economy, can not be separated from global developments. Therefore, the main issue of the country is the continuous and focused effort to find a way to make membership possible with the lowest cost and highest benefits. In this way, knowing the exact effects and consequences of membership in this organization will be a great help in going through the process of joining successfully. In this regard, the study of the effects of green subsidies on macro variables in the agricultural sector is a very important issue.

The policy of applying green subsidies in the agricultural sector can increase job opportunities by creating new markets for products and services, providing employment opportunities for more people inside the country. Based on the results obtained from the model, employment in the agricultural sector has increased, and given that the total amount of capital and labor in the model is assumed to be constant, so this increase means the transfer of these inputs from other sectors of production to the agricultural sector and Due to this, employment in industry and services has decreased. Also, with the implementation of the green subsidy policy, investment in agriculture has increased, which is due to increased production in this sector and as a result, increased use of intermediate inputs. The results obtained from the mentioned shocks show that value added in the agricultural sector has an upward trend, which is due to the increase in the use of factors of production in this sector.

Considering that the application of green subsidy policy in Iran's agricultural sector in the form of different scenarios, has created positive changes on macroeconomic variables such as employment, investment and value added, in this type of subsidy management objectives in agriculture, stabilizing and increasing farmers' incomes Encouraging investors to invest, encouraging manufacturers and researching new technology and increasing productivity is followed, so considering that in this study, due to the lack of implementation of this policy and model simulation based on the cost of implementing this policy to the public sector has been done. It is suggested that in the future, with the actual implementation of this policy by the government, the qualitative factors of its implementation can be examined.

Implementation of this policy and accession to the World Trade Organization in the medium and long term, can attract more foreign investment, directly and indirectly, increase the access of domestic companies to financial and credit facilities of international financial institutions, provide the ground for purchasing equipment and advanced technology. Day, removal of marketing barriers in the country's export items.

In the plan to create green subsidies in Iran, we can consider three stages of implementation, which include providing facilities to farmers, farmers share in the profits of the product, and pricing in agricultural products. In order to implement this plan, the government can allocate facilities as subsidies to farmers based on a specific formula every year, especially from the beginning of the cultivation of agricultural products. Part of these facilities can be in the form of loans to mechanize agricultural equipment, including the purchase of tractors, conversion of agricultural land to modern irrigation. Also, an amount of it should be provided for cost research and another amount in line with agricultural insurance and agricultural products insurance to compensate for damages caused by unforeseen events. Providing facilities for the development of the packaging industry and the creation of processing industries, marketing of agricultural products and other items can be considered as other stages of its implementation. It is suggested that part of these facilities be applied for free with a 5 or 6 percent interest rate on bank loans and deposits.

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The attachment

```
Update using the ras method
Set i / 1*3;/
Alias (i,j);
Table a0(i,j) 'known base matrix'
Table z1(i,j) 'unknown industry flows'
Parameter
 x(j)   'observed total output'
 u(i)   'observed row totals'
 v(j)   'observed column totals'
 a1(i,j) 'unknown matrix A;'
u(i) = sum(j, z1(i,j));
v(j) = sum(i, z1(i,j));
a1(i,j) = z1(i,j)/x(j));
display u, v, a1;
 ١ --- *RAS updating
Parameter
 r(i) 'row adjustment'
 s(j) 'column adjustment;'
r(i) = 1;
s(j) = 1;
Parameter oldr, olds, maxdelta;
maxdelta = 1
repeat
 oldr(i)  = r(i);
 olds(j)  = s(j);
r(i)    = r(i)*u(i)/sum(j, r(i)*a0(i,j)*x(j)*s(j));
s(j)    = s(j)*v(j)/sum(i, r(i)*a0(i,j)*x(j)*s(j));
maxdelta = max(smax(i, abs(oldr(i) - r(i))),smax(j, abs(olds(j) - s(j))));
display maxdelta;
until maxdelta < 0.005;
Parameter report(*,i,j) 'summary report;'
option report:3:1:2;
report('A0' ,i,j) = a0(i,j);
report('A1' ,i,j) = a1(i,j);
report('RAS',i,j) = r(i)*a0(i,j)*s(j);
 ٢ --- *Entropy formulation   a*ln(a/a0)
```

```
*The RAS procedure gives the solution to the Entropy formulation
Variable
obj    'objective value'
a(i,j) 'estimated A matrix'
z(i,j) 'estimated Z matrix;'
Positive Variable a, z;
Equation
rowbal(i) 'row totals'
colbal(j) 'column totals'
defobjent 'entropy definition;'
rowbal(i).. sum(j, a(i,j)*x(j)) =e= u(i);
colbal(j).. sum(i, a(i,j)*x(j)) =e= v(j);
defobjent.. obj =e= sum((i,j), x(j)*a(i,j)*log(a(i,j)/a0(i,j)));
Model mEntropy / rowbal, colbal, defobjent;/
*we need to exclude small values to avoid domain violations
a.lo(i,j) = 1e-5;
solve mEntropy using nlp min obj; report('Entropy',i,j) = a.l(i,j);
۳––– *Entropy with flow variable
      *we can balance the flow matrix instead of the A matrix
Variable zv(i,j) 'industry flows;'
Equation
 rowbalz(i) 'row totals'
 colbalz(j) 'column totals tive'
 defobjentz 'entropy objective using flows;'
 rowbalz(i).. sum(j, zv(i,j)) =e= u(i);
 colbalz(j).. sum(i, zv(i,j)) =e= v(j);
Parameter zbar(i,j) 'reference flow;'
zbar(i,j)  = a0(i,j)*x(j);
zv.lo(i,j) = 1;
defobjentz.. obj =e= sum((i,j), zv(i,j)*log(zv(i,j)/zbar(i,j)));
Model mEntropyz / rowbalz, colbalz, defobjentz;/
*turn off detailed outputs
option limRow = 0, limCol = 0, solPrint = off;
solve mEntropyz using nlp min obj; report('EntropyZ',i,j) = zv.l(i,j)/x(j);
۴––– *absolute deviation formulations result in LPs
 *MAD Mean Absolute Deviations
 *MAPE Mean absolute percentage error
 *Linf Infinity norm
Positive Variable
  ap(i,j) 'positive deviation iation'
  an(i,j) 'negative deviation'
  amax    'maximum absilute dev;'
Equation
  defabs(i,j)  'absolute definition'
  defmaxp(i,j) 'max positive'
  defmaxn(i,j) 'max neagtive'
  defmad       'MAD definition'
  defmade      'mean absolute percentage error'
  deflinf      'infinity norm;'
defabs(i,j)..  a(i,j) - a0(i,j) =e= ap(i,j) - an(i,j);
defmaxp(i,j).. a(i,j) - a0(i,j) =l=  amax;
defmaxn(i,j).. a(i,j) - a0(i,j) =g= -amax;
defmad..  obj =e=   1/sqr(card(i))*sum((i,j), ap(i,j) + an(i,j));
defmade.. obj =e= 100/sqr(card(i))*sum((i,j),(ap(i,j) + an(i,j))/a0(i,j));
defLinf.. obj =e= amax;
Model
```

```
  mMAD  / rowbal, colbal, defabs,  defmad/
  mMADE / rowbal, colbal, defabs,  defmade/
  mLinf / rowbal, colbal, defmaxp, defmaxn, deflinf;/
solve mMAD  using lp min obj; report('MAD' ,i,j) = a.l(i,j);
solve mMADe using lp min obj; report('MADE',i,j) = a.l(i,j;(
solve mLinf using lp min obj; report('Linf',i,j) = a.l(i,j);
۵ --- *Squared Deviations can be solved with powerful QP codes
      *SD     squared deviations
      *RSD    relative squared deviations
Equation defsd, defrsd;
defsd..  obj =e= sum((i,j), sqr(a(i,j) + a0(i,j;)))
defrsd.. obj =e= sum((i,j), sqr(a(i,j) + a0(i,j))/a0(i,j;))
Model
  mSD  / rowbal, colbal, defsd/
  mRSD / rowbal, colbal, defrsd;/
solve mSD  using qcp min obj; report('SD' ,i,j) = a.l(i,j);
solve mRSD using qcp min obj; report('RSD',i,j) = a.l(i,j);
display report;CGE modeling Equilibrium point estimation
Set
   i   'sectors'          / agri    'agriculture                              'indus   'industries'
                           service 'services       '/
   f   'factors of production'  / labor   'labor'
                                   Capital    'capital   'ins 'institutions'         / labr    'labor'
                              ent     'enterprises     'hh  'household type income'  / hhtrn   'transfer recipients'
                              hhlab   'wage earners'
                              hhcap   'rentiers *       '/the institution names and the factor names "capital"
 *are referred to explicitly below.  if changed, they must also be
 *changed where referenced.
 *the printing of the gnp accounts assume that there is a sector
 *labeled "service".
 *subsets defined below: "define indexes"
   iag(i)  'ag sectors' / agri/
   iagn(i) 'non ag sectors'
   ie(i)   'export sectors'
   ied(i)  'sectors with export demand eqn'
   iedn(i) 'sectors with no export demand eqn'
   ien(i)  'non export sectors'
   im(i)   'import sectors'
   imn(i)  'non import sectors;'
Alias (i,j);
*for sam
Set
   isam 'categories' / commdty,  activity,    valuad
                      insttns,  households, govt
                      kaccount, world,      total/
   isam1(isam)       / total/
   isam2(isam);

Alias (isam2,isam3);
```

```
Parameter sam(isam,isam) 'social accounting matrix;'
isam2(isam) = not isam1(isam);
Parameter
 *read in parameters
 *read in for initialization of variables
  enttax0   'enterprise tax revenue'
  entsav0   'enterprise savings'
  exr0      'exchange rate'
  e0(i)     'exports'
  fbor0     'net foreign borrowing'
  fsav0     'net foreign savings'
  gdtot0    'total volume of government consumption'
  gent0     'payments from government to enterprises'
  govsav0   'government savings'
  hhsav0    'household savings'
  hht0      'household transfers'
  invest0   'total investment'
  m0(i)     'imports'
  mps0(hh)  'household marginal propensity to save'
  pd0(i)    'domestic goods price'
  pe0(i)    'domestic price of exports'
  pindex0   'gnp deflator'
  pm0(i)    'domestic price of imports'
  remit0    'net remittances from abroad'
  sstax0    'social security tax revenue'
  tothhtax0 'household tax revenue'
  xd0(i)    'domestic output'
  volume
 *read in table for initialization of variables (need not be declared)
 *table fctres1(i,f) factor demand by sector
 *table fctry(i,f)   factor income by sector
 *read in parameters as rates, shares, elasticities
  dstr(i)   'ratio of inventory investment to gross output'
  esr       'enterprise savings rate'
  etr       'enterprise tax rate'
  gles(i)   'government consumption shares'
  htax(hh)  'household tax rate'
  itax(i)   'indirect tax rates'
  kish(i)   'shares of investment by sector of destination'
  rhsh(hh)  'household remittance share'
  rhoc(i)   'Armington function exponent'
  rhoe(i)   'export demand price elasticity'
  rhot(i)   'cet function exponent'
  sstr      'social security tax rate'
  te(i)     'export subsidy rates'
  tm(i)     'tariff rates on imports'
  thsh(hh)  'household shares of government transfers'
 *read in table of parameters (need not be declared(
```

```
*table cles(i,hh)      household consumption shares
*table imat(i,j)       capital composition matrix
*table io(i,j)         input-output coefficients
*table sintyh(hh,ins)  household distribution of institutional income
*computed parameters from read in data calibration
*computed parameters for initialization of variables
 fd0(f)      'factor demand, aggregate'
 fs0(f)      'factor supply, aggregate'
 int0(i)     'intermediate input demand'
 netsub0     'export duty revenue'
 p0(i)       'price of composite good'
 pk0(i)      'capital goods price by sector of destination'
 pva0(i)     'value added price by sector'
 pwm(i)      'world market price of imports '
 pwe0(i)     'world price of exports'
 pwse(i)     'world price of export substitutes'
 px0(i)      'average output price'
 var0(i)     'value added rate by sector'
 wfdist(i,f) 'factor price sectoral proportionality constants'
 wf0(f)      'factor price, aggregate average'
 xxd0(i)     'domestic sales, volume'
 x0(i)       'composite good supply, volume'
 yfctr0(f)   'factor income summed over sector'
 yfsect0(i)  'factor income by sector'
 yh0(hh)     'household income'
 yinst0(ins) 'institutional income'

*computed parameters as rates, shares
 ac(i)       'Armington function shift parameter'
 ad(i)       'production function shift parameter'
 alpha(i,f)  'factor share parameter-production function'
 at(i)       'cet function shift parameter'
 delta(i)    'Armington function share parameter'
 econst(i)   'export demand constant'
 gamma(i)    'cet function share parameter'
 pwts(i)     'price index weights'
 qd(i)       'dummy variable for computing ad(i)'
 rmd(i)      'ratio of imports to domestic sales'
 sumsh       'sum of share correction parameter'
 sumhhsh(hh) 'sum of share for hh cles'
 sumimsh(i)  'sum of share for imat'
 tereal(i)   'real export subsidy rate in 1390 '
 tmreal(i)   'real tariff rate in 1390 ';
```

مقاله پژوهشی

جلد ۳۵، شماره ٤، زمستان ۱٤۰۰، ص ۳٦٥-۳٤۹

بررسی اثر اعمال یارانه سبز بر اشتغال، سرمایه‌گذاری و ارزش‌افزوده بخش کشاورزی ایران با استفاده از مدل CGE

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چکیده

یکی از سیاست‌های مهم اقتصادی در اغلب کشورها حمایت از تولیدکننده یا مصرف‌کننده از طریق پرداخت یارانه است. مقوله یارانه سبز در راستای توسعه کشاورزی مطرح شده که هم راستا با قانون هدفمندکردن یارانه‌ها، اما به شکلی واقعی می‌باشد. یارانه سبز ویژه کشاورزان و به منظور رونق کسب و کار و صنعت بخش کشاورزی است. هدف از این تحقیق، بررسی آثار الحاق ایران به سازمان تجارت جهانی، با اعمال سیاست شبیه‌سازی شده یارانه سبز بر روی متغیرهای اشتغال، سرمایه‌گذاری و ارزش‌افزوده در بخش کشاورزی می‌باشد، که در قالب سناریوهای ٪۲۰، ٪۵۰ و ٪۱۰۰ طراحی شده است. کالیبراسیون مدل با بکارگیری ماتریس حسابداری اجتماعی سال ۱۳۹۰ و سناریوی پایه (٪۰ اعمال یارانه سبز) صورت پذیرفت. جهت تجزیه و تحلیل اطلاعات در این تحقیق از نرم‌افزار GAMS استفاده شده است. نتایج نشان می‌دهد که در جریان آثار الحاق ایران به سازمان تجارت جهانی و با اعمال سیاست شبیه‌سازی یارانه سبز، اشتغال در بخش کشاورزی در سناریوهای ۲۰، ۵۰ و ۱۰۰ درصد، افزایش می‌یابد. همچنین با اعمال سیاست یارانه سبز، سرمایه‌گذاری در بخش کشاورزی روند افزایشی دارد، که به دلیل افزایش تولید در این بخش و در نتیجه افزایش استفاده از نهاده‌های واسطه می‌باشد. نتایج بدست آمده از شوک‌های مذکور نشان می‌دهد که ارزش‌افزوده در بخش کشاورزی روندی صعودی دارد، که به دلیل افزایش به‌کارگیری عوامل تولید در این بخش می‌باشد.

واژه‌های کلیدی: بخش کشاورزی، سازمان تجارت جهانی، مدل CGE، یارانه سبز

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