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The Effects of Granting Subsidies to Agricultural Inputs on Iranian Households' Welfare and Environment by Emphasis on Computable General Equilibrium Model

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Abstract

This study seeks to investigate all the direct and indirect effects of agricultural input subsidies on agricultural production using the computable general equilibrium method, the effect of agricultural input prices and subsidies on macroeconomic variables, food security, household welfare and the environment. The results showed that the reform of subsidies in the agricultural sector by reducing agricultural production and rising prices, will reduce the final demand for agricultural products, especially basic products for households, and therefore will endanger food security. The findings also indicate that by applying the desired scenarios, the production of fisheries sectors decreases more than other production sectors. Reduction of subsidies paid to the agricultural sector also leads to a decrease in the welfare of urban and rural consumers Is. In addition, reducing subsidies in the agricultural sector in the future will lead to a reduction in environmental pollution. Due to the low income of farmers, if subsidies are reduced in this sector, producers will not be able to change technology, and therefore with increasing production costs, production in the agricultural sector has decreased more sharply than other sectors, and in this regard supports the agricultural sector, is necessary. In addition, it is suggested that the subsidy be reduced gradually, along with the payment of cash subsidies to farmers, especially villagers.

Keywords: Subsidy, Calculable General Balance Model, Food Security, Household Welfare, Pollution.

Introduction

The price of goods plays a crucial role in a market system. Governments usually make a decisive intervention against price changes and try to avoid inflation or deflation through controlling the market or applying certain policies. However, according to some economists, the governments' intervention in the market system disturbs the delicate balance of price which it, in turn, confuses consumers, manufacturers as well as investors. Conversely, some believe that governments' intervention is necessary to support both domestic products and people on low income. It is evident that any types of governments' intervention in the price of commodities disturbs the market system, as a result, prices do not reflect real social cost in competitive situations (Abadi & Abadi, 2019). Iranian economists have arrived at the conclusion that the government actively intervenes in the market system (Zolnour, 2002). Such interventions have many reasons, including direct and.or indirect policies, as well as the governmental structure of Iranian economy. In other words, the government controls the greater part of economy, as well as it directly or indirectly takes over most of production firms (Behkish, 2020).

There are many obvious reasons behind the importance of the agriculture sector. First, the price of goods has a big effect on agricultural products (Mojaver Husseini, 2006). Second, the conflict between consumers and producers of agricultural products is thought of as a permanent issue facing politicians and planners in developing countries. As people living in developing countries need to spend at least a half of their income for purchasing foodstuff, so, people on medium and low-income have a tight budget (Bayes et al., 2009).

Definition of Concepts

The concept of subsidy and reforms in subsidies

Subsidy is money paid by a government to make prices lowers and reduce the cost of commodities. It is generally paid to balance the household budget, reduce the effects of market (consumer subsidy), cut down production costs, as well as to support producers (production subsidy). Generally speaking, the government grants subsidy to not only provides consumers with products at a low cost, but also to give producers strength to compete with other ones. The purpose of paying subsidy is to allocate resources efficiently, fix prices, make a balance between supply and demand, as well as to redistribute incomes (Parmeh, 2014). Subsidies are classified under two main headings, including reformed and free.

All consumers of a specific product receive the same amount of free subsidy, and it targets the market system. Subsidy for petrol is a case in point. There is a direct link between its distribution and amount of purchasing. It means that, the higher people buy, the larger they receive subsidy. However, being mainly granted to the rich is one of the major flaws in this type of subsidy (Alizade, 2010).

Subsidies to Agriculture

One of the major strategic aims of many developed and underdeveloped countries is to support the agricultural sector. Governments seek to support it directly or indirectly through adopting some policies (Kubursi, 2015). Development of this sector will depend crucially on government's supporting plans, so several policies have been formulated by the state in order to encourage new investments in this sector which it, in turns, lead to increase in production. Some of the most coherent policies are granting subsidy on production inputs, providing credits of the agriculture sector with subsidy in order to make investment decisions, compensating victims of natural disasters, paying subsidy on agricultural insurance, as well as making different infrastructural investments in rural development (Amini, 2018). Energy subsidy is another example of subsidy on the agricultural sector.

Research theoretical framework

Since several factors disturb the delicate balance of production, distribution, consumption, and foreign trade sectors, formulating effective support plans is thought of one major economic policy. Therefore, it is considered as a corroborative tool by which governments support different economic sectors as well as people on low and medium income.

The agriculture is a strategic sector in many countries, so any removal of or reduction in supports is seriously investigated. Moreover, as it faces higher risks than other sectors related to food security and nutrition, because of its nature, a broad range of supportive policies are employed to maintain its commodities.

However, despite the formation of World Trade Organization and its protocols, there is still widespread debate among its member over how much governments must support agricultural goods (Kehoe & Serra Puche, 2018).

Two main policies, including government's intervention in economy and economic extrication, have been discussed for adopting economic development policy for years. However, economists have failed to reach a consensus on selecting one of them as the favorable policy.

More recently, developed countries have gradually replaced economic extrication with government's intervention and supporting and they strongly recommend such strategy to other nations. However, there is still no considerable change in this field in Iran, especially in the agricultural sector. It is worth noting that Iranian government has failed to support the agricultural sector during the past three decades, and we have sometimes witnessed a marginal patronage.

Literature Review

A considerable amount of literature has been published on studying the mediating effect of subsidy on agricultural activities. (Mehrabi Boshr Abadi & Mousavi Mohammadi, 2009) examined the effect of food subsidies reforms on the production inputs in Iran using the computable general equilibrium model. Results showed that all available policies led to a decrease in production of all investigated goods, except for cash payment which contributed to a rise in the production of non-agricultural goods.

(Akbari Moqadam, 2004) carried out a research to examine the effect of cuts in subsidy on the agricultural sector, changes in the income tax, as well as cuts in agricultural activities, on the level of productivity and income among rural and urban families. Results showed a direct, negative relationship between cuts in subsidy for agricultural sector as well as the production of all related sectors and revenue of rural and urban households.

(Karami Najafi & Ismaeli, 2010) examined removal of subsidy on the agricultural sector and its conversion into cash payments using computable general equilibrium model. Results illustrated that reduction in direct subsidies on the agricultural sector leads to detrimental consequences.

However, increase in cash payments for agricultural activities has many advantages, including a less increase in prices of goods, and a rise in export, value-added, employment rate, as well as income and wage.

(Javanbakht & Salami, 2009) examined the effect of removal of agricultural subsidies and associated industries on households' welfare and economy. According to results, the impact of this policy on households and economic factors is so negligible that it could be omitted. Motovaselli and Fould (2006) studied the effect of increase in world oil price on the gross domestic production (GDP) and employment in Iran using computable general equilibrium. Results showed a direct, positive correlation between increase in oil price and GDP, which it is due to a rise in the price of all elements associated with GDP. (Lin & Jiang, 2010) analyzed reforms in energy subsidy using computable general equilibrium and showed that cuts in energy subsidy had a significant effect on energy demand and gases, while a negative effect was found for macroeconomic variables.

Methodology

CGE model

As can be seen from (Figure 1), computable general equilibrium model formulates the cyclic pattern between revenue and expenditure, to put it simply, it shows transactions among economic agents.

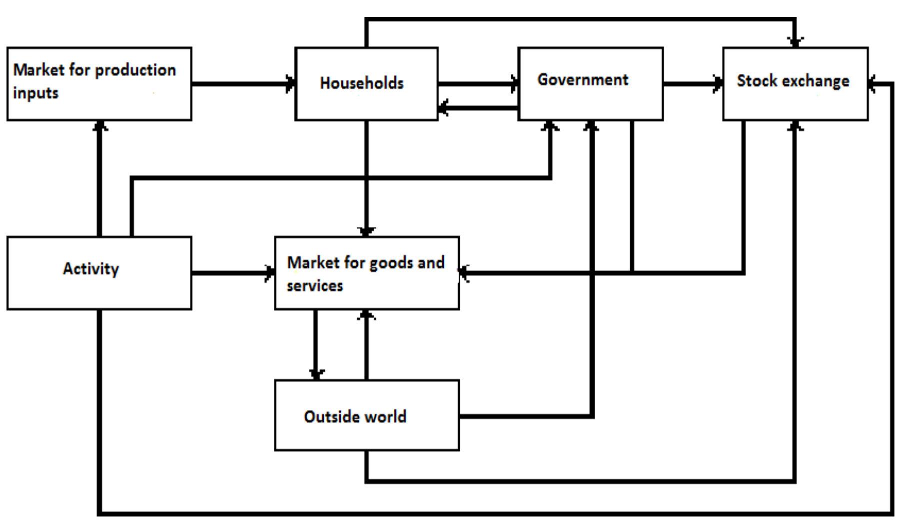

Figure 1. Revenue-expenditure cyclic patter (Dikalio et al., 1999)

As can be seen from the pattern, production is done through the combination of mediating goods and services with the primary production components which are provided by the households. In addition, households consume or deposit income from selling production inputs after tax. In this model, earn income by means of direct tax (received from households), indirect tax, or foreign transitional payments, then the government either spend its income or invest in the stock exchange market.

The stock exchange market invests in different services and goods using financial resources obtained from governmental and non-governmental as well as foreign savings. It is also worth noting that there seems to be an interaction between market for goods and services and foreign countries in this model, that is, goods and services are exported to or imported from foreign countries.

The computable general equilibrium works as a framework on the basis of macroeconomic general equilibrium which forms a close association among revenues of different groups, the demanding pattern, payment balance, and the multi-sector structure.

There is a set of values and prices which settle excess demand for all goods and services at nominal or real values.

Walras Law assumes that $P.Z(P) = 0$ $Z(P^*) = 0$.,

Where,

Z= excess demand

P= price vector

P*= equilibrium values where excess demand equals zero

To put it simply, the model is thought of as an experimental economic laboratory studying qualitative effects of economic policies on domestic economy. One of the many advantages of such models is to establish either linear or non-linear associations among different activities and markets for goods and services, production inputs, as well as organizations (Lafgaren et al., 2010).

Computable general equilibrium models are also well-known as transaction capitalization, applied general equilibrium, as well as social accounting matrix-based general equilibrium models.

As mentioned earlier, the CGE model seeks to formulate the revenue-expenditure cyclic flow of an economy where markets for goods and production inputs serve as consumers and producers.

Transactions through such models are generally based on optimal behavior of economic agents. Therefore, consumers maximize their favorite variable given the budget, so the applicant is selected.

Moreover, since producers are perfectly willing to maximize their profit, they act as the supplier in this model. Market price set the stage to shape a balance situation, where the supply and demand for all goods and services become balanced. Moreover, when the ration of return to scale is constant, the zero profit condition appears to hold true for all activities.

Components of the computable general equilibrium model are divided into three groups, including endogenous, exogenous, and policy making.

Endogenous components are those introduced by the market and balanced by macro indexes, like prices (price of goods, price of inputs, as well as foreign exchange rate), production, and employment.

Exogenous components are those imposed by domestic or foreign conditions but they are not influenced by the components of market system, like production inputs, world's prices, and some structural problems.

Policy making components are those determined for exerting influence on endogenous variables, like tariff rates, subsidies, direct and indirect tax, governments' expenditure, as well as foreign exchange rate (if it is constant).

There are also some values called parameter in CGE model which, for example, show how much endogenous components are sensitive to exogenous ones, and vice versa. Generally speaking, CGE model is a system of simultaneous equations composed of € parameters. The endogenous vector Y is obtained from the exogenous vector Z (equation 1):

$$F(\theta, Z, Y) = 0 \qquad (1)$$

It is evident that CGE model lacks error terms. Absence of an error term in the right side of the equation indicates that it has not been modeled random which it is necessarily contrary to the random econometrics. In every set of CGE equations, the systematic part of model, including ∂ parameters as well as an assumed Z vector cause a wholesale response in vector Y, this is the organized part of the model.

Selection of values associated with parameters of the model strongly affects the results achieved from a policy simulation. Measuring parameters or the numerical specification of CGE models is done by means of two distinctive methods, including econometric and calibration. The econometric method was first employed by (Bohringer & Loschel, 2006) as well as (Holden & Perman, 1974). This method uses statistical methods to measure parameters associated with CGE model.

Using statistical tests is one of the many advantages of the method. It means that every parameter that is measured based on the econometric method has a close association with standard deviation and the confidence interval.

Although the econometric method is proved effective to measure ∂ parameters, it has been rarely employed by innovators of CGE model. Calibration method is easy and requires less data than the econometric method. In this method, parameters are evaluated based on data obtained from a certain year.

This method was first put forward by (Rouyani, 2008), and it has been widely employed to measure parameters associated with CGE model since 1970. In fact, a static multi-section CGE model was used to meet objectives of the present study.

Research's framework of CGE model

Armington Theory assumes that goods supplied to the domestic or export markets are poor substitutes. In a research, (Dekalo, 1999) emphasizes on the poor substitution of domestic goods supplied to export markets and those distributed in the domestic market. The assumption is strongly true for imported commodities.

Domestic prices of commodity exports (PERC) are the product of World prices of exports (PWEc) and exchange rate (ER) minus export subsidy (Tec). Footnote C indicates commodity (equation 2):

$$PER_c = PWE_c \times ER(1 - TE_c) \qquad (2)$$

Commodities produced in the country (QXCc) are make available on the domestic market (QDc) or imported (QEc). Distributing products between these two markets is stated using onstant Elasticity of Transformation equation (CET) (equation 3):

$$QXC_c = a(\gamma QE_c^{\rho_x} + (1-\gamma)QD_c^{\rho_x})^{\frac{1}{\rho_x}} \qquad (3)$$

Where, a is efficiency, γ is the ratio of imported commodity, and ρ_x is equation elasticity.

The price of imported commodity is consisted of several components, including the price for import based on the exchange rate, cost of transportation and trading services, which is stated as the carriage insurance and freight (CIF), as well as import tax. Import domestic price of commodities (PMRc) is defined as the world price of imported commodities (included CIF price), exchange rate, and import tariff (TMc) (equation 4):

$$PMR_c = PWM_c \times ER(1 + TM_c) \qquad (4)$$

When there are non-tariff barriers, domestic import price is defined as (equation 5): (Faen & Holmoy, 2003).

$$PMR_c = PWM_c \times ER(1 + TM_c)(1 + NTM_c) \qquad (5)$$

Where, NTMc is defined as tariff for for non-tariff barriers. TMc and NTMc are considered as political parameters.

Failure to achieve proper elasticity (Showan and Wali, 1984), as well as disregarding non-tariff barriers is main disadvantages of trading studies. Non-tariff barriers are also included in CGE model.

Commodities made available on the domestic market (QQC) are included imported as well as domestic goods. Therefore, combined commodities are composed of two components, including domestic demand for commodities produced in the country (QDc) and imported combined commodities (QMc). Combining domestic and imported commodities is defined by transformation equations with a constant elasticity (CET) (equation 6):

$$QQ_c = ac(\delta_c QM_c^{-\rho_m} + (1-\delta_c)QD_c^{-\rho_m})^{-\frac{1}{\rho_m}} \qquad (6)$$

Where, *ac* is efficiency, δ is portion of imported commodity, and ρ_m is elasticity of transformation. Combined price (PXCc) for a commodity used as an input is defined as follows (equation 7):

$$PXC_c = \frac{(PD_c \times QD_c) + (PE_c \times QE_c)}{QXC_c} \qquad (7)$$

Where PDc and PEc are the price set by domestic producers for commodities which are made available on domestic market or imported, respectively. Moreover, QDc is supplying commodities to the domestic market, QEc is volume of export in terms of activities, and QXCc is the total amount of production.

As previously described, commodities which are made available on the domestic market are included domestic and imported goods. Therefore, the price set by the producer for commodities supplied to the domestic market includes both components. PQSc, the price set by the producers for domestic commodities, is defined as an average weight for prices set by the producer (equation 8):

$$PQS_c = \frac{(PD_c \times QD_c) + (PM_c \times QM_c)}{QQ_c} \quad (8)$$

Where PDc is the price of domestic commodities set by the producer, PMc is the domestic price of imported combined commodities, QDc is the volume of demanded domestic commodities by domestic customers, QMc the volume of combined imported commodities, and QQc is the total volume of combined commodities made available on the domestic market.

The gap between the price set by the producer (PQSc) and the price for purchasing goods (PQDc) is defined as tax sale. Therefore, the price of purchasing is defined as follow (equation 9):

$$PQD_c = PQS_c(1+TS) \quad (9)$$

With regard to energy subsidies, tax sale acts as a political parameter in this study. The price of commodity produced by the A activity (PXa) is defined as Kc portion of every commodities produced by each activity (equation 10), in this equation, footnote *a* indicates the activity.

$$PX_a = \sum k_c PXC_c \quad (10)$$

The value of commodity produced by each activity is measured by multiplying the after tax price of every activity (TXa) by the volume of product (QXa). The revenue gained must be divided between primary and mediating inputs (equation 11):

$$PX_a(1-TX_a)QX_a = (PVA_a \times QVA_a) + (PIN \quad (11)$$

Where PVA and QVA are the price and value-added tax of primary input, respectively. PINT and QINT are the price and value-added tax of aggregated mediating inputs. With regard to the policy of energy subsidy removal, a part of revenue obtained from selling energy carriers is allocated to the production as subsidy, so it is stated as a negative tax in the model. Therefore, TXa acts as another political parameter. PINT is also defined as follows (equation 12):

$$PINT_a = \sum_c \alpha_c PQD_c \quad (12)$$

Where α is the amount of mediating inputs extracted from input-output table or accounting matrix. The production equation is defined as an equation with a constant elasticity substation, which it is an aggregation of primary (value-added) and mediating inputs (equation 13):

$$QX_a = ADX\left[\theta_a(QVA)^{-\rho_v} + (1-\theta_a)(QINT)^{-\rho_v}\right] \quad (13)$$

Where ADX is efficiency, $\partial$is portion, and ρ_v is substation parameter, which all of them are determined and applied exogenously. In a lower level, the production function is assumed as a function with constant elasticity substation, where production holds as a function of all demanded primary inputs, like capital as well as skilled and unskilled labour (equation 14). The equation aggregates all primary inputs:

$$QVA_a = ADVA_a\left[\sum \delta_{fa}(ADFD_{fa}.FD_{fa})^{-\rho_{fa}}\right]^{-\frac{1}{\rho_{fa}}} \quad (14)$$

Where FD is input demanded, ADVA and ADFD are technological efficiency parameters, δ_{fa} is portion parameter, and ρ_{fa} is substitution parameter. Here, footnotes *"a"* and *"f"* indicate the production activity. The total revenue earned by the production agents (YF) is defined as the sum of revenue raised by production agents in different activities (equation 15):

$$YF_f = \sum_a WF_f \times WFDIST_{fa} \times FD_{fa} + tr_f \quad (15)$$

Where WFf is the price of production input (f), $WFDIST_{fa}$ is efficiency of "f" for the activity "a", FDfa the volume of demanded "f" for the activity "a", and trf is the net revenue of agent "f" raise from carrying out commerce with foreign countries. The net revenue raised from foreign countries includes income from engaging in commerce with foreign countries in local currency minus payment refunded to the foreign countries. A part of revenue is deduced as tax on income raised by production agents (TYF) and the rest (YFDIST) is distributed among production agents (equation 16):

$$YFDIST_f = (YF_f)(1-TYF_f) \quad (16)$$

Incomes of households include selling production agents as well as government's transitional subsidies (equation 17):

$$YH_h = \sum_f \lambda_{hf} \times YFDIST_f + GT_h \quad (17)$$

Where λ_{hf} is the portion of production agent *f* in the economy which is supplied by the household *h* and GTh holds for government transitional help offered to the household *h*. As a result, government's transitional help is also assumed as a political parameter. With regard to the policy of removal of energy subsidy, the subsidy is distributed among households in the form of a transitional payment. The consumption demand of households were extracted through two phases. First, households' cost of living is defined as households' income by (equation 18), then direct tax and saving were deduced:

$$HEXP_h = (YH_h(1-TYH_h))(1-SHH_h) \quad (18)$$

Where HEXPh is cst of living of household *h*, TYHh is direct tax, and SHHh is saving which are defined as the ratio of saving after tax. Afterwards, the utility function of household is assumed as Stone-Geary utility function or the linear expenditure system. With regard to the system, consumption demand of households is consisted of two components, including subsistence payments and non-subsistence payments (equation 19):

$$QCD_{ch} \times PQD_c = (PQD_c \times q_{ch}) + \beta_{ch}(HEXP_h - \sum \quad (19)$$

Where qch is subsistence demand for accomodity *c* in the household *h*, β_{ch} is amount of final budget spent on each commodity after the deduction of cost of living. Government's source of income includes tax and revenue arised from exporting raw oil, gas, and other minerals. However, the export income is thought of as government's revenue. It includes income tax, import tax, tax on production, as well as tax on sale. Governmet's expenditures are measured as follows (equation 20):

$$EG = \sum_c PQD_c \times QGD_c \quad (20)$$

Where *EG* government's expenditures, and QGD is government's demand for commodities. The sum of government's expenditures not only includes consumption costs, like transitional payments to households, but also foreign countries as well as subsidies. There are three sources of income for capital (saving and investment), including households' savings, government's savings, and the excess of budget. The saving account is formulated as follows (equation 21):

$$SAV = (\sum_h (YH_h(1-TYH))(SHH) + KAPG + (KA \quad (21)$$

Where KAPG is government's savings and KAPW is the excess of balance payment. Demand for investment is also stated as (equation 22):

$$INV = \sum_c (PQD_c \times QINVD) \quad (22)$$

Necessary conditions for the market balance are balance in supply and demand of production inputs, balance in supply and demand of commodities, as well as balance in the market for trading goods. The balance of trading commodities has been stated in the parameter of foreign countries. (equation 23), illustrates the balance between supply and demand of production inputs:

$$FS_f = \sum_a FD_{fa} \quad (23)$$

Balance in the commodity market (equation 24):

$$QQ_c = QINT_c + \sum_h QCD_{ch} + QGD_c + QINVD_c \quad (24)$$

Balance in the account of foreign countries (equation 25):

$$\sum_c (PWM_c \times QM_c) + \sum_f tr_{rout} = \sum_c (PWE_c \times QE_c) \quad (25)$$

Equation above indicates equality between the value of export plus transitional revenues from other countries and the sum of revenues from import as well as transitional income from domestic institutions to other countries. Here, tr_{rin} and tr_{rout} show transition from other countries to Iran and from Iran to other countries, respectively. The foreign investment (FD) is also defined as the balancing parameter. Additionally, there are the equality between the sum of savings as well as investment and the sum of government's expenditures and revenues.

Results

Determining welfare index

Utility is thought of as the best criteria to measure welfare. However, it has some fundamental flaws, for example, it fails to provide accurate results for more than two households. Utility only discovers the ranking of balanced responses, rather than their interval. Therefore, what is widely used is the index which is equivalent to alterations in welfare. There are many studies where the criteria equivalent to changes has been used to analyze alterations in welfare resulting from liberalization. A research done by Kate Vitanachai et al. is a case in point. In this study, utility was used as a criteria for alterations in welfare (equation 26):

$$EV = E(P^b, u^p) - E(P^b, u^b) \quad (26)$$

Where E holds for expenditures function to achieve utility *u* on the vector of prices (P). Superscripts *b* and *p* indicate amount of variables before and after running the policy (climate changes).

2. Estimating environmental effects

Environmental effects were measured given exogenous coefficients provided for a part of products produced in sectors, pollutant energy subsidies as well as final consumption. Levels of carbon dioxide emission are considered as the most common environmental index. It is the major cause of global warming (Bouringer and Laschel, 2006).

There is enormous literature published on its importance (Wisma and Delink, 2007).

It is worth noting that other pollutants, like methane and nitrogen dioxide, are also measured based on carbon dioxide. With regard to available data, in the present research, emission levels of main pollutants, such as carbon dioxide, methane, and nitrogen dioxide, equivalent to carbon dioxide, nitrogen oxide, carbon monoxide, and sulfur dioxide were measure. Moreover, methane and nitrogen dioxide were converted into the equivalent amount of carbon dioxide according to their conversion factor, then the value added to levels of carbon dioxide. By the term "environmental impacts" is emission levels of above0cited pollutants. During the consumption process, only two pollutants, namely methane and nitrogen dioxide, are emitted.

In general, the source of harmful emissions are consumption of commodity as mediating inputs, emission of pollutants during the production process, emission resulting from final usage of commodities, and last but not least a broad range of services.

However, it is assumed that only fuel inputs cause pollution among commodities used as mediating inputs in the production process. In the same way, emission of pollutant *p* from three different sources is stated as follow (equation 27), (Beghin et al., 2019):

$$EN_p = \sum_a \beta_a^p QX_a + \sum_c \Pi_c^p \left[\sum_a QINT_{ac} + \sum_h QC \right. \quad (27)$$

The expression on the right side of the equation above consist four components.

The first term states emission of pollutant *p* during the production process in the section *a*. it also illustrates emission of pollution from reactions when fuel burns. In this expression, term β shows emission levels of pollutant *p* per production of one unite commodity in sector *a*.

Term $QINT_{ac}$ shows consumption level of commodity *c* as a mediating input in sector *a*.

Term QCD_{ch} states the final consumption level of commodity *c* by the household *h*.

Term QQf_{cff} shows other final consumption fields of commodity *c*, where FF refers to a broad range of final usages.

Term Π_c^p shows emission of pollutant *p* per one unites of commodity *c*.

Two last terms present final consumption. However, other final usages only include fuel consumption.

Value mentioned above was measured with regard to physical amounts (Dessus & Bussolo, 1998).

A preview of investigated scenarios from the viewpoint of welfare and environment taking an approach to subsidies on agricultural inputs

A cut in subsidies on agricultural sector

There are some crucial reasons why the agricultural sector is important. Firstly, prices of goods can largely affect agricultural commodities. Secondly, the conflict between consumers and producers of agricultural commodities is a highly controversial issue facing planners and politicians in developed countries.

As communities living in urban areas need to spend at least a half of their income in order to cover the high costs of foodstuff, a marked increase in the prices will be a reason to a big decrease in the revenue of people on low and medium-income.

Generally speaking, studying efficiency of Iranian supportive policies in the agricultural sector is of the most importance. Among all supportive strategies, financial approaches, especially subsidies, play a pivotal role. It is even claimed that subsidies became the cornerstone of many supportive strategies. Subsidies are classified according to many indexes in economy. One classification is according to stages of paying for goods or services from production to consumption, which includes export, consumption, production, and service subsidies.

Export subsidy is money that is paid by a government to exporters in order to create and maintain competitive advantage in global markets. Production subsidy includes all type of government's financial supports of the production sector. Service subsidies are generally paid to cut down the cost of distribution or fixed price for the final consumer.

Paying subsidies started 1973, and since then government began to grant production subsidy. Production subsidies have increased from 7.6 billion in 1973 to 8755 billion in 2010. It is worth noting that we have witnessed the regressive trend of production subsidies recently.

According to the input-output table, in 2001, production subsidies for agriculture were 5979.35 billion, while subsidies for other sectors were 4500.79.

To put it simply, agricultural activities received almost 57% of total production subsidy. Production subsidy to agriculture includes a wide range of payments in order to supply inexpensive inputs, secured purchase, mechanization, reconstruction of production firms, as well as making investment in infrastructure activities.

There was a reduction in production subsidies to agriculture in the fifth sustainable development plan than the Fourth one.

The total sum of production subsidies granted to agriculture in the fifth development plan was 21905 billion; therefore given the average annual growth rate (22%), this sector has witnessed a decrease from 8755 billion in 2010 to 2500 billion in the first eight months of 2015.

Moreover, the annual average granted subsidy to agriculture within the fifth development plan (4381 billion) was significantly less than that within the fourth development plan (10776 billion).

Unfortunately, the total sum of subsidies (21905 billion) granted during this period has been less than the amount anticipated (36299 billion), which indicates only 60% of plans have been materialized.

The highest and lowest percent of plan launched has been 92% in 2011 and 34% in 2015, respectively. The present research studied a cut in subsidies to agriculture in different five levels.

With regard to subsidies reforms, it is important to find out the reasons behind a decrease in state subsidies to agriculture (Table 1).

Table 1. Investigated scenarios over computable general equilibrium model

Scenarios	scenario#1 (Changes in %)	Scenario #2 (changes in %)	Scenario #3 (changes in %)	Scenario #4 (changes in %)	Scenario #5 (changes in %)
A cut in state subsidy to agriculture	10	20	40	60	80

Economic effects of a decrease in state subsidy to agriculture in the form of computable general equilibrium model

In this chapter economic effects associated with a cut are state subsidiary to agriculture are reviewed. For this purpose, effects of a decrease in state subsidy to agriculture on changes in the production levels of the agricultural commodities in the framework of a computable general equilibrium model were analyzed. The social accounting matrix used in the research carried out by (Faraj Zade, 2012). Therefore, some restraints imposed on domestic production of the agricultural sector and their effects on other economic sectors were examined. In this research, economic, welfare, and environmental impacts of cuts in state subsidy to agriculture were studied. It is worth noting that several modifications were made to the social accounting matrix for 2006 received from the central Bank (Faraj Zade, 2012).

The modifications included segregation of the agricultural sector into subsectors producing wheat, rice, sugar beet, cotton wool, maize, barely, cattle, forest, and fishery and so on. Moreover, bank accounts of rural household as well as their economic deciles were segregated from that of the urban households. The labor was also divided into two groups, including skilled and unskilled. Furthermore, software GAMS24.9.1 was used to study the effects of climatic scenarios in the form of CGE model.

Data in (Table 1) shows the effects of cuts in state subsidy to agriculture on different agricultural sectors.

Signs "+" and "-" indicate increases and decreases in production levels after considering the scenarios, respectively. The effects of given scenarios on the agricultural subsector were analyzed. As can be seen from (Table 2), all production subsectors experienced a decrease after a cut by 80% in state subsidies to agriculture.

To be more precise, when subsidies have decreased by 10%, the maximum and minimum decrease was reported for wheat and oat, respectively.

Table (2) shows that, production of them decreased by 20 and 4.9 percent, respectively. Moreover, of all agricultural subsectors, 10% cut in state subsidy to agriculture led to a decrease in production of cattle, fishery, forest, and farms by 2.4, 10.4, 10, and 8 percent, respectively. In other words, it can be

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concluded that fishery was strongly influenced by exercising the scenarios related to cuts in subsidiary to agriculture, so input and output of this subsector showed a considerable decrease.

The more reduction in subsidies to agriculture is made, the more production of agricultural commodities is influenced, to such an extent that a decrease by 94% has been reported in the field of fishery.

Table 2. Effects of cuts in state subsidies to different sectors of economy

Production sectors	**Scenario #1 (Changes in %)**	**Scenario #2 (Changes in %)**	**Scenario #3 (Changes in %)**	**Scenario #4 (Changes in %)**	**Scenario #5 (Changes in %)**
Wheat	20	39.4	73	94.3	100
Rice	12.7	26	54.3	82.2	99.2
Sugar beet	11.8	24	50.2	79	100
Cotton wool	11	22.7	48	75.07	96.9
Maize	8.9	19.2	44	73.2	96.4
Oat	4.9	10.6	26.4	52.3	89.3
Cattle	2.4	5	11.6	22.4	51.8
Forest and farm	8	17.5	41.1	69.5	93.4
Fishery	10.4	21.6	46.1	72	94.4
Other agricultural commodities	1.6	3.2	7.4	16.4	52.6
Mining	+1.6	+3.2	+6.4	+9.9	+12.4
Food industries	10.4	21.2	44.2	69.6	91.5
Clothing, leather, dry goods	9.3	18.9	38.5	60	84.3
Wood and paper	2.2	4.8	11.1	19.7	35.3
Oil and gas	0.024	0.1	0.5	0.9	1.1
Petrol	0.09	0.3	1.5	5	19.7
Kerosene	1.8	3.9	۲9.	17.3	31.4
Gasoline	1.3	2.8	6.3	11.8	28.8
Mazut	+5.3	+11.8	+31.8	+92	+646.9
Liquid gas	۰.4۰	1.3	4.9	12.4	100
Other petroleum products	+0.9	+1.8	+3.1	+3.4	6.3
Natural gas	0.8	1.7	4.2	8.2	16.5
Electricity	0.1	0.3	۰.9۰	2.2	7.9
Other industries	0.042	0.2	1	2.7	8.2
Transportation	+0.072	0.004	1.1	5.2	23.3
Other services	+2.4	+5	+11	+18.1	+17.5
Total sum of production	3.11	6.59	14.97	26.22	38.75

Source: research data

Results showed that reduction in subsidy to agriculture had a positive effect on production levels of other industries like mining, mazut, other petroleum products, transportation, and related services.

The biggest effect has been estimated on the production of mazut. To be precise, 10% decrease in subsidy to agriculture led to an increase in the production levels of mining, mazut, and other petroleum products by 1.6, 5.3, and 0.9%.

Moreover, transportation and other services have witnessed 0.072 and 2.4% increase, respectively.

However, sharp cuts in subsidy to agriculture caused a decrease in the production levels of transportation. For example, reduction by 80% in state subsidy to agriculture caused a 23.3% decrease in the transportation.

In general, as can be seen from (Table 2), cuts in subsidies to agricultural subsector led to a reduction in all different production activities. According to data, 10 and 20% decrease in subsidy to agriculture caused a reduction by 3.11 and 6.59% in the production levels of all economic sectors. Moreover, 80% decrease is state subsidy granted to the agricultural sector led to 38.75% decrease in the economy growth due to reduction in production levels of agricultural subsectors.

4.8 Effects of cuts in state subsidy to agriculture on households' welfare in the form of CGE model

In this chapter, effects of cuts in state subsidy to agriculture on households' welfare are examined. First, alterations in households" demands for agricultural and non-agricultural commodities after running investigated scenarios were studied. Data are available in (Table 3). Results showed that the more state subsidy to agriculture decreases, the fewer households demand will be.

As can be seen from (Table 3), the major reduction in demand was reported for rice and fishery.

Based on the results, it can be concluded that implementation of these strategies will lead to a decrease in domestic agricultural production levels, which it, in turn, causes an increase in the price of agricultural production and their import rates, and finally demands for such production goes down.

According to the first investigated scenario, 10% decrease in state subsidy to agriculture made a reduction by 4.22% in households' final demand for all productions. Afterwards, more cuts in subsidies paid to the agricultural sector led to 9.32% decrease in household's demand. All other things being equal, a reduction by 40 and 60% in subsidy to agriculture caused 20.15 and 39.05% decreases in households' final demand. Finally, implementing the last investigated scenario led to 62.11% decreases in households' demand for different production goods.

Table 3. Effects of cuts in state subsidy to agricultural sector on households' final demand for different products

Production sectors	Scenario #1 (changes in percent)	Scenario #2 (changes in percent)	Scenario #3 (changes in percent)	Scenario #4 (changes in percent)	Scenario #5 (changes in percent)
Wheat	4.83	10.18	22.96	40.23	63.83
Rice	5	10.57	24	42.49	67.84
Cattle	4.88	10.28	23.21	40.73	64.71
Forest and farmland	4.89	10.33	23.36	41.11	65.65
Fishery	4.91	10.39	23.63	41.95	68.22
Other agricultural products	4.90	10.33	23.36	41.12	65.66
Households' final demand for all products	4.22	9.32	20.15	39.05	62.11

Source: research Data

(Table 4) illustrates results associated with the effects of cuts in subsidy to the agricultural sector on households' welfare based on urban and rural income deciles. As can be seen from (Table 4), the more subsidies to agriculture is decreased, the less households' welfare will be. Therefore, reduction of households' welfare is attributed to cuts in domestic production and increase in the prices of goods. Moreover, results showed that rural communities suffered more difficulties associated with reduction of state subsidy to the agricultural sector than urban households.

Unlike urban households, welfare of rural communities is strongly influenced by reduction in subsidy to agriculture.

As most of people in rural areas are working in agriculture and animal husbandry, they will suffer more difficulties due to alterations in the amount of subsidy paid to agricultural sector than communities living in cities.

As a result, the more state subsidies to households are decreased, the less welfare of all rural and urban households will be improved.

Results illustrate that the fifth scenario, a reduction by 80% in subsidy to agriculture, had the most impact of people's welfare, while the first scenario, a reduction by 80% in subsidy to agriculture, had the least impact of people's welfare.

More precisely, all other things being equal, welfare of people on high income, the first deciles, reduced from 3.65% to 47.20% when cuts in subsidy to agriculture ranged from 10% to 80%.

However, welfare of the second decile, reduced from 3.72% to 47.53% after the changes were made. As can be seen from data, welfare of the fourth decile, reduced from 3.76% to 48.29%. The general trend towards the ninth decile, or, more precisely, people on low income, showed the least welfare ranging from 4.32% to 61.47%.

Furthermore, results associated with rural communities also illustrate that alterations in the first deciles welfare after the reduction of state subsidy to the agricultural sector were 5.62%, 11.70%, 25.67%, 43.47%, and

68.26%, respectively. These changes in the second deciles were 5.69%, 11.8%, 12.26%, 44.39, and 69.71%, respectively.

Finally, the 10th deciles experienced cuts ranging from 7.28% to 100% when a reduction by 10% and 80% were made in the amount of state subsidy to agriculture.

Table 4. Effects of a reduction in subsidy to agriculture on different income groups

Urban households	**Scenario #1 (changes in %)**	**Scenario #2 (changes in %)**	**Scenario #3 (changes in %)**	**Scenario #4 (changes in %)**	**Scenario #5 (changes in %)**
1st decile	3.65	7.70	17.39	30.44	47.20
2nd decile	3.72	7.85	17.79	31.23	47.53
3rd decile	3.62	7.66	17.40	30.67	47.36
4th decile	3.76	7.95	18.05	31.76	48.29
5th decile	3.92	8.29	18.75	32.81	50.13
6th decile	4.09	8.65	19.66	34.68	53.89
7th decile	4.21	8.93	20.43	36.38	58.10
8th decile	4.35	9.24	21.18	37.86	61.47
9th decile	4.32	9.19	21.16	38.10	62.79
10th decile	3.44	7.40	17.51	33	60.68
Rural households	**Scenario #1 (changes in %)**	**Scenario #2 (changes in %)**	**Scenario #3 (changes in %)**	**Scenario #4 (changes in %)**	**Scenario #5 (changes in %)**
1st decile	5.62	11.70	25.67	43.47	68.26
2nd decile	5.69	11.87	26.12	44.39	69.71
3rd decile	5.93	12.37	27.26	46.31	72.31
4th decile	6.13	12.80	28.14	47.59	73.26
5th decile	6.07	12.67	27.99	47.68	74.74
6th decile	6.19	12.93	28.56	48.63	76.06
7th decile	3.07	12.71	28.12	48.43	77.06
8th decile	6.17	12.91	28.59	48.86	76.76
9th decile	۱۴6.	12.85	28.50	48.85	77.42
10th decile	7.28	15.45	35.43	63.69	100

Source: research data

In this chapter, general alterations in urban and rural households' welfare are analyzed. As can be seen from (Table 5), effects associated with a cut of 10% in state subsidy to agriculture on communities living in urban and rural areas were estimated to be 3.90% and 6.34%, respectively.

Generally, alterations in households' welfare based on the scenario were estimated at 4.50%. When a cut of 20% in subsidy to agriculture was made Iranian households' welfare experience a worse situation, to such an extent that the indicators range from 8.29 to 13.29 for urban and rural communities, respectively. When the third scenario was implemented, or, more precisely, a reduction of 60% in the given subsidy, the welfare index was estimated at 19.04% and 29.63%

for urban and rural communities, respectively. By and large, the lost welfare of Iranian households was measure at 21.71% after running the investigated scenario. Moreover, a reduction in welfare was estimated at 38.58% and 61.54%, respectively, after implementing the fourth and fifth scenarios.

Table 5. Effects of cuts in subsidy to agriculture on urban and rural households

Title	Scenario #1 (changes in %)	Scenario #2 (changes in %)	Scenario #3 (changes in %)	Scenario #4 (changes in %)	Scenario #5 (changes in %)
Urban households	3.90	8.29	19.04	34.19	55.64
Rural households	6.34	13.29	29.63	51.12	78.49
Total sum of households	4.50	9.52	21.71	38.58	61.54

Source: research data

5.8 environmental effects associated with cuts in subsidy to agriculture in the form CGE model

In this chapter, environmental effects associated with cuts in subsidy to agriculture were analyzed. Data are available in (Table 5). As can be seen from (Table 6), after reducing state subsidy to agriculture, levels of pollution factors, like CO ‹CH_4 ‹N_2O, reduced, which was greater in the fifth scenario than the first one. Cuts in the production levels of the industrial, oil, and gas sectors are major reasons for it. Moreover, a reduction in pollution level from fertilizers was also reported in this scenario. It is mainly because of cuts is state subsidies granted to the agricultural sector, which, in turn, leads to a reduction in the use of fertilizers and production levels.

Table 6. Effects of cuts in subsidy to agriculture on environmental pollution

Source of pollution	Scenario #1 (changes in %)	Scenario #2 (changes in %)	Scenario #3 (changes in %)	Scenario #4 (changes in %)	Scenario #5 (changes in %)
Nox	1.14	2.36	5.12	8.85	19.19
SO2	0.02	0.11	0.5	0.88	1.15
CO	2.98	6.05	12.57	20.71	39.45
CO2	+0.07	+0.07	+0.01	+2.11	+40.26
CH4	1.86	3.80	7.87	10.49	21.79
N_2O	7.49	15.01	30	44.93	67.11
Fertilizer	13.39	26.70	51.85	72.90	90.07

Source: Research data

Effects of cuts in subsidy to agriculture on the production levels of NOx were estimated at 1.14% and 19.19% for the first and the fifth scenarios, respectively. When it comes to SO2, alterations in pollution were ranged from 0.02% to 1.15% as a reduction in state subsidy went down from 10% to 80%.

As can be seen from the (Table 6), air pollution arising from the emission of CO2 increased by 0.07%. The growth in the production of oil and its derivatives is a major reason for these alterations ranging from 0.07% to 40.26%. Results associated with changes in air pollution levels resulting from energy production are available in (Table 7). Data shows that the least and the most pollution are from CO and N2O, respectively.

Results associated with effects of cuts in subsidy to agricultural sector on households' consumption are available in (Table 8). As can be seen from the table, when subsidy to agriculture went down by 10%, alterations in pollution levels of CH4 and N2O were 3.95% and 4.42%, respectively.

However, when subsidies to agriculture decreased by 80%, such alterations were reported 57.19% and 61.87%, respectively.

Table 7. Effects of cuts in state subsidy to agricultural sectors on environmental pollution from sources of energy

Sources of pollution	Scenario # 1 (changes in %)	Scenario # 2 (changes in %)	Scenario # 3 (changes in %)	Scenario # 4 (changes in %)	Scenario # 5 (changes in %)
NOx	0.88	1.89	4.65	9.68	24.70
SO2	0.71	1.61	4.46	10.91	33.74
CO	0.17	0.47	1.82	5.58	20.37
CO2	0.92	2.02	5.025	10.40	24.90
CH4	0.54	1.24	3.42	8.04	22.99
N2O	1.10	2.34	5.52	11.3	27.76

Source: research data

As can be seen from (Table 7), production of CO2 decreased by 0.92% and 22.90% after considering the first and the fifth scenarios, respectively. Moreover, after implementing reforms in subsidies, changes in emission levels of SO2 ranged from 0.72% to 33.74%. Results showed a drastic change in the production levels of N2O than other factors.

In other words, an increase in production of N2O was observed when cuts in state subsidies to agriculture raised from 10% to 80%. However, slight changes in pollution levels was reported for CO. Afterwards, total change in pollution equivalent to emission figures of CO2 was measured and results associated with the effects of cuts in state subsidy to agriculture on this factor were estimated. Data are available in (Table 8). Results illustrate a decrease in environmental pollution after considering investigated scenarios. To put it simply, there is a direct link between cuts in state subsidies to agriculture and environmental pollution levels.

Table 8. Effects of cuts in subsidy to agriculture on pollution

Pollution	Scenario #1 (changes in %)	Scenario #2 (changes in %)	Scenario #3 (changes in %)	Scenario #4 (changes in %)	Scenario #5 (changes in %)
Pollution limits (equivalent to CO2)	0.23	2.62	6.04	10.72	12.52

Source: research data

(Table 9) shows a clear trend between cuts in state subsidy to agriculture and environmental pollution from households' consumption. As can be seen from (Table 9), pollution levels of CH4 and N2O ranged from 3.95% to 4.42, respectively, by considering scenario 1. All things being equal, an alteration from 57.19% to 61.87% was made by constructing scenario 2.

Table 9. Effects of cuts in subsidy to agriculture on total of pollution from households' consumption

Pollution	Scenario#1 (changes in %)	Scenario#2 (changes in %)	Scenario#3 (changes in %)	Scenario#4 (changes in %)	Scenario#5 (changes in %)
CH4	3.95	8.40	19.32	34.76	57.19
N2O	4.42	9.35	21.35	38.04	61.87

Source: research data

Discussion

Production subsidy to agriculture is thought of as a supportive strategy for corroborating domestic producers to promote domestic production, help to lessen the costs of production, as well as increase export.

It includes subsidies for agricultural inputs and secures purchasing. Such agricultural inputs as chemical fertilizers, pesticides, and seeds are so important in agriculture that the largest production subsidy is granted to them.

State subsidies to agricultural inputs have been paid by the government for years. However, inadequate usage of these inputs, damaging to the environment, increasing state's financial liabilities, traffic in inputs cause to reduce the efficiency of such strategies.

Furthermore, recent state policies to implement reforms in production and consumption subsidies, on the one hand, and the necessity of preparing agricultural sector to join the World Trade Organization, as well as making some reforms in subsidy policies, on the other hand, has doubled the importance of studying economic effects of granting subsidy for agricultural inputs on production levels for planners and decision-makers in this field.

State subsidy is generally paid for agricultural inputs to decrease costs associated with the production and supply of foodstuff. However, despite some advantages, providing producers with inexpensive inputs contribute to some disadvantages, like creating a false relative advantage in some economic activities, misusing of invaluable investment sources, cuts in competition among producers, the dissipation of agricultural inputs, as well as damaging to the environment, especially by using fertilizers and pesticides.

When a large amount of inexpensive energy subsidy is granted to producers, its dissipation will be unavoidable.

Energy inputs in the agricultural sector are electricity and fossil fuel (gasoline). With regard to increases in the price of energy carriers as well as potential substitution of different inputs for others, alterations in the consumption levels of such inputs as water, chemical pesticides, chemical fertilizers, and energy, are unavoidable which are also very damaging to the environment.

Generally speaking, as the government has a really tight budget as well as side effects associated with using inexpensive agricultural inputs, especially chemical fertilizers, are numerous, it is important to consider the financial impacts of inputs distribution to adopt efficient strategies.

Conclusion

The present research aimed to study the effects of cuts in state subsidy to agriculture on macroeconomic parameters by an emphasis on households' welfare and environment in the form of the CGE model. Research results showed a considerable decrease in all agricultural subsectors when subsidies to agriculture went down by 80%. Wheat and oat experienced the highest and lowest decrease in production. Data illustrate that fishery has greatly suffered from the consequences of policies towards reduction in subsidies. When a great reduction in subsidies to agriculture was taken, production of the subsectors, especially fishery, showed a marked decrease by 94%. The present research also studied the effects of cuts in state subsidy to agriculture on Iranian households' welfare. Results showed that a reduction in subsidies granted to agriculture lead to a decrease in the welfare of rural and urban households. Reduction in domestic production and an increase in the price of commodities lead to a decrease in the demand of Iranian households for foodstuff. Results showed that rural households greatly suffered from the consequences of cuts in subsidy to agriculture than urban communities. As most the people living in rural areas are farmers or grazer, cuts in subsidies and consequently increases in costs of living lead to a decrease in their welfare. As most rural households have farmland, they are much susceptible to cuts in subsidies. On other hand, in urban communities, the rich are slightly affected by such strategies than people on a low income, because they do not have to allocate a substantial portion of their income to foodstuff. It means that the income of producers of agricultural commodities is strongly affected by the policy towards reduction in state subsidy to agriculture. Since households are producers of goods, they cannot afford to purchase foodstuff, which it, in turn, will negatively affect, production activities. As they lack enough money to pay for goods, production agents will experience cuts in production activities for the second time. The cycle continually repeats to such an extent than households completely lose their purchasing power.

As the present research was carried out into agriculture, it is strongly recommended to do some studies of this type throughout Iran and in different economic fields to adopt secure strategies. In this regard, the following suggestions are put forward:

According to results, removal of or cuts in subsidy decreases production rate and households' welfare which it, in turn, leads to an increase in the price of commodities. On the other hand, it may contribute to the efficiency of inputs in the long term. So, it is recommended to attract new investment to reconstruct infrastructures and facilities or to use efficient practices and technologies. So, the government is recommended to provide supportive payments or to pay low-interest loans to set the stage for the reconstruction of infrastructures which will lead to an increase in efficiency of such inputs as water and machinery.

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