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Full Length Research Paper

Study of the effect of targeting energy carriers' subsidies on Prices of Agricultural products

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Given the increasing importance of food safety in the countries and more important role of agricultural sector as a supplier of raw materials in other sectors, the dependence of this sector on energy sources was increased. Current study examined the impact of targeting the energy subsidies on prices of agricultural products by using computable general equilibrium model. The model result in the first scenario, increasing the prices of carriers to world level by calculating dollar with exchange rate showed that the most increasing prices was related to fishing with 69.5 percent. In the second scenario, if the prices of energy carrier increase to world prices level according to free rate of dollar, the prices of agricultural products two times more than the first scenario. In third scenario with 38% increasing carriers' prices, the percent of price change in different products was less than first and second scenarios. In the fourth scenario the gas oil price and electricity price to the boundary prices level (with free rate of dollar) was increased that the results were almost similar to the second scenario. The difference between these two scenarios is most noticeable in other sectors, because the usage of energy carriers in them was different.

Key words: Computable general equilibrium, Agriculture، energy carriers.

INTRODUCTION

Agriculture sector is the major economic sectors and provide basic needs (Aghaiee and Amini Fard, 2011). Contributing 15 percent in GDP, providing employment for 22.7% of country's employees and covering more than 30 percent of non-oil exports is proof on the importance of agriculture (Karbasi et al., 2004).

According to the above items, it needs to pay special concern and attention to growing tools of agricultural sector. One of these tools is energy resource that it plays a significant role in creating reconstruction capabilities (Sasoli and saleh, 2007).

According to International Monetary Fund (IMF) study, total subsidies paid to energy carriers in the country in August 2007 is equal to about 17 percent of total Expenses of government. In this year, no profit of government from low pricing energy in internal markets was forecasted about 32 milliard Dollars (Manzur et al., 2009). In Iran, apparent subsidies of energy are provided from government budget and majorly from export oil income and gas. Hence, the low price of energy carriersand gas cause to increase demand to efficiency level of energy consumption in Country and also Partial of government budget is allocated to them. It seems that continuing this pricing process in energy industry, Government will face to budget deficit particularly in stagnation periods of oil global market in future. On this basis, in recent years Considerations of performance and also budget limitations have lead government to change structure of energy carriers market (Manzur et al., 2009). Unbroken, deep and wide depending on energy resources require that continues and comprehensive endeavor and efforts to provide efficient solutions in order to optimize the production and consumption of energy and determine proper price for it to be done. The agricultural sector is one of the most important consumers of electrical energy and most important oil

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product is gas. In recent four decades, the energy consumption in Iran agricultural sector increase with higher rate than the production growth of this sector and one of it's factors is paying energy subsidies, which totally 59% of total paid subsides to agricultural sector was included energy subsidies in period 1369-88, Due to limited natural resources, high financial burden of energy for government and the negative effects of inappropriate use of different energy sources on human health and the environment, it is necessary to investigate energy consumption patterns in the agricultural sector (Hatirli et al., 2005).

Computable general equilibrium approach is able to present more exact analysis of results and consequences of economic policies by considering direct and indirect effects and also scale effects and substitution effects of a policy. So in scientific circles, usually effect of energy price modification on economic and environmental variables is studied in format of this Pattern (Weyant, 1985).

Also in this Study it was tried to investigate possible effects of different scenarios of energy price modification on agricultural sector by designing a calculable general equilibrium model. Mabagu and Chitiga (Mabugu and Chitiga, 2008) studied effects of increasing further support of the agricultural sector on productivity and the welfare of poor households in South Africa. They applied a up to down general equilibrium simulation model. Their model predicts that supporting agricultural productions will have minor impact on GDP because when the actual consumption of households is reduced, exports and imports will reduced. Food production, other productions, trade and hotels will expense. Other industries either receive little profit or do not take effect. The effect on households depends on the amount of their production factors and consumption pattern which this effect is very small and thus its effect on poverty reduction is very little.

Bandara and Coxhead 1999, used a computable general equilibrium model to assess and quantify the effects of traditional releasing and reducing tariff on environmental benefits in agriculture in Sri Lanka. From their perspective, reformation policies from liberalizing can lead to the relative profitability of manufacturing in various sectors as well as major changes in the structure of production, income and consumption. Macdonald et al., 2003, have studied change in agricultural policies on income distribution by preparing Social Accounting Matrix (SAM) of South Africa. The results indicated that Increasing final demand of agricultural products and reducing price support had more benefits for poor households. However these Interests are low. 6 Percent reducing price support of agricultural products cause to reduce the price of agricultural products in amount of 7 percent; But since this reduction is centralized only in Agricultural Section, therefore reduction in supportive prices had limited effect on price structure in non-food Sections.

Thabet and Chemingui 2001 determined the effects of internal and external reforms in agricultural policy on rural household income and income distribution in Tunisia by simulating a computable general equilibrium model CGE. This model in which the Tunisian households were divided into ten categories, including nine rural categories and one urban class, impacts of reducing the domestic supports and agricultural tariffs on the economic welfare were be evaluated. Results from the model showed that the agricultural reforms reduce average welfare of majority rural classes and only the increase in yield level of agricultural products can cause to improve rural income level.

L ö f green and Robinson 1999, analyzed the effects of reduced trade support in agriculture and industry on urban and rural Moroccan households' welfare in countable general equilibrium and based on social accounting matrix 1994 that reducing support of agricultural sector provide significant welfare benefits totally, but the effect of eliminating tariffs in industrial sector is lower, which it show that these tariffs have low relative effect on deviation of domestic prices.

Diao et al., 2003, investigated the effects of China entry to World Trade Organization on agricultural sector income by using a multiregional countable general equilibrium model. Scenarios were checked including these two Cases:

1) Agricultural tariff rate reduce equivalent to other tariffs rate such as cereals, vegetable oil and meat products
2) In addition to reducing support in agricultural sector, supporting the Tariff in non-agricultural sectors was reduced.

Results showed that if commercial release is done only in agricultural sector, total welfare will increase, but income gap between areas will be more widespread and agricultural sector will bearing loss. But totally eliminating commercial barriers in both Agricultural sector and nonagricultural sectors lead to farmers take more benefits.

Elyasyan and Hosseini 1987, study the effects of subsidies elimination in agricultural inputs application including fertilizers, pesticides, seeds and machinery, water, and related effects on farmers' incomes by increasing the exchange rate and thus increasing the input price. The results showed that the profitability index of one hectare of irrigated wheat in years 1371 - 72 after economic liberalization, had been equivalent to two times of 71-70 years before economic liberalization.

Salami 1993, calculated price and non-price support for each strategic products unit by considering the fuel subsidy and without taking into account it with analyzing the economic effects of Iran accession to World Trade Organization on the agricultural sector and other sectors

of the economy in a general equilibrium model. In this study we have shown that the fuel subsidy has substantially effects on the final cost of products.

MATERIALS AND METHODS

Among the numerical solution models, computable general equilibrium models (CGE) from late 1970s, are used largely by national and international organizations for economic policy analysis at in partial level and the whole economy. The main advantage of computable general equilibrium models is that the market mutual reactions related to prices displays consistent with micro-level. Simultaneously explaining the source of people's income and place of its consumption enables this model that the effects of policy interventions on the overall performance of the economy and the distribution of income will be considered. This topic has become CGE models as a standard tool for quantitative analyzing interventions of policy making in many areas like fiscal policy, trade policy, environmental policy (Mehr Ara and Barkhordari, 2003 and Bohringer et al., (2004) in CGE models, economic interactions occur in internal, imported and exported goods market and also production factors market (labor and capital) besides transitive payments (tax And subsidies). For one economic analysis based on general equilibrium, it is needed to classified and present minor economic data so it can provide accurate numbers of model parameters in one base year. There are different Classifications such as Social Accounting Matrix and input - output tables for using in general equilibrium model Public but applying data in these two formats have problems and insufficiencies for designing one general equilibrium model in Iran that practically it makes difficult calculating general equilibrium model. In general equilibrium model of this study, Micro Consistent Matrix Wisdom (MCM) 2 in year1380 were used as basis data.

However, in general case, available data in this matrix are Somewhat like Social Accounting Matrix but designed matrix in this research has basic differences with Social Accounting Matrix year 1380. Name of MCM was taken from recent studies in general equilibrium modeling. This matrix is the new form of traditional accounting matrix that it is appropriate for general equilibrium modeling. Also some studies use this matrix as equivalent of one Rectangular SAM that it shows well how data related to general equilibrium model (Manzur et al., 2009).

MCM table unlike SAM that is based on the accounting concepts stated several important economic concepts that is base of general equilibrium modeling. Each row in this matrix show one market so matrix rows are goods and services market Products and also production factors market. In each row, positive Values indicate offer and negative values indicate demand in that market. with this interpretation, if total flow of entered goods to economy is equal to total flow of removed product from economy , horizontal sum of each row is equal to zero and this same condition related to market clearance condition 3 that is indefeasible for each commodity in general equilibrium models (market equilibrium).

Modulated MCM of the force ministry were used matrix data in this research in 1994. Studied framework of equations was codified in Mixed Complementary Problem (MCP) format. This Pattern is located in general equilibrium or structural patterns format.

The model of this study consists of 4 manufacturing sections which these manufacturing sectors offer 21 groups of goods and services. Layer functions with constant elasticity of substitution (NCES), show how inputs are combined and produce output. Production inputs are capital K, labor L, energy E (6 energy carries) and intermediate materials, M (15 commodity categories), is shown in abbreviated form KLEM, in general equilibrium models. These inputs in layers of added value (including capital and labor work), energy layer (combining electricity and other energy carriers) and layer of other intermediate inputs are classified. These inputs with form function NCES between inputs show cost structure for each sector or manufacturing activity. Production Factors, including labor, mixed income, sector-specific capital and operating surplus (in energy), which are considered in model according to divides of little data matrix. Another important assumption made in this model, taking exogenous supply of labor and capital by household. The assumption in dynamic general equilibrium models is excluded. Governments, corporations (enterprises) and households are model institutions. Households are classified as rural and urban segregation. Institutions are the supplier of labor and capital. Household gain their utility through the consumption of energy combined commodity and non energy combined commodity. Each combined commodity is consisted of a CES combination of related goods. In this model, households face with 21 commodities and one option for saving.

Production structure

Products are performed by using non energy intermediate goods, energy goods and primary inputs. In all these parts is satisfied zero profit condition. Electricity is considered substitution by summing other energies. It should be noted that in literature on computable general equilibrium to avoid complexities of used mathematical equation is used graphical representation of production structure. In other words, each mathematical equation can be represented NCES as a layered graph.

In showing the layered presentation of production structure is trying to state all the necessary information for compiling for the zero profit condition for each part. In

the stated structure the elasticity of substitution in each layer is expressed as parameter. The layered structure of the production for activities is shown in the following diagram. Production structure in studied general equilibrium model. According to layered structure CES, the relationship of production structure and accumulation of different inputs can be expressed mathematically as follows:

$$KLE(S) = \alpha_{KLE}\left[\alpha_{KL}KL(S)^{1-\delta} + (1-\alpha_{KL})E^{1-\delta}\right]^{\frac{1}{1-\delta}}$$

$$Z(S) = \alpha_{KLEM}\left[\alpha_{KLE}KLE(S)^{1-\beta} + (1-\alpha_{KLE})M^{1-\beta}\right]^{\frac{1}{1-\beta}}$$

$$KL(S) = \alpha_{KL}\left[\alpha_{K}K(S)^{1-\varepsilon} + (1-\alpha_{K})L(S)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$$

Where:

$Z(S)$ the product of S part, E energy input ($L(S$ manpower in S part, $K(S$ capital in S part , M the aggregated intermediate good, α_{KLE} the share between the energy and added value, α_{KLEM} the share of aggregated commodity and composite of energy and added value, α_{KL} the share between the labor and capital, β the elasticity of substitution between composite of energy and added value with aggregated commodity, the elasticity of substitution between labor and capital and δ the elasticity of substitution between energy and added value.

The conditions of Zero profit

Production structure based on the zero profit conditions is expressed. The zero-profit conditions represents equality of unit's cost with unit's income for manufacturing sections.

Zero profit condition for the manufacturing activities

Manufacturer's behavior in the economy is demonstrated with aim of layer functions with constant elasticity of substitution NCES. Manufacturer, labor and capital combine with intermediate materials and energy and produce a product or products. This combination based on the elasticity of substitution and the contribution of each factor in production is expressed. Production structure in general equilibrium model of this study is a layered structure, and it can be defined Leontief, Cobb-Douglas and CES for each layer of production function. Based on production structure, the zero profit condition for each activity has been developed. Assuming a Leontief structure in the first layer and the structure CES in later layers, the zero-profit condition for each segment s can be expressed as follows:

Which the share of aggregated inputs and contribution of each input in each layer are expressed as α and θ respectively. The variables w_f ، p_e ، p_j ، ps_i^s indicate the prices of production factors, domestic prices for energy carriers, and domestic prices of non energy carriers and separated price of manufacturer respectively. Also sw ، si ، so are expressed as the tax on factors, tax on intermediate inputs and tax on product respectively. Rising energy prices are expressed as tax on energy se. Also λ, β and η are elasticity of substitution between production factors and the elasticity of substitution between intermediate goods and the elasticity of substitution between energy carriers respectively.

$$\pi = \left(\sum_i \alpha_i^s (ps_i^s(1-so_i^s))^{1-\tau_s}\right)^{\frac{1}{1-\tau_s}} - \left[\begin{array}{l} \alpha_f^s\left(\sum_f \theta_f^s (w_f(1-sw_f^s))^{1-\lambda_s}\right)^{\frac{1}{1-\lambda_s}} + \alpha_j^s\left(\sum_j \theta_j^s (p_j(1-si_j^s))^{1-\beta_s}\right)^{\frac{1}{1-\beta_s}} \\ + (1-\alpha_f^s-\alpha_j^s)\left(\sum_e \theta_e^s (p_e(1-se_e^s))^{1-\mu_s}\right)^{\frac{1}{1-\mu_s}} \end{array}\right] = 0$$

Examined Scenarios in this study

Changes in the prices of non energy section such as agricultural sector is a function of changes in energy prices, the rate of use of energy data by non energy sectors and the rate of use of non energy data by non energy sector. Studying the effect of price increase or removal of energy subsidies In this study in four scenarios 4 in separate price levels due to energy price and the world price was designed that it is as follows:

- First scenario: simultaneous rising the energy price to the world prices level (according to dollar with its exchange rate (reference)
- Second scenario: simultaneous increasing the price of energy carriers to the world prices level (regarding dollars with free rate)
- Third scenario: 38 percent increasing price of energy carriers (due to the rising approval cost of integrating Commission of Parliament)
- Fourth scenario: increasing prices of oil, gas and electricity to the border prices level with the free rate of the dollar

The following scenarios are considered with respect to being two rate of dollars and several changes of dollars in

Table 1. Scenarios of increase in prices of energy carriers (to RLS)

carriers	Current Price	Scenario 1	Scenario 2	Scenario 3	Scenario 4
		Increasing price to border price level (with exchange rate of dollar)	Increasing price to border price level (with free rate of dollar)	38 percent increase	Increasing prices of oil, gas and electricity to the global prices level(with free rate of dollar)
Petrol	7000	14510	20320	9800	-
Diesel	2500	14230	19920	3500	19920
Kerosene	2500	14300	20030	3500	-
Oil	2000	14560	20390	2800	-
Electricity	208	1240	1240	291	1240
Natural gas	600	1075	1075	840	-

Source: Energy balance and OPEC website.

Table 2. Increasing changes in prices of agricultural products in studied scenarios (percent)

Agricultural Crops	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Wheat	19.7	57.7	18.1	57.5
Paddy and rice	5	31.3	5.3	33.4
Sugar beet and sugar cane	45.2	98	40.7	92.1
Other Industrial Plants	37.8	93.6	29.8	95.7
Other agricultural products	31.8	79.2	16.3	94.9
Horticultural crops	37.4	94.3	28.1	100.6
Cattle, buffalo, sheep, goats and other live animals except poultry	28.7	72.1	23.7	76.9
hen, live chickens and other poultry	40.8	96.8	34.6	102.4
Livestock and poultry products	20.1	57.5	19	61.3
Honey, fresh cocoons and other bee and silk products	23	35.4	16.3	24.4
Forestry products and stumpage	27.4	66.5	13.2	26.4
Fish and other fishing products	69.5	149.1	61.4	151.1

recent months and the increasing carrier prices to border prices is calculated due to both free and reference rates or exchange.

Border prices of petrol, diesel, kerosene, fuel oil, electricity and natural gas are calculated 14510, 14230, 14300, 14560, 1240 and 1075 IRR respectively by using the exchange rate of the dollar(£ 25,000). The marginal cost of carriers is calculated with free rate of dollar (35,000 rails) which considered as second scenario in the above table.

In the third scenario, the criterion is passed legislation of Islamic Parliament Commission which the under this Act, an 38 percent increase of carriers prices compared to the current price have been considered as the other scenario.

Also in this study, particularly impacts of prices change on agriculture with other sectors of carriers are taken into account. on the other hand, as mentioned in previous chapters, most consumed inputs in agriculture sector are gasoil and electricity which because of the more supporting farmers by implementation of targeted subsidies it has not increased in comparison to other sectors, thus in the latter scenario, increasing electricity and gasoil prices in border prices level is considered.

Results and Discussion

Since every part in the Input - Output table for manufacturing product needs input of other sectors as intermediate input. In effect of increasing prices of petroleum products, electricity and natural gas as used input in other economic sectors, final price of products of these sectors will increase. Also any part for manufacturing its product use products of other sectors as intermediate input.

As mentioned in previous chapters, in order to study more detailed scenarios in agriculture sector, agricultural crops are divided into 12 subgroups: wheat, paddy, rice, sugar beet and sugar cane, industrial crops and other crops, horticultural crops, cattle, buffalo, sheep and other live animals, hen, chicken and other poultry, animal and poultry products, honey and other bee and silk products, forestry products and fish and other fishing products. Results of targeting energy carriers' subsidies on agricultural products in four studied scenarios are

in the below table 2.

By removing subsidies, the cost of various consumed energies, including electricity, gas and gasoil increased directly and in parallel to it, the current costs of production will increase. On the other hand, by removing subsidies, the cost of transporting raw materials to farms or factories and then costs of distributing product and deliver to the consumer will increase, which this matter cause to increase the prices of agricultural crops naturally. Since the energy of electricity and oil products are one of the most important inputs in agricultural sector and on the other hand, their consumption in the agricultural sector have been had increasing trend during the recent period. Therefore, by eliminating all agricultural subsidies, the prices of all agricultural crops will increase.

Based on the obtained results, among different sub sectors of agriculture, targeting energy subsidies and the rising carriers cost to the world price level by calculating dollar with its exchange rate (the first scenario) will follow the highest increase in the fishing price. After it, the cultivation and production of sugar beet, breeding hen, live chicken and other poultry, industrial plants and other horticultural products will experience largest increase 45.2, 40.8, 37.8 and 37.4 percent respectively and breeding paddy and producing rice, livestock products, poultry and bee and silkworm products will experience smallest price change 5, 20.1 and 23 percent respectively because of the energy price liberalization.

It is noteworthy that the major consumption of energy carriers in agriculture sector is related to electricity and gas. Water pumping for irrigation (agriculture, pumping again, and gravity and under pressure irrigation), water pumping for producing agricultural crops (horticulture, livestock, poultry, etc) and reproducing and breeding aquatics in inland waters including the electricity usages in agriculture sector. Other issues raised in the agricultural sector, energy consumption in dryers, as well as agricultural machineries, in which among them agricultural machineries have the important role in gasoil consumption, since the technology of producing these machineries is out of date and old, the usage of these machines is estimated 40% higher than the world norm.

Gas oil (diesel) in operations including plowing, disking, leveling and other operations like fertilize ring seeding, spraying and harvesting, which requires the use of machinery is generally used and totally it is consumed in sub sector of poultry and agriculture (cereals, legumes and vegetables) and greenhouse cultivations and breeding livestock and aquatics. Since the contribution of fishing and poultry in agricultural sub-sectors in the consumption of gas oil is higher, thus as it was also observed in the above results, optimizing fuel consumption in these activities, in order to attain saving in the consumption has high importance.

In the second scenario, if due to free rate of dollar, the cost of energy carriers increase to global prices, the prices of agricultural products increased approximately 2.5 times more than the previous scenario, and similarly, maximum price increases would be in fishing activity, the production of sugar beet, poultry, etc. horticultural products and other industrial plants.

According to approval of Islamic Parliament Commission, with a 38 percent increase in the price of the carriers, ie if the price of petrol, diesel and kerosene, fuel oil, electricity and gas increase up to £9800, £ 3500, £ 2800, £ 9800 291 and £ 840 respectively, the prices of agricultural products will increase as follows: wheat 18.1%, rice 5.3%, sugar 40.7%, other industrial crops 29.8% and other agricultural crops 16.3%, horticultural products 28.1% and cattle and buffalo23.7%,hen, chicken and other live poultry 34.6 percent, livestock products and poultry19%, honey and bees and silkworm products, 16.3 percent, forestry products 13.2 percent and fishing, 61.4%. In this scenario, the change percentage in different products is less than the first and second scenarios, but the comparison of the relative changes in the prices of different products due to the contribution of the different activities in consuming energy carriers is similar with two previous scenarios.

Also, as noted above, the major consumed carriers are gas oil and electricity (about 99% of consumed fuel in this sector is related to these two inputs). So increasing prices of the agricultural products by removing subsidies on energy carriers is more affected by gas oil and electricity, so in fourth scenario it accompany only with increasing gas oil and electricity prices up to the boundary prices (with free rate of dollars), and the results indicated that by increasing prices, there are similar effects with second scenario that it mean when the price of all energy carriers increase with free rate of dollar. The difference between these two scenarios is most noticeable in other sectors because the consumption of energy carriers in them is different.

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