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The Impact of Fuel Subsidy Targeting in Iran Using a CGE Model

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Abstract

Despite the implementation of the first phase of fuel subsidy targeting in December 2010, there are still debates over the economic impact of this project in Iran. A CGE model is used to analyze the impact of fuel subsidy targeting in Iran in four different scenarios. The data are used in the framework of SAM for the year 2001. In all scenarios, indirect subsidies are removed completely and replared with direct subsidies to households, manufacturing and service sectors and government institutions. The findings of this paper show that the effect of fuel subsidy targeting on economic variables depends on the way this policy is implemented. We find that an increase in the income of low-income household results in an increase in the production level of basic goods. Moreover, the result shows that the mining industry, glass and other non-metallic minerals and other service sectors have comparative advantages. In all senatrios, the elimination of in direct subsidies results in stagflation. The inflation rate resulted from this policy is predicted to be between 16.1 to 21.1 percent. Furthermore, in all senariors, higher direct payments of subsidies to households are associated with higher growth and inflation rates and lower balance of payments.

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1. Introduction

Subsidy policy and its impacts has always been a major concern of economic theory and policy. Governments may ignore the economic sector's efficiency to acheive a certain level of justice. However, because of administrative problems and negative economic effects of increasing indirect subsidies, many developing countries began some sort of subsidy reform program after 1980s. Subsidy reform, as one instrument of government fiscal policy, can affect the micro and macroeconomic variables in an economy.

Paying indirect subsidies in Iran, has had an upward trend. While the subsidies volume was 9.2% of GDP in 2001, the ratio increased to 28.9% in 2006. Nearly 90 percent of this ratio is related to the subsidy on energy carriers (Emami Meibodi et al., 2011). Oil-exporting countries are the major energy subsidizers. Among them Iran (after Russia) had the largest subsidies in dollar terms in 2005, it subsidized mostly oil products amounting to 37 billion USD in that year (IEA, 2007). The price controlling policy has had many detrimental social and economic effects including, draining and diverting public budget, substituting energy with other inputs in the production function, increasing energy consumption, decreasing foreign exchange revenues, and increasing the country's dependence on imports, undermining the investment in alternative energy sources and technologies, and finally causing environmental pollution (Mirshojaeian Hosseini & kaneko, 2012). It is interesting to note that in contrary to welfare goals of subsidies, indirect subsidies benefit the rich more than the poor, and hence subsidies are badly targeted.

In 2004, Iran's oil consumption was about 1.5 million barrels per day, which is equivalent to the consumption of oil in Spain. While GDP of Spain is seven times larger than that of Iran .In Iran, energy productivity is very low and energy intensity is very high. Energy productivity, is the ratio of GDP to the number of equivalent crude oil of energy consumption. This index for Iran was 238 US dollars in 2008. While the global average of this index is 736 US dollars and in Europe Union is about 1452 US dollars. Energy intensity measures units of energy per unit of gross domestic product (GDP). In 2008 4.2. But the global and European energy intensity indices for Iran are 1.4 and 0.7, respectively. In Saudi Arabia and China, this index, is 2.7 and 3.4 respectively (Ministry of Energy (MOE) 2008).

Although the implementation of the first phase of Iran's subsidy targeting started in December 2010, the debate over the positive and

negative impact of the project, is still continuing. Establishing the price mechanism is an important step in the development of different countries, but one of the major concerns of the subsidy reform - due to high inflation and low employment in Iran– is the inflationary effects of subsidy targeting followed by negative effects on production and employment.

In this paper, a static CGE model with classical approach and micro-economy simulation are used to predict micro and macroeconomic impacts of fuel subsidy targeting in Iran. In this study, Mixed Complementarity Problems (MCP) technique and GAMS-MPSGE software are used for computing the results. More specifically, we examine the impacts of the full subsidy targeting on dependent variables, namely, production, employment, price level, exports and imports.

In Rahiminia et al., (2015) the impact of changing the way of subsidy payment on the micro variables of domestic production and employment has been investigated in two different scenarios. In this paper four different scenarios are considered to investigate the effect of subsidies reform. The purpose of designing various scenarios in this study is to observe the economic variables response to changes in the share of household, manufacturing and government of repaying cash subsidy. Moreover, the dependent variables in this study include Gross Domestic Production, employment, price level, exports and imports at micro and macro levels. The study focuses on the cash subsidy repaid to households and manufacturing sectors, regarding full subsidy targeting.

Breisinger et al. (2012) have studied leveraging fuel subsidy reform in transition in Yemen. They show that overall growth effects of subsidy reduction are positive. However, the effect of subsidy reform on poverty depends on the way the reform is designed.

Lin and Jiang (2011) estimated energy subsidies in China and assessed the impact of energy subsidy reform by using a CGE model. Their findings show that removing energy subsidies will result in a significant fall in energy demand and emissions, but will have a negative impact on macroeconomic variables. They conclude that offsetting policies could be adopted so that certain shares of these subsidies are reallocated to support other sustainable development measures, which could lead to an energy intensity reduction and hence improve the quality of environment.

Akbari Moghadam (2012) studied the impact of subsidy targeting on rural and urban welfare in Qazvin Province in Iran. The subsidy targeting results show that the welfare of rural households in Qazvin Province

increases by 66.4% and the welfare of urban households in this province declines by 38.9%.

Khiyabani (2008) has designed a CGE model to examine the effects of energy carrier price increases in three different scenarios. The results show that the rising cost of energy carriers causes a decline of about 4.6 percent in production and about 6.9 percent decline in employment. It increases inflation by about 35 percent. One of the strengths of this study is considering various income groups of households. However, in this study, the cash subsidy refunds are not simulated.

Ariabod et al. (2013) have studied the effect of subsidy targeting of energy carriers on agricultural products by using a CGE model in Iran. The results of this paper indicated that in four scenarios, this policy has positive effect on agricultural products.

The structure of this paper is as follows. After the introduction, the CGE model is presented in Section 2. The results are reported in Section 3. Section 4 is concluding remarks.

2. CGE Mode

Computable General Equilibrium (CGE) model, taken from Walrasian's general equilibrium theory, is a major tool for the quantitative analysis of economic and public policy in the World (Can, 2011). These models accommodate the micro-consistent, systematic analysis of complex economic problems where analytical solutions are either not available or do not provide adequate information. Compared to analytical models, the CGE approach facilitates the analysis of complex economic interactions and the impact assessment of structural policy changes. Also, compared to partial equilibrium models, these models allow evaluating the adjustments of agents on both the supply and the demand side, reactions in the labor market, and changes in resource allocation across activities. "Moreover, CGE models capture the major budget constraints of an economy, particularly the balance of payment and the macroeconomic constraints; as well as the distributional impact on households in terms of both income and welfare" (Bohringer et al., 2004; Müller and Ferrari, 2011). "CGE models taking into account economic sectors, provides a versatile empirical simulation laboratory for analyzing quantitatively the effects of economic policies and external shocks on the domestic economy within a system that is associated with all sectors of the economy and the whole world" (Robinson et al., 1999; Lofgern and Robinson, 1999). The main

advantage of these models is that of market reactions related to price, show compatible with wisdom level (Ariabod et al., 2013). Policy variables in these models can take many forms, such as tax rates, subsidy policies, trade policy, environmental policy, etc.

2.1. SAM Calculated for the Model

Economic simulation of a CGE model and data collection are the first important steps of modelling. The initial data of these models are collected in a square matrix (Social Accounting Matrix (SAM)), and CGE model establishes the relation between accounts of SAM into a set of simultaneous nonlinear equations, by using the modern general equilibrium theory (Can, 2011). The base data are used in the framework SAM year 2001. Researchers have calculated SAM for CGE model of the study, using Input-Output table (Statistical Center of Iran, 2001) and some supplementary data from Banoee (2012) and national accounts statistics. The general form of the SAM is given in Appendix (1). The SAM used in the model is described shortly below.

We aggregate all goods of Input-Output 2001 into 15 types: 1: crops and horticulture; 2: livestock, forestry, fishing; 3: the mining industry; 4: food industry; 5: leather and tanning; 6: wood, paper and publishing; 7: chemicals, rubber products, and petroleum; 8: glass and other non-metallic mineral; 9: basic metals and metal products; 10: machine tools; 11: other Industries; 12: water, electricity and gas; 13: building; 14: transport; 15: other Services. Manufacturing and service activities and corresponding goods and services have been divided into 15 general groups in the SAM of this model. An important assumption in our calculated SAM is that each manufacturing activity only produces its corresponding product.

The production factors of the model are capital and labor factors, and these are combined to produce added value. Economic activities combine intermediate goods and added value to produce final products. These products are devoted to domestic sale and export. On the other hand, the commodities existing in domestic market include imported goods and domestic products. All of this information is contained in the SAM and presented in a summary form in table 1. The information of table (1) demonstrates that other services sector has the most share of added value of production factor and total production. In addition, the mining industry and machine tools products have the most share of export and import total respectively. Notice that the building sector has not the share of neither of

export and import. Also, the share of water-electricity-gas sector in import is zero. In the end, the share of wood-paper-publishing and water-electricity-gas sectors in export is high low (.0001).

Table 1. The Share of Economic Sectors in Added Value, Total Production, Export and Import

Manufacturing and service sectors	Share of sector in added value	Share of sector in total production	Share of sector in export	Share of sector in import
Crops and horticulture	.085	.072	.057	.082
Livestock, forestry and fishing	.038	.052	.007	.003
The mining industry	.174	.109	.681	.009
Food	.037	.084	.011	.079
Leather and Tanning	.012	.021	.052	.083
Wood, paper and publishing	.005	.007	0 (.0001)	.023
Chemicals, rubber products, and petroleum	.034	.045	.092	.162
Glass and other non-metallic mineral	.013	.017	.008	.008
Basic metals and metal products	.019	.036	.021	.083
Machine tools	.016	.024	.001	.232
Other Industries	.019	.042	.008	.152
Water, electricity and gas	.013	.021	0 (.0001)	0
Building	.047	.077	0	0
Transport	.047	.052	.034	.047
Other Services	.451	.341	.022	.035

Source: Research computing in SAM

Government and households are the model institutions; the companies' institution is not considered in the modeling study. Also Households are classified into urban and rural households. The income of production factor is the most important fraction in household revenue. The share of urban and rural households of production factor are presented in

table 2. The households' income is allocated to tax, consumption and saving. We bring the percentage of household income that is allocated to the tax in table 3.

Table 2. The Households' Share of Production Factor (Percent)

Household	Share of capital factor	Share of labor factor
Urban households	80.5	80.5
Rural households	19.5	19.5

Source: Banoee (2012)

Table 3. The tax rate of household income (percent)

	Urban households	Rural households
The tax rate of income	4.80	3.15

Source: Banoee (2012)

The parameters of the model are divided into free and calibrated parameters. Calibrated parameters of the model are obtained from the calibration procedure and free parameters are obtained from previous internal studies of Iran.

2.2. CGE Model Relation

The CGE models have optimization in the behavior of consumer and producer, which is the most striking advantage of the models. The theory of consumer and producer behavior brings about demand and supply equations of good and factor markets. The set of the model's equations are obtained of these equations along with some of the macroeconomic laws, such as the model constraints. In the model of this study, households are the owners of production factors and earn income from the sale of labor and capital factors. Income of households after income taxes deducting is spent on the consumption of goods and services and the rest is saved. So producers earn income from the sale of their product and spend it to pay the purchase production factors and intermediate materials. In this model, households maximize the Cobb-Douglas utility function with regard to budget constraints which is shown in equation (1):

$$\text{MAX} \quad U = \prod_{c=1}^{n} QH_{ch}^{B_{ch}^{m}} \quad , \ \sum_{c=1}^{n} B_{ch}^{m} = 1 \qquad (1)$$

$$\text{S.t} \quad , \sum_{c=1}^{n} \text{PQ}_c . \text{QH}_{ch} = \text{M}_h$$

Where:

U Denotes the utility function of households; QH_{ch} household consumption of products; PQ_c price of products; $\text{B}_{\text{ch}}^{\text{m}}$ marginal household expenditure share of products and M_h household income.

Therefore, the producers maximize their profits according to layer production function. Figure 1 shows the layer production function considered in this model.

Equation (2) and (3) define the production technology. Products are performed by using intermediate materials, primary inputs and production factors. In the first phase of production, manufacturers combine intermediate materials and primary inputs by using Cobb-Douglas function. Added value by production factors is provided (Leontief function). Finally the manufacturer produces final goods with combined aggregated intermediate goods and added value (using Leontief function). All in all, these parts are satisfied with zero profit condition.

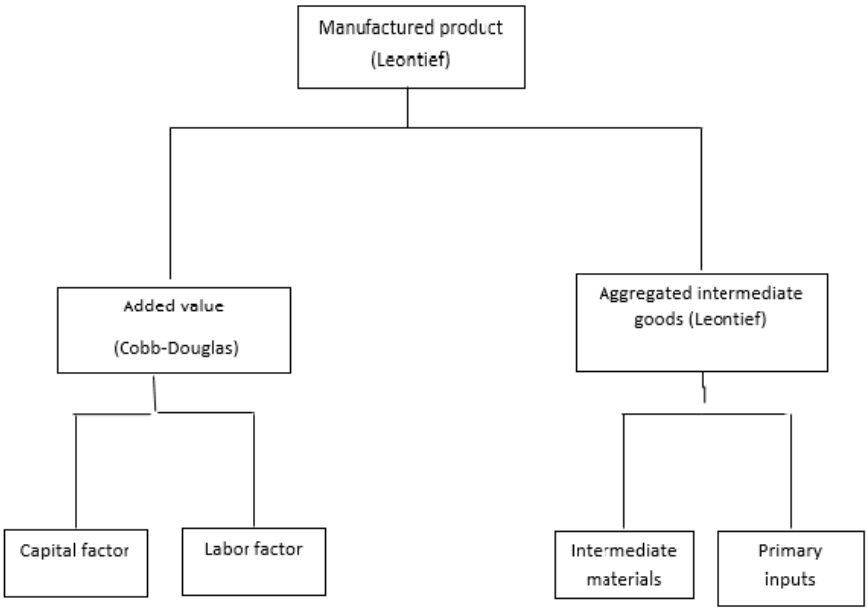

Figure 1. Layer Production Structure in Studying the Model

$$\mathrm{QINTA_a} = \mathrm{inta_a}.\mathrm{QA_a} \quad (2)$$

$$\mathrm{QVA_a} = \prod_{\mathrm{f=1}}^{\mathrm{m}} \mathrm{QF_{fa}^{a_i}} \quad ,\sum_{\mathrm{i=1}}^{\mathrm{m}} \mathrm{ai} = 1 \quad (3)$$

Where:

$\mathrm{QINTA_a}$ Denotes intermediate input demand; $\mathrm{QA_a}$ domestic output; $\mathrm{QVA_a}$ added value; QF_{fa} factor demand; $\mathrm{inta_a}$ input-output coefficients and a_i CES function shift parameter.

The goods produced by domestic manufacturers, are exported and/or supplied to the domestic market. Domestic manufacturers maximize their income by transfer the function with constant elasticity (CET). The elasticity of substitution between exports and domestic sales of domestic products has been used in previous studies (Akbari Moghadam, 2012). Equation (4) shows the allocation of commodity (C) between export and domestic sales:

$$\mathrm{QX_c} = a_c^t.(\delta_c^t.QE_c^{p_c^t} + (1+\delta_c^t).QD_c^{p_c^t})^{\frac{1}{p_c^t}} \quad (4)$$

The supplied goods and services to the domestic markets include domestic producers and imported goods which create the final supplied products to the domestic market, as the Armington Supply. The substitution degree between domestic and imported goods (Armington elasticity) has been obtained from domestic studies. Armington function is of CES that is shown in equation (5):

$$QQ_c = a_c^q.(\delta_c^q.QM_C^{-p_c^q} + (1-\delta_c^q).QD_C^{-p_c^q})^{\frac{-1}{p_c^q}} \quad (5)$$

Where:

$\mathrm{QX_c}$ is the domestic production; QE_c exports; QD_c domestic consumption of domestic output; QQ_c composite goods supply; QM_c imports; a_c^t CET function shift parameter; δ_c^t CET function share parameter; p_c^t CET function exponent; a_c^q CES function shift parameter; δ_c^q CES function share parameter and p_c^q CES function exponent. The CGE models contain numerous assumptions and complicated mathematical equations, therefore the majority of them are omitted intentionally in this article.

In total, a CGE model can be cast as a mixed complementarity problem (MCP). For illustration, consider a standard Arrow-Debreu economy with n commodities (incl. factors), m sectors and h households

(incl. government). The CGE models endogenous variables can be classified into 3 categories: P, Y and M stand for prices n-vector of all goods and factors (non-negative), a non-negative m-vector for activity levels of CRTS-production sectors and incomes k-vector (non-negative) respectively. On the other hand, in the equilibrium, the variables must fulfill three classes of condition:

1. Zero profit condition of CRTS-producers:

$$\pi_j(p) = R_j(p) - C_j(c) = 0 \quad (6)$$

2. Market clearance for all goods and factors:

$$\sum_j y_j \frac{\partial \pi_j(p)}{\partial p_i} + \sum_n b_{ih} = \sum_h d_{ih} \quad (7)$$

3. The balance of income and expenditure of households (budget constraints for households (incl. government)):

$$\sum_h p_i b_{ih} = M_h = \sum_h p_i . d_{ih} \quad (8)$$

Where:

π_j, R_j and C_j stand for the unit profit function, the unit costs function and the unit revenue function; b_{ih} the initial endowment of household h with commodity; d_{ih} the demand for good I by household h maximizing utility and p_i price of composite goods.

Thus, features of economic equilibrium relate the equilibrium variables to equilibrium conditions (Bohringer et al., 2004; Rutherford 1995; Rutherford 1999).

2.3. Model Policy Variables and Examined Scenarios

In this study, the indirect subsidies paid to the manufacturing and service sectors of the economy are removed and subsequently the subsidies are repaid directly with different proportions to households, productive sectors and government in four scenarios. The indirect subsidies paid are not available according to the classification and the separation of the manufacturing and service sectors in Iran. So another approach is used to estimate the subsidies paid to these sectors. Energy subsidies in Iran, included about 92 percent of total subsidies (Energy balance of Iran,

different years). Figure 2 shows the energy subsidies paid to the macro economic sectors. Estimated subsidy paid to the manufacturing and service sectors is one of the most important portions in this investigation.

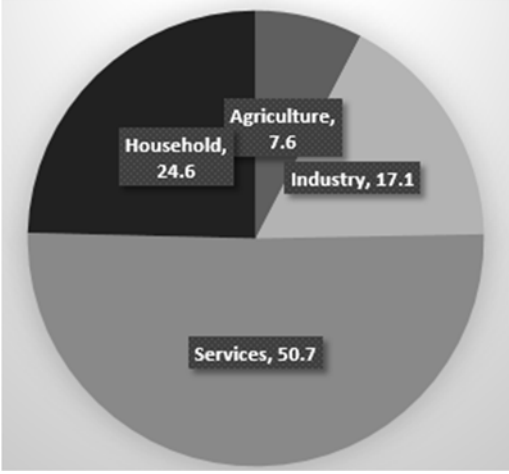

Figure 2. The Subsidies Paid to the Separate Macroeconomic Sectors (Percent)

Source: Energy balance of Iran, 2007-2008

However, in addition to another assumption, it can be assumed that the subsidies paid to the macro economic sectors are equal to energy subsides paid to these sectors. Therefore, the subsidies paid to the separation of manufacturing and service sectors considered in the present research have been estimated. Table 4 shows the share of subsidized economic sectors:

Table 4. The Share of Subsidized Economic Sectors of Total Production Subsidies (Percent)

Manufacturing and service sectors	The subsidies paid-percent
Crops and horticulture	4.24
Livestock, forestry and fishing	5.86
The mining industry	0.37
Food	5.57
Leather and Tanning	1.35
Wood, paper and publishing	0.38

Manufacturing and service sectors	The subsidies paid-percent
Chemicals, rubber products, and petroleum	2.27
Glass and other non-metallic mineral	0.87
Basic metals and metal products	2.26
Machine tools	1.36
Other Industries	2.74
Water, electricity and gas	1.13
Building	4.4
Transport	16.31
Other Services	50.89
Total subsidy	100

Source: Research computing

Examined scenarios in this study are as the followings:

- First scenario: Full remove of the indirect subsidies and its direct payment to the proportions of 50, 30 and 20 percent to the households, economic sectors (manufacturing and service sectors) and the government, respectively (In accordance with the targeting subsidy law in Iran).
- Second scenario: Full remove of the indirect subsidies and its direct payment to the proportions of 60, 20 and 20 percent to the households, economic sectors (manufacturing and service sectors) and the government, respectively.
- Third scenario: Full remove of the indirect subsidies and its direct payment to the proportions of 80, 10 and 10 percent to the households, economic sectors (manufacturing and service sectors) and the government, respectively.
- Fourth scenario: Full remove of the indirect subsidies and its full payment in cash (direct) to the urban and rural households. The share of cash subsidies for urban and rural households is given according to their population proportions, (this data has been taken from the Iran Statistical Center).

3. Results

In this section, the outputs of the programs written in GAMS-MPSGE software are reviewed and analyzed subsequently. The CGE model used

in this study is based on the classical approach and the factor market equilibrium are at full employment level. Supply of production factors are fixed and demands of factors are endogenous in the model that is the classical closure of the model. The results of employment changes in different economic sectors, according to changes in the sectors demand of labor are calculated. Moreover, the GDP at current prices is calculated.

3.1. The Microeconomic Impact of Different Scenarios

Table 5 shows the results of the production changes in manufacturing and service sectors in the scenarios presented. As it is apparent from the results, in the aforementioned four scenarios, most economic sectors are faced with a decline in production. In all scenarios, the greatest decrease is observed in the transport sector products. After this, the wood-paper-publishing and basic metals-metal products sectors are faced with the greatest decrease in production. This shows more dependence of these sectors to the energy subsidies. The production decline is minimal in glass-other non- metallic mineral products, but the mining industry products are faced with production growth in all scenarios.

Through comparing the results of the different scenarios some interesting points are noticed. By moving from the first scenario to the fourth scenario, the more direct the subsidy is paid to households, the more there will be an increase in income of low-income households, and so their consumption of basic goods will increase too. Thus, production reducing rates of food, leather-tanning, including the apparel following section, and agricultural crops, including sectors 1 and 2, decrease from the first scenario to the fourth one.

On the other hand, because of rise in the government revenue in the first scenario through the fourth one and demand increases for other services, products (Given that most of the government consumption is from other services products), other services sectors production increases in the first scenario but decreases in fourth one.

Table 5. Production Changes of Economic Sectors in the Studied Scenarios (Percent)

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Crops and horticulture	-5.5	-5.1	-0.4	+4.2

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Livestock, forestry and fishing	-10.3	-10.9	-8.7	-6.5
The mining industry	+13.2	+15.9	+20.1	+24.6
Food	-10	-10.6	-8	-5.5
Leather and Tanning	-13.8	-14.6	-11.5	-8.7
Wood, paper and publishing	-14.2	-15.9	-16.6	-17.4
Chemicals, rubber products, and petroleum	-6.3	-6.7	-4.8	-3.1
Glass and other non-metallic mineral	-0.7	-0.8	-0.7	-0.6
Basic metals and metal products	-12.9	-14.5	-15.2	-16.2
Machine tools	-11.7	-13	-13.5	-14.1
Other Industries	-12	-13	-12	-11.2
Water, electricity and gas	-5	-5.4	-4.7	-3.9
Building	-	-0.1	-0.4	-0.7
Transport	-19.9	-23	-25.7	-28.6
Other Services	+1	+0.3	-3	-6.4

Source: Research results

In table 6, the results of employment changes, as demand changes of labor factor, in manufacturing and service sectors have been demonstrated in the scenarios presented. The expectation is that when the production level has been reduced in most sectors (table 5), labor demand will be reduced too (table 6). The results show that similar to production changes, the greatest decrease of employment is in the transport sector. After this, in scenario 1 and 2, the greatest decrease of employment is seen in the leather and tanning sector. But by increasing the income of low-income households in the scenarios 3 and 4, production and employment increased in the leather and tanning sector, so the wood-paper-publishing sector has the sharpest decline in employment in these scenarios. Following wood-paper-publishing sector, basic metals and metal products sector are faced with the greatest employment decrease in all scenarios.

The only part in which employment increases in all scenarios is mining industry sector. The employment growth rate in these scenarios are 0.8, 1, 1.2 and 1.5 percent respectively.

With the increase in government institution revenue from payment, decreasing of subsidy in the third, the second and the first scenarios respectively, the government's demand increases for service, products, and employment level of the sector will improve in the country (highest share of total employment in the service sector = 57 percent in base SAM).

Table 6. Employment Changes of Economic Sectors in the Studied Scenarios (Percent)

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Crops and horticulture	-1.7	-1.6	-0.1	+1.4
Livestock, forestry and fishing	-1.6	-1.7	-1.3	-1
The mining industry	+0.8	+1	+1.2	+1.5
Food	-0.7	-0.8	-0.6	-0.4
Leather and Tanning	-1.5	-1.6	-1.2	-0.9
Wood, paper and publishing	-1.3	-1.4	-1.5	-1.6
Chemicals, rubber products, and petroleum	-0.3	-0.3	-0.2	-0.2
Glass and other non-metallic mineral	-0.1	-0.1	-0.1	-0.1
Basic metals and metal products	-1.2	-1.3	-1.4	-1.4
Machine tools	-0.7	-0.8	-0.8	-0.8
Other Industries	-0.6	-0.7	-0.6	-0.6
Water, electricity and gas	-1	-1.1	-0.9	-0.8
Building	-	-	-0.1	-0.1
Transport	-5.6	-6.8	-7.6	-8.4
Other Services	+0.4	+0.1	-1.1	-2.4

Source: Research results

The results in Table 7 show that how price level of domestic production will change after subsidy targeting in all the studied scenarios. The model used is a classic model. Therefore, the relative price of domestic

products is calculated. The numerator of prices (the base price) is the real wage of labor. The results of table 7 show that the highest increase in the price level happens in the transport sector in all of the scenarios. In the aforementioned four scenarios, prices of transport products increase by 56.1, 69.1, 82 and 95.3 percent respectively. Livestock-forestry-fishing, wood-paper-publishing, other services and food sectors–after the transport sector--have the highest increase in prices level respectively. Price levels of chemicals--rubber products--petroleum and glass-other non-metallic mineral products have the lowest increase in the four scenarios. And the mining goods are faced with price levels reducing equal to 18.9, 22, 23.7 and 24.4% respectively in the scenarios presented.

The results of table 7 are extracted according to the production possibilities curve and show the opportunity cost of production or non-production of products. Based on the results of table 7, production in the transport sector has a high opportunity cost for Iran and the mining sector has a comparative advantage in the production.

By comparing the different results of scenarios in table 7, it is found that with the increase in household income from the first scenario to the fourth one, there would be an increase in goods and services demand, and the rise in prices is resonant too.

Table 7. Price Level Changes (Domestic Production) of Economic Sectors in the Studied Scenarios (Percent)

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Crops and horticulture	+8.1	+9.3	+8.9	+7.7
Livestock, forestry and fishing	+20	+23.4	+25.5	+26.6
The mining industry	-3.9	-4.4	-6	-8.2
Food	+16.8	+19.5	+21	+21.5
Leather and Tanning	+14.1	+16.3	+16.8	+16.6
Wood, paper and publishing	+19.3	+22.5	+24.4	+25.5
Chemicals, rubber products, and petroleum	+5.3	+6.2	+5.8	+4.6
Glass and other non-metallic mineral	+5.8	+6.7	+6.4	+5.2
Basic metals and metal products	+12.1	+14	+14.5	+14.4
Machine tools	+10.9	+12.7	+13	+12.5

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Other Industries	+13.8	+16	+16.8	+16.9
Water, electricity and gas	+13.7	+16	+16.6	+16.2
Building	+10.8	+12.5	+12.8	+12.3
Transport	+56.1	+69.1	+82	+95.3
Other Services	+18.9	+22	+23.7	+24.4

Source: Research results

The results in table 8 present changes in export of economic sectors in the studied scenarios. These results show that the mining industry, chemicals-rubber products-petroleum and other services products are faced with an increase in export, and other economic sectors have a decline in export. In other words, these sections have a relative advantage in export. The greatest decreases are observed in the wood-paper-publishing, food and transport sectors.

But export changes in cross-horticultural and chemicals-rubber products-petroleum sectors are not the same as in all scenarios. While the crops and horticulture export decrease by 3.67 and 2.95% respectively in the first and the second scenarios, they increase in the third and the fourth equal to 2.67 and 8.6 percent. In addition, chemical, rubber products and petroleum sector exports have an increase equal to 0.29 percent and have decreased in the other one. Export of the building section in the SAM of the base year is zero Rials. Thus the balance remained unchanged after the subsidy shocks.

Table 8. Export Changes of Economic Sectors in the Studied Scenarios (Percent)

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Crops and horticulture	-3.67	-2.95	+2.67	+8.6
Livestock, forestry and fishing	-19.29	-21.17	-20.72	-20.32
The mining industry	+21.34	+25.07	+30.11	+35.64
Food	-25.49	-27.98	-28.18	-28.45
Leather and Tanning	-21.51	-23.26	-21.49	-19.99
Wood, paper and publishing	-34.13	-37.63	-40.2	-42.66

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Chemicals, rubber products, and petroleum	-0.29	+0.1	+2.84	+5.51
Glass and other non-metallic mineral	+3.72	+4.36	+5.81	+7.31
Basic metals and metal products	-18.25	-20.38	-21.39	-22.59
Machine tools	-16.71	-18.57	-19.28	-20.08
Other Industries	-20.78	-22.84	-23.12	-23.64
Water, electricity and gas	-18.82	-20.93	-21.43	-21.86
Building	-	-	-	-
Transport	-25.08	-28.57	-31.02	-33.69
Other Services	+4.27	+4.51	+3.87	+3.19

Source: Research results

In the last table of the micro results, import exchanges of economic sectors are shown. The mining section imports are faced with a decline in all scenarios with 14.63, 16.36, 17.24 and 18.09 respectively. And this corresponds to a decrease in the relative prices of the products in this sector. The lowest increase in imports is related to products of machine tools and horticulture sectors. Also imports remained unchanged for the building sector because its import in the SAM used is zero. The chemicals, rubber products and petroleum section imports are reduced in the first and the second scenarios, but increase in the third and the fourth ones. On the other hand, other sectors are faced with the increase of import in the scenarios presented.

The results of table (9) show that by reducing the shares of government and production of releasing subsidies, import has increased in most economic sectors. The reason for that is raising the price of domestic products relative to foreign products.

Table 9. Import Changes of Economic Sectors in the Studied Scenarios (Percent)

Manufacturing and service sectors	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
Crops and horticulture	+6.28	+8.38	+14.14	+20.07

Livestock, forestry and fishing	+24.84	+30.18	+40.11	+50.33
The mining industry	-14.63	-16.36	-17.24	-18.09
Food	+18.79	+22.9	+31.37	+40.19
Leather and Tanning	+11.8	+14.74	+21.8	+29.21
Wood, paper and publishing	+18.06	+21.14	+25.76	+30.57
Chemicals, rubber products, and petroleum	-1.2	-0.91	+1.39	+3.64
Glass and other non-metallic mineral	+6.86	+7.84	+8.78	+9.52
Basic metals and metal products	+27.14	+28.48	+30.41	+32.52
Machine tools	+5.03	+5.92	+7.42	+8.9
Other Industries	+10.28	+12.43	+17.03	+21.89
Water, electricity and gas	+18.54	+21.82	+25.99	+29.88
Building	-	-	-	-
Transport	+90.21	+113.36	+142.17	+176.19
Other Services	+37.58	42.84	+43.87	+44.64

Source: Research results

3.2. The macroeconomic impact of different scenarios

In table 10, the impact of full targeting subsidies on the GDP, inflation rate, the total export level and import have been demonstrated in presenting scenarios.

Table 10. The Impact of Full Targeting Subsidies on the Macroeconomic Variables in the Studied Scenarios (Percent)

Description	First Scenario	Second Scenario	Third Scenario	Fourth Scenario
GDP	-3.05	-3.41	-3.40	-2.78
The general prices level (CPI index)	16.1	18.9	20.4	21.1
The total export level	+11.41	+13.64	+17.62	+21.91
The total import level	+13.79	+16.59	+21.44	+26.65

Source: Research results

Some important hints are concluded from table 10. As it is discerned from table 10, GDP level at current prices in the studied scenarios has

fallen to 3.05, 3.41, 3.40 and 2.78% respectively. By comparing scenarios 1 and 4, it is deduced that, by the increase of direct subsidies paid to households in scenario 4 and consequently by the demand increase from households for goods and services, the GDP growth rate will increase from -3.05 to -2.78 percent. In other words, the GDP decline is reduced by 0.27 percent. Due to the increase in the general level of prices, more increase the GDP level at constant prices is expected than the measure at current prices. The reality statistics of the GDP level at constant prices were announced in 2011 and 2012 at 0.3 and -5.8 percent respectively (Central Bank of Iran, 2013). The measure was announced in 2013 as -2.2 percent (Statistical Center of Iran, 2014). Of course, other factors have a role in these statistics along with the subsidy targeting.

Also with moving from the first to the fourth scenario, inflation rate based on consumer price index (CPI) has an upward trend, and this is due to the increase of household consumption demand. Namely, moving from the first to the fourth scenario, household income increases, their demands of goods and services grow and finally prices of goods and services will rise. The results forecast that inflation rate in the studied scenarios equal to 16.1, 18.9, 20.4 and 21.1 percent respectively. The results of inflation rate are only of subsidy targeting channel. But the reality statistics of inflation rate were announced in 2011, 2012 and 2013 as 12.4, 21.5 and 30.5 percent respectively (Central Bank of Iran, 2014). Because of the economic situation, further increases in reality of inflation rate compared to the results of this investigation, such as economic sanctions, the stagflation of economics is one of the important results of this study in all scenarios.

Despite the decline in exports in most economic sectors (Results of Table 8), but total exports have increased in all scenarios. The reason is the high share of the mining industry and glass and other non-metallic mineral sections of total exports in the SAM of the base year. In SAM used, the share of the mining industry and glass and other non-metallic mineral sectors of total export according to Rials value is 68 and 0/9 percent respectively. In the first scenario through the fourth, total export has an upward trend so that in the four scenarios 11.41, 13.64, 17.62 and 21.91 percent increase is observed in total exports respectively. Also, with the increase in household demand in the last scenario, total import increases. The increase in imports in the four scenarios examined is 13.79, 16.59, 21.44 and 26.65 percent respectively.

The results of table 10 show that the total import level increases more than the total export in all scenarios. A further increase in the import level rather than the export level shows that the balance of payments is decreasing for the country. One of the other considerable points in the results of table 10 is that going from the first to the fourth scenarios, the difference between imports and exports increases and the country's balance of trade deficit increases. It means the country's foreign currency entry declines and floating exchange rate rises.

4. Conclusion

In this paper, we predict the fuel subsidy targeting effects on the micro and macro-economic variables in Iran. The purpose of considering different scenarios in this study is to observe the response of economic variables to increase or decrease in the share of households, production and government of releasing subsidies. Results show that volatility in the share of these sectors can affect the economic variables. These results are discussed briefly below:

- The results of this study predict the inflationary effects of fuel subsidy targeting based on the CPI index in different scenarios from 16.1 to 21.1 percent. It means increasing the share of household in releasing subsidy refunds, positively affects the price level.
- Gross domestic product at the current price increases by moving toward the last scenario. So that GDP growth in the fourth scenario is 27 percent more than that in the first scenario. In edition an increase the household's share and a decrease in the share of government and production from releasing subsidies has a positive effect on the production of basic goods and has a negative effect on the production of other products. Thus, it is recommended that policy makers pay attention to this important findings in cash subsidy repaid to manufacturing and service sectors.
- The findings of this study suggests that by adjusting subsidies, the balance payment will decrease. Moreover, decreasing the share of manufacturing sectors from subsidies, increases the balance of payments deficit in Iran.
- According to our results, we cannot determine the best scenario for subsidy targeting unless the authorities identify their targets first.

Moreover, the result shows that the mining industry, chemicals-rubber products-petroleum and other services sectors are internationally competitive. In all senatrios, the elimination of in direct subsidies results in stagflation. The inflation rate resulted from this policy is predicted to be between 16.1 to 21.1 percent. Furthermore, in all senariors, higher direct payments of subsidies to households are associated with higher growth and inflation rates and lower balance of payments.

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Appendix 1: Schematic Social Accounting Matrix (SAM) in This Study

	Activities	Commodities	Factors	Households	Government	Capital	Rest of world	Aggregate
Activities		Domestic sales						Activities revenues
Commodities	Intermediate inputs			Private consumption	Government consumption	Investment	Exports	Aggregate demand
Factors	Value added							Factors revenues
Households			Households Income of factors		Direct subsidies to households			Households revenues
Government	Indirect subsidies	Import tariffs	Government revenue of factors	Income taxes				Government revenues
Capital				Private savings	Government savings		Foreign savings	Saving
Rest of world		Imports						Currency out
Aggregate	Activities expenditures	Aggregate supply	Factors expenditures	Households expenditures	Government expenditures	Capital expenditures	Currency entry	

Source: Rahiminia et al. (2015)

Appendix 2: Mathematical Equations of Model (Lofgern et al., 2002), With the Required Changes in Practical Model.

$$PA_a = \sum PXAC_{ac} \quad (1)$$

$$PINTA_a = \sum_{c \epsilon C} PQ_c \,.\, ica_{ca} \quad (2)$$

$$PVA_a = PA_a - \sum_{c \epsilon C} PQ_c \,.\, ica_{ca} \quad (3)$$

$$\mathrm{PA_a}.(1 - ta_a).\mathrm{QA_a} = \mathrm{PVA_a}.\mathrm{QVA_a} \ + \mathrm{PINTA_a}.\mathrm{QINTA_a} \quad (4)$$

$$\mathrm{PE_c} = \mathrm{pwe_c}.(1 - te_c).\mathrm{EXR} \quad (5)$$

$$\mathrm{PM_c} = \mathrm{pwm_c}.(1 + \mathrm{tm_c}).\mathrm{EXR} \quad (6)$$

$$PDD_c = PDS_c + \sum_{c'} PQ_c . icd_{c',c} \quad (7)$$

$$PX_c = \frac{PDD_c . QD_c + PE_c . QE_c}{QX_c} \quad (8)$$

$$PQ_c = \frac{PDD_c . QD_c + PM_c . QM_c}{QQ_c} \quad (9)$$

$$\mathrm{QINTA_a} = \mathrm{inta_a}.\mathrm{QA_a} \quad (10)$$

$$\mathrm{QVA_a} = \prod_{\mathrm{f=1}}^{\mathrm{m}} \mathrm{QF_{fa}^{a_i}} \quad , \quad \sum_{\mathrm{i=1}}^{\mathrm{m}} \mathrm{ai} = 1 \quad (11)$$

$$\mathrm{WF_k}.WFDIST_{ka} = \mathrm{PVA_a}.\mathrm{QVA_a}.\mathrm{a_i}.\mathrm{QF_{ka}^{-1}} \quad (12)$$

$$\mathrm{WF_l}.WFDIST_{la} = \mathrm{PVA_a}.\mathrm{QVA_a}.\mathrm{a_i}.\mathrm{QF_{la}^{-1}} \quad (13)$$

$$\mathrm{QX_c} = a_c^t.(\delta_c^t.QE_c^{p_c^t} + (1+\delta_c^t).QD_c^{p_c^t})^{\frac{1}{p_c^t}} \quad (14)$$

$$\frac{\mathrm{QE_c}}{\mathrm{QD_c}} = \left[\frac{\mathrm{PE_c}}{\mathrm{PDS_c}}.\frac{1-_{\delta_c^t}}{\delta_c^t}\right]^{\frac{1}{p_c^t-1}} \quad (15)$$

$$QQ_c = a_c^q.(\delta_c^q.QM_C^{-p_c^q} + (1-\delta_c^q).QD_C^{-p_c^q})^{\frac{-1}{p_c^q}} \quad (16)$$

$$\frac{\mathrm{QM_c}}{\mathrm{QD_c}} = \left[\frac{\mathrm{PDD_c}}{\mathrm{PM_c}}.\frac{\delta_c^q}{1-\delta_c^q}\right]^{\frac{1}{1+p_c^q}} \quad (17)$$

$$\mathrm{PQ_c}.\mathrm{QH_{ch}} = \beta_{ch}^m.\mathrm{EH_h} \quad (18)$$

$$QINV_c = \overline{IADJ}.qinv_c \quad (19)$$

$$QG_c = \overline{GADJ}.qg_c \quad (20)$$

$$QQ_c = \sum_a QINT_{ca} + \sum_h QH_{ch} + qg_c + QINV_c \quad (21)$$

$$YF_f = \sum_a WF_f . WFDIST_{fa}.QF_{fa} \quad (22)$$

$$YF_{hf} = shif_{hf}.\sum_a WF_f . WFDIST_{fa}.QF_{fa} \quad (23)$$

$$\mathrm{YL_h} = \sum_{\mathrm{f\in F}} \mathrm{YF}_{hf} + \sum_i tr_{h,i} \quad (24)$$

$$YG = \sum_{\mathrm{h}\in\mathrm{H}} \overline{\mathrm{TINS_h}} \,.\, \mathrm{YL_h} + \sum_c tq_c (PDD_c . QD_c + PM_c . QM_c) + \sum_{\mathrm{c}\in\mathrm{C}} \mathrm{tm_c} \,.\, \mathrm{QM_c} . pwm_c . \mathrm{EXR} + \sum_{\mathrm{c}\in\mathrm{C}} \mathrm{te_c} \,.\, \mathrm{QE_c} . pwe_c . \mathrm{EXR} + \sum_a ta_a . PA_a . QA_a \quad (25)$$

$$EG = \sum_{\mathrm{c}\in\mathrm{C}} \mathrm{PQ_c} \,.\, \mathrm{QG_c} + \sum_i tr_{i,gow} \quad (26)$$

$$YG = \sum_{\mathrm{h}\in\mathrm{H}} \overline{\mathrm{TINS_h}} \,.\, \mathrm{YL_h} + \sum_c tq_c (PDD_c . QD_c + PM_c . QM_c) + \sum_{\mathrm{c}\in\mathrm{C}} \mathrm{tm_c} \,.\, \mathrm{QM_c} . pwm_c . \mathrm{EXR} + \sum_{\mathrm{c}\in\mathrm{C}} \mathrm{te_c} \,.\, \mathrm{QE_c} . pwe_c . \mathrm{EXR} + \sum_a ta_a . PA_a . QA_a = \sum_{\mathrm{c}\in\mathrm{C}} \mathrm{PQ_c} \,.\, \mathrm{QG_c} + \sum_i tr_{i,gow} + \mathrm{GSAV} \quad (27)$$

$$\sum_{a\in A} QF_{fa} = \overline{QFS_f} \quad (28)$$

$$\sum_h mps_h . (1 - ty_h) . YL_h + GSAV + FSAV . EXR = \sum_{c\in C} PQ_c . QINV_c \quad (29)$$

$$\sum_{c\in CM} pwm_c . QM_c = \sum_{c\in CM} pwe_c . QE_c + \overline{FSAV} \quad (30)$$

$$CPI = \sum_c PQ_c \,.\, cwts_c \quad (31)$$