A General Equilibrium Analysis of Alternative Scenarios for Food and Energy Subsidy Reforms in Iran

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Abstract

In 1996 the government of Iran submitted its application to join the World Trade Organization (WTO). To meet WTO obligations, the government has launched several market-oriented reforms to deal with existing distortions such as heavily subsidized food and petroleum products. From the beginning of 2002, the Iranian government committed itself to implementing subsidy policy reform intended to adjust distortions and structural imbalances. However, the impact of the reform on needy and vulnerable households was a source of concern. In this paper we use the GTAP7inGAMS static CGE model with 20 household types in rural and urban areas, grouped according to income, to simulate the welfare impacts of subsidy policy reform in Iran. The static GTAP7inGAMS model is calibrated using the GTAP 7 database representing the world economy for 2004. Subsidy rates were adjusted by incorporating protection data prepared by Iranian statistical centers, and the Petroleum and Coal Products (p-c) sector in the GTAP7 database was disaggregated into four energy commodities: gasoline, diesel, kerosene and fuel oil, since the initial level of subsidies on these energy commodities reported by Iranian statistical centers are quite different from each other. Results indicate that removing food and energy subsidies and introducing compensating direct income payments to all income groups would significantly increase the welfare levels of lower income households in rural areas and all income households in urban areas reflecting the high level of distortions. However, the reform would make the highest income rural households worse off.

Keywords: subsidy, reform, income groups, GTAP7inGAMS

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1 Introduction

Since 1979, Iran has endured almost two decades of revolution, war and reform as well as international pressures which brought about considerable socio-economic losses, heavy military and civilian casualties, a drop in energy commodities' production and export. In general, the government of Iran has put in place socio-economic policies and schemes through five-year development plans in order to put the economic sectors on an acceptable growth path, consistent with the cultural and social values of Iranians. In the beginning, the government embarked on a new rationing system through the release of coupons to households based on the number of children and adults, aimed at making some food and energy commodities[3] more affordable for lower income groups. Under this subsidy policy, a minimum quota of basic food and energy stuffs was allocated to urban and rural households at specified prices through cooperative stores. In August 1988, with the cessation of the Iran-Iraq war and the socio-economic requisite for an appropriate programme to reconstruct the economy, the government of Iran committed itself to reforming the existing rationing system in an efficient way, so most of the benefits from the rationed commodities would accrue to the poor and lower income groups. To achieve this, the government planned to implement a targeted subsidy scheme. Not surprisingly, government spending on implicit and explicit subsidies over the first Five-Year Plan 1989/90-1993/94 had progressively increased. Total subsidy expenditure in Iran totalled about 25 percent of the country's GDP, of which 12 percent accrued to energy subsidies, while the socio-economic effects of existing subsidies to different income households were controversial.

In 1995, the second five-year development plan was implemented. Despite taking many socio-economic issues into consideration, the central government placed emphasis on reviewing and reforming basic food and energy subsidies. The government decided to initiate a subsidy phase out policy on the necessities consumed by the whole population. For instance, the government initially replaced generalized meat and egg subsidies with a cash transfer programme and then eventually removed these subsidies during the second development plan 1995/96-1999/00. In addition, the government outlined a plan to adjust consumption patterns and income distribution parameters by reforming subsidies aimed at poverty alleviation in order to raise living standards across the country. The third development plan clearly committed the government of Iran to continuing down the path of targeting public subsidies on basic necessities and energy commodities. In this respect, the government was obliged to research and measure the socio-economic impacts of targeting these subsidies. Thus, the central government sought to instigate a programme of targeting subsidies on wheat, rice, vegetable oil and cheese, sugar, powdered milk and medicine, fertilizer and energy commodities throughout the first and second years of the third plan 2000/01-2004/05[4]. In 2005, the government of Iran reformed public subsidies targeting basic necessities and energy commodities subsidies. Since the impact of the consumption subsidy reform on vulnerable households is a source of concern, in this paper we analyze the welfare impacts of subsidy policy reform in Iran on 20 household types in rural and urban areas, grouped according to income.

[3]- The coupon system in Iran has covered gasoline, gas oil, crude oil, antiknock, sugar, vegetable oil, meat, egg, cheese and butter, soap and washing powder.
[4]- The article 46, section 1, of the third development plan.

World Bank (1999) states that generalized subsidy schemes are not a cost-effective approach to transfer income to the needy households in that they are accompanied by 'rent-seeking', significant leakages to higher income households and they redirect economic resources to particular interest groups rather than employing public resources efficiently. World Bank (2005, p.42) affirmed that there are three significant rationales for reforming the energy-subsidy scheme: "its cost is high, it has a distorting impact on economic decisions, and it benefits the rich much more than the poor". An investigation of the impacts of subsidy reform would contribute to increased public consciousness of reform consequences. World Bank (2005, p.25) also states that there are at least three significant rationales for reforming the food-subsidy scheme: "the ineffectiveness, cost and inefficiency of the current system". Many poor households have not benefited from food subsidies.

By 1996/97 the food subsidy schemes in Egypt accounted for 5.5 percent of government expenditures, included 'unrationed bread and flour' (77 percent of subsidy cost) and 'rationed cooking oil and sugar' (23 percent). The major issues surrounding Egypt's food subsidy policy are the fact that the food subsidies were non-targeted and include sizeable leakages. Even those lower income groups who gain from food subsidy schemes receive amounts that are inadequate to raise them out of poverty. Lo¨fgren and El-Said (2000) employed a CGE model to simulate the short-term effects of different food subsidy scenarios. The targeting of sugar and cooking oil had a progressive impact on the bottom two quintiles of the poor in rural and urban regions, although removal of this subsidy scheme was regressive. The lowest income groups experienced a consumption loss of 1.1 percent. However, the effect was reversed if the government compensated the adverse effects of subsidy elimination by transferring the government savings to the poor. To sum up, if the food subsidy program is completely removed, targeted state schemes are essential to protect the lower income households from the detrimental effects.

Khosravinejad (2009) examines the effects of reforming subsidies on basic food stuffs on welfare indices across the country with a representative sample of Iranian households classified into five groups according to their income level. The results from price and income elasticities as well as welfare indices drawn by the Almost Ideal Demand System method show that reforming bread subsidies decreases welfare indices among lowest income groups by a greater percentage than sugar and vegetable oil. In contrast, the welfare indices of fourth and fifth income groups were adversely affected by reducing sugar and vegetable oil subsidies. Farajzadeh and Najafi (2004) analysed welfare and nutritional effects of phasing out basic necessities' subsidies on income deciles of Iranian urban and rural households. The results derived from an Almost Ideal Demand System (AIDS) applying the Seemingly Unrelated Regression method to estimate price and income elasticities confirm that a one-time increase in the price of food commodities such as bread would have a greater nutritional affect on rural households, while the results would be the reversed in the case of rice. Furthermore, analysing income effects of increasing the prices of sugar and bread showed that rural households are very likely to experience a larger reduction in real income than urban households.

Birol et al. (1995) investigated the socio-economic effects of a subsidy phase out policy on the energy sector in Iran. A standard econometric method was applied to analyze two scenarios: increasing the current level of domestic energy prices to half the border prices and then increasing them to the world level. Empirical results revealed that under the first scenario (second scenario), Iran would be able to save 13 percent (18 percent) of domestic oil

consumption. As expected, removing energy subsidies would result in a welfare loss for lower income households, while the income generated from the extra quantity of oil caused by the removal of subsidies could compensate for the adverse effect of high energy prices by providing direct subsidies for the truly needy segments of Iranians.

Jensen and Tarr (2002) developed a multi-sector computable general equilibrium model to analyze the impacts of trade and market reform on welfare levels in Iran, where the government obligated itself to start a dual exchange rate regime, nontariff barriers on all products and reform of domestic energy subsidies to assist the most vulnerable segments of the population. Households were classified into 10 rural and 10 urban households according to different levels of income. The prices of petrol and gasoline were only about 10 percent of world prices and petroleum subsidies accounted for an estimated 18 percent of GDP. Results showed that if the fiscal surplus from the removal of the energy subsidies is totally allocated to the households through direct income payments, the lowest income households in urban areas gain about 116 percent of their income and poorest households in rural areas gain 239 percent.

Manzoor et al. (2009) addressed the question of how much the reform of energy subsidies in general, and electricity in particular, impacts the consumption patterns and expenditures of Iranian households and production of other goods and services. A small open economy computable general equilibrium model including 18 production sectors, government, rural and urban households, was developed through construction of a Micro Consistent Matrix (MCM) of 2001 for energy analysis. As expected, the results of the model showed that eliminating subsidies causes a rise of domestic prices as well as activity deterioration owing to the increase of input prices. Removing energy subsidies also decreases the welfare levels of rural and urban households by 13 and 12 percent respectively caused by the growing consumer price index from 76 to 84 percent.

2 Data and Model

2.1 Benchmark Data

The benchmark data for Iran are derived mainly from the GTAP7[5] data base, a fully documented and a consistent global data base representing the world economy for 2004. The GTAP7 data base is a relatively disaggregated data base, comprising 57 commodities, 113 regions and five primary factors covering the entire set of goods and services in the global economy. The 2001 input-output table, provided by the Statistical Center of Iran (SCI), along with some complementary tables were utilized to construct the Iranian input-output table under the GTAP classification. Since the SCI table is not consistent with the GTAP data base classification outlined in Huff, McDougall and Walmsley (2000), some adjustments were made to the 2001 input-output table in order to meet the GTAP data base requirements.

The full 57 sectors and 113 regions GTAP7 data base is aggregated to regions in which Iran (IRN) is considered as a specific region facing fixed world prices for traded commodities. In

[5]- The Global Trade Analysis Project (GTAP)

addition, the 57 commodities are aggregated to 17 groups of commodities employed in this research, maintaining as much disaggregation as possible for major agricultural commodities and five energy sectors which are heavily subsidized by the government. Table 1 portrays a listing of 17 aggregated sectors along with their relationship to the 57 sectors available in the GTAP7 data base. Wheat, milk, vegetable oil, dairy products, sugar, and energy commodities are left disaggregated due to the fact that they have significant proportions in the consumption bundle of Iranian rural and urban households and have been heavily subsidized by the central government to protect needy households. Other agricultural commodities are all aggregated to form "Agricultural Products". In addition, the group of "Processed-Agricultural Products" consists of processed rice, food products, and beverages and tobacco products. "Transport" is comprised of sea transport, air transport and other transport. Furthermore, all GTAP service sectors are aggregated to form a single "Services" aggregate, and the rest of GTAP7 commodities except for metal, which is considered as a group, are all aggregated into "Others".

2.2 The Model

This research employs the GTAP7inGAMS static CGE model as the core of its empirical framework to simulate the welfare impacts of subsidy policy reform in Iran. In the GTAP7inGAMS model used in this study, three types of equations define the equilibrium: zero profit, market clearance, and income balance in which commodity prices and activity levels for constant-returns-to-scale firms are the major variables employed to define the equilibrium. The static GTAP7inGAMS model is calibrated using the GTAP 7 database, and formulated as a system of nonlinear complementarity equations in the GAMS/MPSGE[6] programming language by Brooke et al. (1996) and Rutherford (1987). The GTAP7inGAMS model is based on optimizing behavior. Consumers maximize welfare subject to a budget constraint given by the fixed levels of investment and public expenditure. Intermediate inputs and primary factors of production, such as skilled and unskilled labor, physical capital, land and natural resources are combined to minimize production costs incurred by individual producers subject to given technology (Rutherford, 2010).

Behavioral parameters in the GTAP7inGAMS model include the factor substitution elasticities, the factor transformation elasticities, the source substitution or *Armington* elasticities, the investment parameters, and the consumer demand elasticities. Most of these parameters enter directly from GTAP7 data base. Primary factors of production in GTAP7inGAMS are assumed to substitute for one another based on the constant elasticity of substitution (σ_{VA}) taken from the SALTER parameter file (Jomini *et al.*1991). In the core GTAP7inGAMS production technology the optimal combination of primary factors is assumed to be invariant to price of intermediates, implying the equivalent elasticity of substitution between any primary factor and intermediates. The factor transformation elasticities ($\sigma_T < 0$) determine the degree of primary factor mobility in a given simulation. If the elasticity of transformation for specific primary factor endowments $\sigma_T \to 0$, then the supply of factors across various uses is unresponsive to changes in relative returns, while $\sigma_T \to -\infty$ implies that the allocation of factors to different uses is extremely responsive to relative returns, consequently, the factor is perfectly mobile and reclassified into the set of mobile factors.

[6]- The GAMS/MPSGE stands for the Mathematical Programming System for General Equilibrium analysis (MPSGE) within the Generalized Algebraic Modelling System (GAMS).

Table 1: Sectors in Aggregated GTAP7 Dataset

Sectors	GTAP7 Sectors (Description and code[7])
Energy sectors	
Coal	Coal (coa)
Oil	Oil (oil)
Gas	Gas (gas), Gas manufacture, distribution (gdt),
Electricity	Electricity (ely)
Petroleum and Coal Products	Petroleum and Coal Products (p-c)
Non-energy sectors	
Wheat	Wheat (wht)
Milk	Milk (rmk)
Meat	Cattle, Sheep, Goats, Horse(cmt) and Meat Products (omt)
Vegetable Oil	Vegetable Oils and Fats (vol)
Dairy Products	Dairy Products (mil)
Sugar	Sugar (sgr)
Agricultural products	Paddy Rice (pdr), Cereal Grains (gro), Vegetables, Fruits and Nuts (v_f), Oil Seed (osd), Sugar cane and Sugar beet (c_b), Plant-based Fibers (pbf), Crops (ocr), Cattle, Sheep, Goats, Horses (ctl), Animal Products (oap), Wool, Silk-worm Cocoons (wol).
Processed-agricultural products	Processed Rice (pcr), Food Products (ofd), Beverages and Tobacco Products (b_t)
Transport	Transport n.e.c. (otp), Sea Transport (wtp), Air Transport (atp)
Services	Communication (cmn), Financial services n.e.c. (ofi), Insurance (isr), Business services n.e.c. (obs), Recreation and other services (ros), PubAdmin/Defence/Health/Educat (osg), Dwellings (dwe)
Metal	Metals n.e.c. (nfm), Metal products (fmp),
Others	Forestry (frs), Fishing (fsh), Minerals n.e.c. (omn), Textiles (tex), Wearing apparel (wap), Leather products (lea), Wood products (lum), Paper products, Publishing (ppp), Chemical,rubber, plastic prods (crp), Mineral products n.e.c. (nmm), Ferrous metals (i_s), Motor vehicles and parts (mvh),Transport equipment n.e.c. (otn), Electronic equipment (ele), Machinery and equipment n.e.c. (ome), Manufactures n.e.c. (omf), Water (wtr), Construction (cns), Trade (trd),

Sources: author's analysis

2.2.1 Production

In the GTAP7inGAMS model, the technology of the production activities is modeled using a nested function of constant elasticity of substitution (CES). Value-added is described by the CES

[7]- GTAP sector codes are shown in brackets.

aggregate of primary factors of production, where the GTAP7 dataset provides the CES substitution elasticity between primary factors. The production technology distinguishes between the primary and intermediate factors of production and therefore, profit maximizing producers are capable of choosing the optimal combination of primary factors independently of the intermediate inputs' prices. The nested CES functions allow different elasticities of substitution to be exist between primary factors of production and goods. According to Ramskov and Munksgaard (2011), the nested CES function is the most popular functional form in CGE models, as its flexibility in the elasticities of substitution. Figure 1 shows the structure of production for the GTAP7 commodities.

2.2.2 Representative Consumer

The representative consumer in the model owns a fixed endowment of primary factors of production: Land, Capital, Skilled and Unskilled Labour which supplied to the production sector, while the government is assumed to own Natural Resources. The model allows households, particularly in rural areas, to consume home commodities which are valued at activity-specific producer prices, so, they are not constrained to consume only marketed commodities. Final private demand for each household in the model is specified through a two-level structure. At the first level, composite' good final demands are modeled by maximization of a Stone-Geary utility function subject to the budget constraint. At the second level, the purchase of final demands is characterized by a CES function (as in the Armington aggregation nest) which allows substitution between imported and domestic sources of different commodities in household consumption. Figure 2 portrays a 2-level nested LES-CES function where the LES aggregation at the top yields a unit expenditure function.

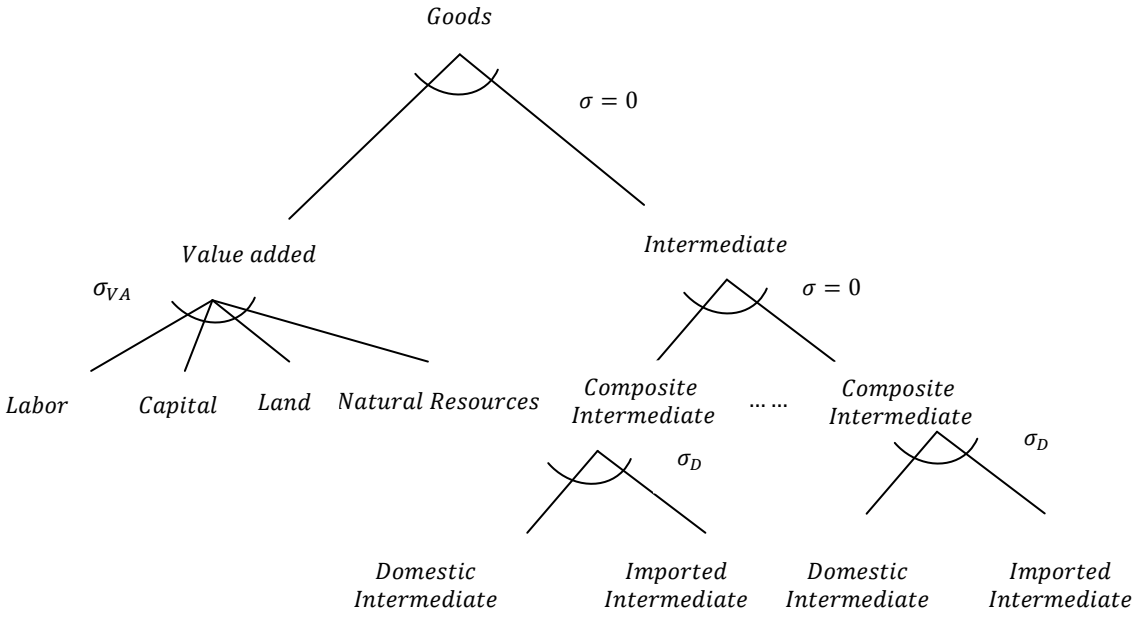

Figure 1: nested C.E.S. production function of GTAP7 commodities

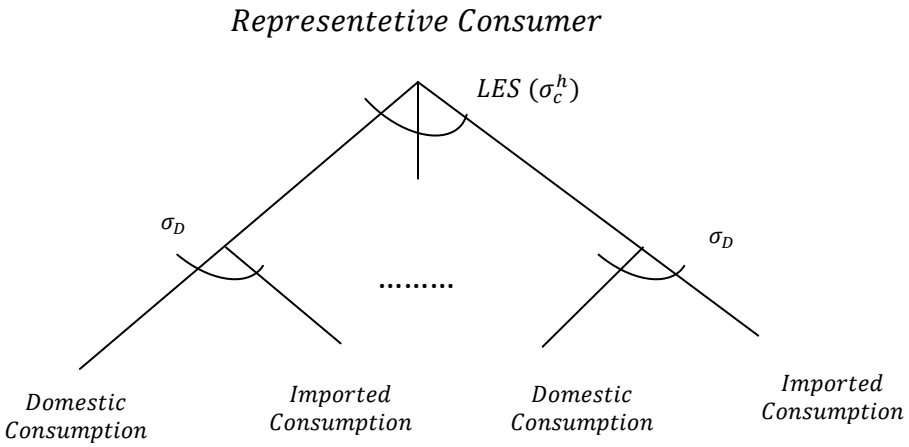

Figure 2: Private Consumption

As has already been noted, the primary factors of production in the GTAP7 dataset: Land, Unskilled labour, Skilled Labour, Capital and Natural Resources are employed by industries to produce GTAP7 commodities. Table 2 gives a numerical representation of how the primary factors are used in the production of the GTAP7 aggregated commodities. As is evident from Table 2, all food and agricultural sectors are unskilled labour-intensive sectors in the economy, except for Sugar and Processed-Agricultural Products which are capital-intensive sectors. The seven energy sectors: Oil. Gas, Electricity, Gasoline, Diesel, Kerosene and Fuel oil are also the most capital-intensive in the economy. The average endowment of capital-to-labour is about 4 in Iran; the usage of capital-to-labour is about 1.2 in food and agricultural sectors, while this ratio is about 15 in energy sectors.

2.2.3 Trade

In the GTAP7inGAMS model, defining demands for domestically produced and imported goods from different trading partners is based on Armington (1969) structure. It is assumed that domestic and imported varieties of the same good are treated as differentiated products by domestic users of those commodities, namely, the representative consumer, firms and the government. In addition, these commodities are assumed to be imperfect substitutes for each other. Once there are more than one trading partners in the model, imports from different areas are differentiated from each other. It can be noted that, most of the well-known CGE trade models such as the Global Trade Analysis Project (GTAP) model, and the MONASH Model are Armington models. Indeed, the Armington assumptions of product differentiation and imperfect substitution have been employed to overcome some problems in the CGE trade models. For instance, once a country appears to import and export the same commodities at the same time (cross-hauling), the traditional trade models with homogeneous commodities are not capable of explaining this occurrence (Zhang, 2006).

2.2.4 Government

Government consumption is represented by a Cobb-Douglas aggregation of market commodities. Figure 3 shows the functional form of public consumption where an Armington aggregation of domestic and imported inputs which defines public sector demand is shown at the second level between domestic and imported inputs.

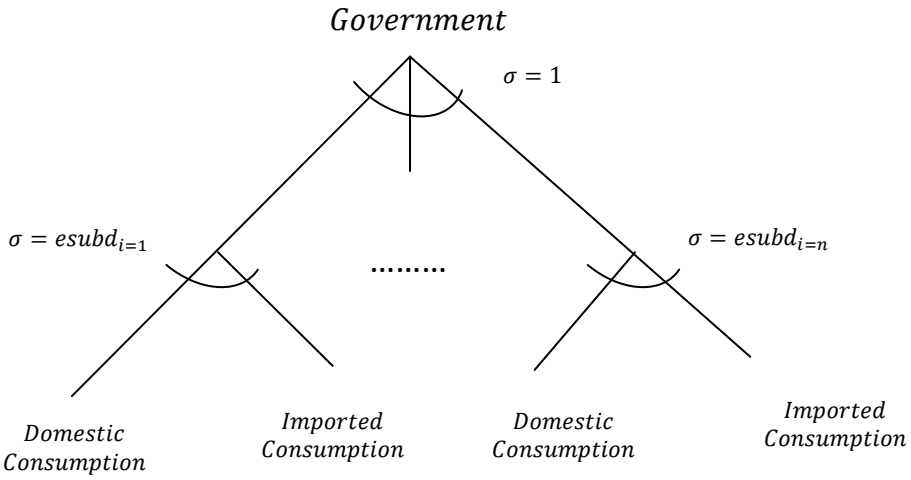

Figure 3: Public Consumption

Table 2. The primary factors of production and their shares in the GTAP7 aggregated commodities (2004 US$ million)

mobile factors	Wheat	Meat	Milk	Vegetables	Dairy Products	Sugar	Agri Products	Processed-Agri Products	Coal	Oil
Unskilled Labour	1269.66	147.29	568.75	149.8	351.74	1.66	2172.68	257.7	38.91	498.64
Skilled Labour	18.35	2.59	8.22	3.57	8.68	0.37	31.4	55.02	3.56	105.79
Capital	879.82	166.51	394.11	124.48	485.73	13.21	1505.56	2281.38	51.86	55421.79
specific factors										
Land	260.84	23.93	51.52	23.46	60.12	0	391.57	0	0	0
Natural Resources	0	49.02	0	0	0	0	0	0	23705.02	59961.11

Primary Factors as a Share of Value Added

mobile factors	Wheat	Meat	Milk	Vegetables	Dairy Products	Sugar	Agri Products	Processed-Agri Products	Coal	Oil
Unskilled Labour	52.28	37.83	55.62	49.72	38.81	10.89	52.98	9.93	0.16	0.43
Skilled Labour	0.76	0.67	0.80	1.18	0.96	2.43	0.77	2.12	0.01	0.09
Capital	36.23	42.77	38.54	41.31	53.60	86.68	36.71	87.94	0.22	47.78
specific factors										
Land	10.74	6.15	5.04	7.79	6.63	0.00	9.55	0.00	0.00	0.00
Natural Resources	0.00	12.59	0.00	0.00	0.00	0.00	0.00	0.00	99.60	51.70

Sources: GTAP7 dataset, and author's calculation.

Table 2. (Continued)

mobile factors	Gas	Electricity	Gasoline	Diesel	Kerosene	Fuel oil	Metal	Transport	Service	Others
Unskilled Labour	2632.53	646.89	39.04	66.7	32.49	15.94	910.6	354.05	4493.56	4972.87
Skilled Labour	1181.41	304.17	7.78	13.29	6.53	3.15	165.43	72.2	6110.62	971.99
Capital	10918.92	2300.23	611.17	1044.12	500.35	252.98	3644.46	2516.3	22014.91	29281.29
specific factors										
Land	0	0	0	0	0	0	0	0	0	0
Natural Resources	1087.14	0	0	0	0	0	0	0	0	125.12

Primary Factors as a Share of Value Added

mobile factors	Gas	Electricity	Gasoline	Diesel	Kerosene	Fuel oil	Metal	Transport	Service	Others
Unskilled Labour	16.64	19.90	5.93	5.93	6.02	5.86	19.29	12.03	13.78	14.07
Skilled Labour	7.47	9.36	1.18	1.18	1.21	1.16	3.50	2.45	18.73	2.75
Capital	69.02	70.75	92.88	92.88	92.77	92.98	77.21	85.51	67.49	82.83
specific factors										
Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Natural Resources	6.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35

Sources: GTAP7 dataset, and author's calculation.

2.3 Extensions to the Basic Model

Two significant extensions to the basic model for the purpose of drawing further results of subsidy reform are described in this paper. These include disaggregating the Petroleum Products (p_c) sector, and disaggregating the single household into 20 income groups of households, ten urban and ten rural groups. In addition to studing the socio-economic impacts of consumption subsidy reform at macro levels, the extensions to the model produce estimates of energy and food subsidy reform on different income groups of households in urban and rural regions.

2.3.1 Disaggregation of the Petroleum Products (p_c) sector

It is necessary to disaggregate the Petroleum and Coal Products (p-c) sector in the GTAP7 database into four component energy commodities: gasoline, diesel, kerosene and fuel oil, since the initial level of subsidies on these energy commodities reported by Iranian statistical centers are significant and different from each other. Horridge (2005) developed a GEMPACK utility called SplitCom with the aim of facilitating the disaggregation of the standard GTAP database to any preferred level of regional and commodity aggregation. In a similar vein, Sue Wing (2006) provides a synthesis of bottom-up and top-down approaches to disaggregation of the electricity sector given different technologies of electricity production. The technique used to disaggregate the Petroleum and Coal Products sector in this research is similar in spirit to the bottom-up and top-down method introduced by Sue Wing. Like the SplitCom utility, the technique in this research requires the necessary estimates for the splitting shares derived from exogenous information.

The disaggregation of a GTAP account for each region necessitates further information on the products' sub-sectoral row and column totals, the different utilization of each product between intermediate use and various components of final demand, and estimates of the different production technologies and value added components within each product subsector (Mraz and Matthews, 2007). This additional information is drawn from the Statistical Center of Iran (SCI), the Central Bank of Iran (CBI), Energy Balance Sheet and Iran's Statistical Yearbook. On the production side, the disaggregated energy commodities in the GTAP7 database are either consumed or employed for further processing into the higher value added products.

Table 3 illustrates the estimated shares of the four disaggregated energy commodities in the Firms' Domestic Purchases and imports at Market Prices matrix obtained from Iran Energy Balance Sheet of 2004. Of the four energy commodities, the consumption share of diesel in the food and agricultural sectors is largest, accounting for around 97 percent of petroleum products. In the Coal, Oil, Gas, Transport and Service sectors, consumption patterns of disaggregated energy commodities are quite similar (the shares of diesel, gasoline, fuel oil and kerosene are around 38, 27, 21 and 13 percent respectively). The Metal sector uses only gasoline and diesel, not Kerosene or Fuel Oil. The share of fuel oil in the Other sector is much higher than the other energy commodities, accounting for around 71 percent.

The detailed Iran input output table from 2001 supplied by the Statistical Center of Iran (SCI) is used to calculate factor shares in the four disaggregated energy commodities. Table 4 reports the weight of primary factors in the production of all aggregated goods as well as disaggregated

Petroleum Products. For the agricultural sectors Wheat, Milk, Meat, Vegetables, Dairy Products, Sugar, Agricultural Products and Processed Agricultural Products, the primary inputs Land, Unskilled labour and Capital make up about 97 percent of value added. The four energy sectors Coal, Oil, Gas and Electricity along with Metal, Transport, Services and Other sectors are capital intensive in the economy, making up on average 70 percent of value added. Likewise, the four disaggregated energy sectors gasoline, Diesel, Kerosene and Fuel Oil are also the most capital-intensive in the economy, accounted for around 93 percent of value added.

To disaggregate the Petroleum Products in the representative agents accounts, information on the utilization of disaggregated energy commodities by the representative consumer and the government is drawn from the Urban and Rural Households' Income and Expenditure Survey for 2004 supplied by the SCI and the Central Bank of Iran. Given the constraints on the total values of the components of trade accounts implied by the initial GTAP7 database, complementary data on the main macroeconomic indicators such as import and export obtained from Iran's Statistical Yearbook and Energy Balance Sheet of 2004 are used to split the Petroleum Products in the bilateral trade flows matrix. Using the shares of disaggregated energy commodities, bilateral exports at market and world prices as well as bilateral imports at world prices are used to disaggregate the Petroleum Products in the trade flow accounts.

Table 5 reports the calculated shares of disaggregated energy commodities within private consumption, public consumption, and trade flow accounts. Among petroleum products, Diesel has the highest share in the both private and public consumption, accounting for more than 38 percent, while Kerosene has the lowest share, accounting for only 12 percent. The third and fourth columns of Table 5 illustrate the value shares of imports and exports of each energy commodity in total imports and exports of the Petroleum Products. The resulting export and import shares indicate that 95 percent of the Petroleum Products export belongs to Fuel Oil, while the export shares of Diesel and kerosene are not significant. Moreover, Iran only imported Gasoline in 2004.

2.3.2 The Model with Heterogeneous Households

Mapping private consumption to disaggregated households in the model is crucial to analyzing various income groups' welfare. In the model used in this study, private final demands are characterized by 20 households, 10 rural and 10 urban grouped according to income. Because the foremost purpose of this research is to quantify welfare effects of removing consumption subsidies across income levels of households, the technique of disaggregating households by income and area is crucial. As is common in CGE models, household income and expenditure surveys can be used to facilitate the estimation of the shares of household expenditure on different goods and services, and disaggregation of households into different income groups (Bacon, et.al. 2010). As has already been noted, the Urban and Rural Households' Income and Expenditure Survey of 2004 conducted by the SCI in accordance with the COICOP classification is employed to disaggregate the private consumption in the

Table 3. The Consumption Shares of the Petroleum Products in the GTAP7 Production sectors

	Wheat	Milk	Meat	Vegetables	Dairy Products	Sugar	Agri Products	Processed-Agri Products	Coal	Oil	Gas	Electricity	Gasoline	Diesel	Kerosene	Fuel oil	Metal	Transport	Service	Others
Wheat																				
Milk																				
Meat																				
Vegetables																				
Dairy Products																				
Sugar																				
Agri Products																				
Processed-Agri Products																				
Coal																				
Oil																				
Gas																				
Electricity																				
Gasoline	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.27	0.27	0.01	0.27	0.38	0.13	0.21	0.58	0.27	0.27	0.01
Diesel	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.38	0.38	0.38	0.29	0.27	0.38	0.13	0.21	0.42	0.38	0.38	0.29
Kerosene	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.13	0.13	0.13	0.00	0.27	0.38	0.13	0.21	0.00	0.13	0.13	0.00
Fuel oil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.21	0.21	0.71	0.27	0.38	0.13	0.21	0.00	0.21	0.21	0.71
Metal																				
Transport																				
Service																				
Others																				

Source: Iran *Energy Balance Sheet* of 2004, and author's calculation

GTAP7 dataset. The first step to utilize the information of this survey is to ensure that the survey concordance table is well-matched with GTAP7 data. To incorporate the information of heterogeneous households' incomes and expenditures from COICOP database in the GTAP database, it is first necessary to construct an appropriate mapping between the two databases.

Table 4. Factor Shares in GTAP7 Sectors

	Land	unskilled Labour	Skilled-Labour	Capital	Natural Resources
All aggregated sectors excluding the petroleum products					
Wheat	0.12	0.54	0.01	0.34	0.00
Milk	0.12	0.54	0.01	0.34	0.00
Meat	0.08	0.37	0.01	0.40	0.15
Vegetables	0.10	0.50	0.01	0.39	0.00
Dairy Products	0.08	0.39	0.01	0.52	0.00
Sugar	0.00	0.11	0.02	0.87	0.00
Agri Products	0.12	0.54	0.01	0.34	0.00
Processed-Agri Products	0.00	0.10	0.02	0.88	0.00
Coal	0.00	0.27	0.03	0.33	0.36
Oil	0.00	0.01	0.00	0.70	0.29
Gas	0.00	0.18	0.08	0.70	0.05
Electricity	0.00	0.20	0.09	0.71	0.00
Transport	0.00	0.11	0.02	0.87	0.00
Service	0.00	0.14	0.18	0.68	0.00
Others	0.00	0.13	0.03	0.84	0.00
Metal	0.00	0.19	0.03	0.78	0.00
Disaggregated petroleum products					
Gasoline	0.00	0.06	0.01	0.93	0.00
Diesel	0.00	0.06	0.01	0.93	0.00
Kerosene	0.00	0.06	0.01	0.93	0.00
Fuel oil	0.00	0.06	0.01	0.93	0.00

Source: The 2001 Iran Input Output table, and author's calculation

Table 6 shows the 57×47 the transition matrix translating the 47×1 final demand matrix based on COICOP into a 57×1 demand for intermediate good matrix based on GTAP7. In this table, COICOP commodities are displayed in columns by the index ($j = 1,2,\ldots,47$), and GTAP categories are represented in rows by the index ($i = 1,2,\ldots.,57$). Following Sahin and van der Mensbrugghe (2007), the consumption categories' shares are calculated for COICOP and GTAP7 commodities separately, and then combined within the transition matrix. In this context, β_j and α_{ij}, which represent the consumption share of each category (column j) in COICOP database and the consumption share of product i within the category j in GTAP database

Table 5. The final demand, import and export shares of energy commodities in total Petroleum Products

	Consumption	Government	Export	Import
Wheat				
Milk				
Meat				
Vegetables				
Dairy Products				
Sugar				
Agri Products				
Processed-Agri Products				
Coal				
Oil				
Gas				
Electricity				
Gasoline	0.273187	0.273187	0	1
Diesel	0.383088	0.383088	0.015	0
Kerosene	0.128743	0.128743	0.035	0
Fuel oil	0.214983	0.214983	0.95	0
Metal				
Transport				
Service				
Others				

Source: author's calculation

Table 6. The COICOP-GTAP transition matrix

COICOP / GTAP	Food	Non-Alcoholic Beverages	Alcoholic Beverages	Tobacco	…..	Total
i=1	j=1	2	3	4	j=47	
1-Paddy rice	$c_{(1,1)}$	$c_{(1,2)}$	$c_{(1,3)}$	$c_{(1,4)}$	…..	
2-Wheat	$c_{(2,1)}$	$c_{(2,2)}$	$c_{(2,3)}$	$c_{(2,4)}$	…..	
3-Crops	$c_{(3,1)}$	$c_{(3,2)}$	$c_{(3,3)}$	$c_{(3,4)}$	…..	
4-Beverages, tobacco products	$c_{(4,1)}$	$c_{(4,2)}$	$c_{(4,3)}$	$c_{(4,4)}$	…..	
…..	…..	…..	…..	…..		
57-……	$c_{(57,1)}$	$c_{(57,2)}$	$c_{(57,3)}$	$c_{(57,4)}$	…..	
i=57	$C_1 = \sum_i c_{(i,1)}$	$C_1 = \sum_i c_{(i,2)}$	$C_1 = \sum_i c_{(i,3)}$	$C_1 = \sum_i c_{(i,4)}$	…..	$\sum_j C_j = \sum_i \sum_j c_{ij}$

Source: Sahin and van der Mensbrugghe (2007).

respectively, are used to calculate the transition matrix coefficients (tr_{ij}) in row i and column j. The consumption share β_j is defined as the proportion of consumption category C_j within total household consumption $\sum_j C_j$ ($\beta_j = C_j / \sum_j C_j$). Similarly, α_{ij} is defined as $\alpha_{ij} = c_{ij}/C_j$ where

c_{ij} is the consumption of good i in category j, and C_j refers to the total demand for intermediate consumption goods in category j ($C_j = \sum_i c_{ij}$). The coefficient tr_{ij} which represents the share of production goods i in total household demand ($c_{ij}/\sum_j C_j$) can be defined as a function of the consumption shares ($tr_{ij} = \alpha_{ij} \times \beta_j$).

To disaggregate private expenditure[8] in the model, private expenditure shares ($share\_h(i,h,n)$[9]) at different income deciles (n) of both rural and urban households (h) for 20 aggregated commodities (i) in the GTAP7 dataset are calculated in accordance with coefficients of the transition matrix. Tables 7 and 8 report private expenditures' shares based on rural and urban households deciles respectively. In both rural and urban households, the share of private expenditure on all GTAP7 food and agricultural commodities, Transport, Services and Other increased monotonically by income level. In rural income groups, the shares of private expenditure on Oil, Gas, Electricity, Gasoline, Diesel, Kerosene and Fuel oil all increased with income, while the expenditure share of Coal had an upward trend at lower deciles and a downward trend at higher deciles. Regarding energy commodities, in rural households the distribution of expenditure across deciles is more homogenous compared to urban households. In urban households, the shares of private expenditure on Oil, Gas, Electricity and Gasoline increased monotonically by income level, while the expenditure shares of Kerosene and Fuel oil declined as income rises. Private expenditure shares of Diesel and Coal had upward trends at higher deciles of urban households.

In the survey of 2004 based on the COICOP classification, Household income includes all wages and salaries obtained from self-employment in agricultural and non-agricultural activities, private and public sector employment, and other income during the reference period. The COICOP income shares are then applied to calculate GTAP7 shares of endowments with the aim of disaggregating the representative consumer's income account in the model (GTAP7 vector $vfm(f,i)$). Table 9 illustrates calculated shares of endowments based on both rural and urban households in the deciles ($svfm(f,h,n)$). In rural households, shares of all endowments except Capital increased monotonically as income rises, while the share of Capital stays steadily among the first seven income deciles and increased significantly in the higher income households. Overall urban households earn a larger share of their income from Capital and Labour. As income rises in urban households, the share of Capital, Labour and Natural Resources increased monotonically, while just the higher income groups make a reasonable income from Land.

[8]- GTAP7 vectors $vdpm(i,\text{irn}) + vipm(i,\text{irn})$

[9]- $share\_h(i,h,n)$ represents private expenditure shares where set i is GTAP aggregated commodities in the model, set $h \in \{urban, rural\}$ characterizes rural and urban households, and set $n \in (1,2,3,\ldots,20)$ signifies income groups of households.

Table 7. Shares of total household expenditure on the GTAP7 aggregated commodities by rural households (%)

	Rural1	Rural2	Rural3	Rural4	Rural5	Rural6	Rural7	Rural8	Rural9	Rural10	Sum
Wheat	0.00011	0.00798	0.02542	0.02782	0.02923	0.02627	0.03995	0.04982	0.07183	0.26430	0.54272
Milk	0.01201	0.02352	0.03103	0.03618	0.03881	0.04615	0.04876	0.05268	0.06648	0.09117	0.44680
Meat	0.01020	0.01835	0.02451	0.03045	0.03751	0.04510	0.05455	0.06446	0.08232	0.13910	0.50654
Vegetables	0.01863	0.03182	0.03916	0.04548	0.05067	0.05753	0.06032	0.06759	0.08274	0.11117	0.56509
Dairy Products	0.01460	0.02510	0.03066	0.03374	0.03948	0.04564	0.05083	0.05828	0.06414	0.08433	0.44680
Sugar	0.01651	0.02717	0.03451	0.03801	0.04439	0.05204	0.05663	0.06403	0.07621	0.10713	0.51663
Agri Products	0.00885	0.01679	0.02352	0.02845	0.03478	0.04022	0.04794	0.05964	0.07531	0.13736	0.47287
Processed-Agri Products	0.02474	0.03242	0.03865	0.04095	0.04195	0.04558	0.04861	0.04995	0.05374	0.05776	0.43436
Coal	0.00346	0.01802	0.01941	0.02039	0.02347	0.02741	0.02269	0.02113	0.02279	0.02805	0.20683
Oil	0.00384	0.01258	0.01422	0.01707	0.02009	0.02205	0.02443	0.02666	0.02831	0.03758	0.20683
Gas	0.01047	0.01622	0.01888	0.02128	0.02173	0.02317	0.02560	0.02978	0.03160	0.04125	0.23997
Electricity	0.01992	0.03286	0.03627	0.04470	0.05032	0.05200	0.05818	0.06046	0.07518	0.08603	0.51592
Gasoline	0.00300	0.01000	0.01800	0.02100	0.02700	0.03200	0.04200	0.05100	0.06600	0.12300	0.39300
Diesel	0.00300	0.02600	0.02600	0.03400	0.02400	0.01300	0.06700	0.18400	0.16300	0.40200	0.94200
Kerosene	0.02400	0.05100	0.06000	0.06900	0.09200	0.09100	0.10600	0.12100	0.13700	0.17200	0.92300
Fuel oil	0.02327	0.04945	0.05818	0.06691	0.08921	0.08824	0.10278	0.11733	0.13284	0.16678	0.89500
Transport	0.00693	0.01238	0.01603	0.01781	0.02120	0.02367	0.02773	0.03430	0.04347	0.06960	0.27312
Service	0.00460	0.00814	0.01129	0.01459	0.01735	0.02093	0.02650	0.03601	0.04278	0.07796	0.26014
Metal	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.50000
Others	0.00645	0.01087	0.01431	0.01794	0.02136	0.02599	0.03194	0.03934	0.05332	0.11526	0.33679

Sources: author's calculation.

Table 8. Shares of total household expenditure on the GTAP7 aggregated commodities by urban households (%)

	Urban1	Urban2	Urban3	Urban4	Urban5	Urban6	Urban7	Urban8	Urban9	Urban10	Sum
Wheat	0.00210	0.00672	0.02142	0.02344	0.02463	0.02213	0.03366	0.04197	0.06052	0.22069	0.45728
Milk	0.02807	0.03728	0.04175	0.04731	0.04939	0.05475	0.05986	0.06590	0.07428	0.09462	0.55320
Meat	0.01370	0.02189	0.02776	0.03478	0.04133	0.04775	0.05536	0.06663	0.07873	0.10554	0.49346
Vegetables	0.02088	0.02812	0.03214	0.03688	0.03963	0.04338	0.04641	0.05138	0.06082	0.07527	0.43491
Dairy Products	0.02249	0.03459	0.03894	0.04563	0.05087	0.05632	0.06212	0.06661	0.07818	0.09746	0.55320
Sugar	0.02533	0.03604	0.03859	0.04390	0.04529	0.04864	0.05185	0.05733	0.06337	0.07304	0.48337
Agri Products	0.01415	0.02334	0.03026	0.03730	0.04364	0.05032	0.05876	0.06987	0.08534	0.11415	0.52713
Processed-Agri Products	0.03222	0.04222	0.05034	0.05333	0.05463	0.05935	0.06330	0.06504	0.06999	0.07522	0.56564
Coal	0.12781	0.06898	0.11241	0.03913	0.04163	0.05704	0.06804	0.07401	0.09075	0.11338	0.79317
Oil	0.04646	0.05766	0.06274	0.06876	0.06921	0.09554	0.07416	0.09104	0.08616	0.14145	0.79317
Gas	0.03967	0.05577	0.06366	0.07072	0.07504	0.07985	0.08346	0.09440	0.08753	0.10992	0.76003
Electricity	0.02311	0.03177	0.03739	0.03895	0.04201	0.04572	0.05211	0.05840	0.06562	0.08900	0.48408
Gasoline	0.00900	0.01700	0.02300	0.04000	0.04800	0.05700	0.07200	0.08200	0.10900	0.15000	0.60700
Diesel	0.00100	0.00100	0.00200	0.00400	0.00900	0.00400	0.00200	0.00600	0.00800	0.02100	0.05800
Kerosene	0.01000	0.00800	0.00700	0.00900	0.00900	0.00500	0.00900	0.00700	0.00700	0.00600	0.07700
Fuel oil	0.02625	0.01995	0.01575	0.01260	0.00945	0.00735	0.00630	0.00315	0.00315	0.00105	0.10500
Transport	0.02297	0.03259	0.04250	0.04864	0.05419	0.06881	0.07675	0.08796	0.10887	0.18360	0.72688
Service	0.01365	0.02660	0.03382	0.04385	0.05407	0.06587	0.07624	0.09315	0.12884	0.20378	0.73986
Metal	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.50000
Others	0.01682	0.02694	0.03409	0.03999	0.04693	0.05427	0.06394	0.07669	0.09771	0.20584	0.66321

Sources: author's calculation.

Table 9. shares of GTAP7 endowments based on both rural and urban households in the deciles (%)

$svfm(f,h,n)$	Rural1	Rural2	Rural3	Rural4	Rural5	Rural6	Rural7	Rural8	Rural9	Rural10
Land	0.012589	0.030559	0.043768	0.056419	0.06404	0.073085	0.098305	0.113101	0.136607	0.229429
Unskilled Labour	0.00955	0.017624	0.020634	0.026475	0.0313	0.034709	0.041731	0.049169	0.054626	0.064412
Skilled Labour	0.00955	0.017624	0.020634	0.026475	0.0313	0.034709	0.041731	0.049169	0.054626	0.064412
Capital	0.013081	0.015265	0.016679	0.01631	0.017541	0.018101	0.018505	0.021451	0.024388	0.037995
Natural Resources	0.011273	0.027206	0.040419	0.057023	0.069282	0.096335	0.085426	0.113399	0.157247	0.286992
$svfm(f,h,n)$	Urban1	Urban2	Urban3	Urban.4	Urban5	Urban6	Urban7	Urban8	Urban9	Urban10
Land	0.000622	0.000906	0.001334	0.001095	0.001572	0.015675	0.013245	0.023744	0.034814	0.049092
Unskilled Labour	0.020499	0.029777	0.040503	0.050341	0.059575	0.064646	0.076853	0.08636	0.095938	0.125277
Skilled Labour	0.020499	0.029777	0.040503	0.050341	0.059575	0.064646	0.076853	0.08636	0.095938	0.125277
Capital	0.035665	0.039548	0.046905	0.057334	0.06071	0.074376	0.079312	0.097824	0.121813	0.187195
Natural Resources	0.001784	0.002404	0.003346	0.0033	0.004301	0.004631	0.003786	0.007026	0.01023	0.014592

Sources: author's calculation.

2.4 Adjusting Tax Rates in the GTAP7 Data Base

In the GTAP7 data base, consumption tax/subsidy rates reflect differences between domestic and world market values of commodities. Consumption subsidy data available for Iran in the GTAP7 database were underestimated for most of commodities. Therefore, the GTAP7 consumption subsidies cannot accurately describe the structure of subsidized commodity markets in Iran. Table 10 compares the GTAP7 consumption tax/subsidy rates with real consumption subsidies collected from statistical centers of Iran for the aggregated commodities considered in this research. As is evident from Table 10, there are significant differences between the GTAP7 and Iranian consumption subsidy data for many commodities.

At the aggregate level, the GTAP7 consumption subsidy rates of the food and agricultural commodities are about three percent, while the Iranian consumption subsidy rates of the same commodities are around 30 percent. According to the published data by the Iranian statistical centers, consumption of energy commodities is heavily subsidized with average rates of around 80 percent, whilst the GTAP7 data base reports that all fuel and power for households' domestic use are taxed at around one percent. Given these differences between the subsidy data in GTAP7 and those officially reported by the government of Iran, it is necessary to adjust subsidy rates in the GTAP data base while minimizing their effects on the value flows of other accounts in GTAP7. This section addresses a tax/subsidy-adjustment procedure to improve information on the consumption taxes/subsidies (t_{ir}^{pd}) in the initial, pre-simulation data base.

Table 10. GTAP7 and Iranian consumption subsidies (% ad valorem rate)

Aggregated Commodities	GTAP7 consumption subsidies (% ad valorem rate)	Adjusted consumption subsidies (% ad valorem rate)
Wheat	-0.747	-37.050
Milk	-0.009	-91.816
Meat	-4.333	-7.799
Vegetables	-0.308	-9.842
Dairy Products	-5.243	-5.243
Sugar	-6.357	-68.784
Agri Products	-0.562	-5.789
Processed-Agri Products	-5.941	-5.941
Coal	0.027	0.027
Oil	0.000	0.000
Gas	4.487	-82.378
Electricity	4.490	-59.938
Gasoline	0.064	-69.309
Diesel	0.064	-93.954
Kerosene	0.064	-93.923
Fuel oil	0.064	-95.218
Transport	2.054	2.054
Service	0.673	0.673
Metal	-0.028	-0.028
Others	-0.295	-0.295

Source: the GTAP7 data base, the SCI and Iran Energy Balance Sheet of 2004

Given that altering just subsidy data and leaving the other flows of the data base untouched will violate the initial consistency of the data base, it is necessary to allow the rest of the data base to change so as to keep the internal balance of the data base. Employing tax/subsidy data which post-dates the base year would not be an appropriate way to improve the quality of the data base. Using data from statistical centers of Iran, the GTAP7inGAMS model itself is used first to alter the base consumption tax/subsidy data in the GTAP7 database, and ultimately to calculate how altering consumption subsidy rates affects other flows. Following Malcolm (1998), the tax adjustment procedure used here includes a number of modifications to the GTAP7inGAMS model. Production and consumption are assumed to be Cobb-Douglas, as so to keep nominal budget and cost shares fixed. Thus, the Armington elasticities, $ESUBD(i)$ are set to unity. All endowment factors are assumed to be perfectly mobile between sectors. Substitution between the composite primary factor and different intermediate inputs is introduced and trade balances are exogenized. Once these modifications to the original model are made, a simulation is run where tax rates are shocked to their desired value and the updated post-simulation database is used for subsequent policy experiments.

Table 11. Pre-update and Post-update values of major GTAP7 accounts (2004 US$ million)

Aggregated Commodities	Pre-shock				Post-shock			
	Private consumption	Output supply	Export	Import	Private consumption	Output supply	Export	Import
Wheat	2917.9	4247.7	41.4	683.9	5209.4	6467.2	75.6	1141.1
Milk	18.7	3028.8	0.0	0.1	240.9	3410.0	0.1	0.2
Meat	1609.0	2905.8	70.4	314.9	1806.4	3389.4	91.4	396.9
Vegetables	1346.6	1002.8	44.3	1718.9	1638.1	1170.0	62.7	2284.1
Dairy Products	4425.1	6151.1	142.8	148.2	4596.7	6576.0	206.7	188.0
Sugar	146.4	279.2	9.8	76.4	463.5	521.8	29.5	173.4
Agri Products	3603.9	6259.1	1076.0	460.3	4102.8	8127.7	2146.7	709.9
Processed-Agri Products	6597.3	7667.9	309.5	1247.9	6324.2	7714.9	394.1	1482.4
Coal	1.4	37.7	0.4	23.9	1.3	23868.5	0.0	50.6
Oil	0.0	50018.8	32741.8	3.6	0.0	118775.3	53508.9	8.9
Gas	2184.0	6924.0	377.0	697.6	13176.7	19874.9	1705.9	2471.6
Electricity	3150.6	10621.2	89.8	103.6	8832.6	21081.0	149.4	188.4
Gasoline	2250.7	5936.7	0.0	1703.0	20242.9	29539.8	0.0	3870.5
Diesel	2258.7	7852.3	51.7	0.0	24272.6	38092.2	84.1	0.0
Kerosene	1477.6	2639.1	120.5	0.0	15109.7	18266.5	280.6	0.0
Fuel oil	164.5	4365.9	3271.0	0.0	1659.2	9170.0	2288.3	0.0
Metal	3014.9	19344.3	3077.5	14027.2	3133.0	30641.0	4070.5	20959.0
Transport	3818.7	11290.1	835.7	123.6	3859.3	18061.5	446.6	147.8
Service	18718.1	48582.3	492.2	1417.9	18978.5	47803.4	801.2	1788.5
Others	20522.7	70048.8	2310.3	25370.4	21369.6	97372.2	3857.0	38730.8

Sources: author's calculation.

Given the internal consistency of the data base, altering consumption subsidies would change the other flows of the data base. Table 11 compares the initial value flows of the private consumption, supply, import and export of aggregated commodities with their values after altering consumption subsidies. As is evident from Table 11, altering the consumption subsidies causes a significant increase in the value of both private consumption and supply for most of

commodities. Except for Coal, Fuel oil and Transport sectors, the value of export for all aggregated commodities increased significantly after altering subsidy rates. Similarly, adjusting subsidy rates leads to an increase in the value of import for most of commodities, while the import of Diesel, Kerosene and Fuel oil stayed constant.

3 Estimating the behavioural parameters used in the calibration process

In general, the elasticity values, which on the one hand, rely on some assumptions that the economy is in equilibrium and on the other hand, influence the outcomes of policy and external shock simulations, feed the CGE equations to analyse a wide array of socio-economic issues, such as tax/subsidy policy reforms. The commonly used functional form designed for modelling the consumption block of a CGE model and estimating price and income elasticities across households is the Linear Expenditure System (LES). According to Boer (2009), the LES is popular specification in the majority of well-known CGE models, such as WorldScan[10], MIRAGE[11], Linkage[12] and GTAP[13]. The resulting LES demand function for the consumption of commodity i by different households is reformulated in equation 1, where the LES parameters, namely, μ_{ih} and α_{ih} involving household h in the model stand for subsistence consumption and marginal expenditure share of each commodity respectively. The formula applied to estimate income/expenditure elasticities is shown in equations (2) where the income elasticity ($\varepsilon_{ih} > 0$) rules out the possibility of inferior commodities to exist (Boer and Missaglia, 2006).

$$(1)\quad X_{ih} = \mu_{ih} + \frac{\alpha_{ih}}{P_i}\left(m_h - \sum_j P_j \cdot \mu_{jh}\right)$$

$$(2)\quad \varepsilon_{ih} = \frac{\alpha_{ih} \cdot m_h}{P_i \cdot X_{ih}}$$

Even though, the LES model of consumer behavior is a linear function of prices and disposable income, its estimation is a highly complex process because of the fact that, the demand function is defined by the non-linear coefficients, μ_{ih} and α_{ih}, which write in a multiplicative structure. However, the LES has been recognized as an appropriate functional form to estimate large systems of equations (Braithwait, 1977, 1980, cited in Capps, Jr, 1983). The system represented by equation (1) which can be viewed as a system of seemingly unrelated regression equations is used here to estimate the LES parameters (μ_{ih} and α_{ih}) by imposing non-negativity constraints on coefficients. Given that total expenditures and incomes are equivalent, the sum of disturbances for each equation is equal to nil and therefore, estimation process breaks down caused by the singularity of the covariance matrix. Judge et al. (1988, cited in Nganou, 2004) recommend omitting one equation arbitrary for the estimation of the demand system. It should be noted that the adding-up restriction ($m_h = \sum_i P_i \cdot X_{ih}$) guarantees that the absent equation is

[10]- A recursively dynamic CGE model for the world economy (Lejour et al., 2006; Don and Verbruggen, 2006).
[11]- The CGE model of CEPII (Centre d'Études Prospectives et d'Informations Internationales).
[12]- A CGE model of the World Bank, uses as default the LES augmented with savings (Van der Mensbrugghe, 2005, p. 21).
[13]- The Global Trade Analysis Project of the Purdue University, (Cranfield et al., 2000; Reimer and Hertel, 2004).

deducible by difference. Estimated LES parameters (μ_{ih} and α_{ih}) are used here to derive the income elasticities of mentioned commodities for each single income group of households. Table 12 reports the income elasticities by household types.

4 Counterfactual Simulations and Results

To evaluate the effects of targeted subsidies reform on all economic agents in general, and on different income groups of rural and urban households in particular, we compare the updated benchmark equilibrium with consumption subsidies to one without subsidies. Given that the suggestion of consumption subsidy removal in the economy is often met with opposition due to expected increased cost to lower income households, it is essential to protect the poor from the adverse impacts of the reform through the implementation of an efficient social safety net program. To measure the welfare gains (losses) of the reform, the model is solved ensuring that the government revenue which was originally distributed to consumers as subsidy is redistributed to all income groups of households in a lump-sum fashion. It is worth noting that the main difference between the consumption subsidy reform considered in this research with the equal-yield subsidy reform described by Jensen and Tarr (2003) is that, in the counterfactual scenario in this research, total nominal government revenue is not assumed to be constant. In the reform in this research, referred to as targeted subsidies reform, the government of Iran eliminates consumption subsidies of the GTAP7 subsidized commodities, causing government spending to fall. Since aggregate real government demand for the commodities remained constant, government revenues are increased. The gain from the price increases is assumed to be exogenously redistributed to households, so as to provide more efficient safety net for the lower income groups. In such a targeted subsidies reform, efficiency gains may occur if more distortionary subsidies are replaced by a less distortionary income transfer.

Since subsidizing food and energy commodities produces high economic distortions, it is expected that implementing the reform yields economic benefits. Table 13 illustrates the aggregate effects of the consumption subsidy reform on output, import, export, real private consumption and price levels of the GTAP7 subsidized commodities. As is evident from table 13, the removal of food and energy subsidies improves the overall welfare by 2.9 percent. The CPI, as expected, will rise significantly in this scenario, accounting for about 97.8 percent. Given that eliminating consumption subsidies of food and energy commodities would lead to an increase in their domestic prices, consumption of those commodities that were heavily subsidized by the government are expected to fall. Regarding food and agricultural goods, the reform leads to a reduction of about 3.5, 75.1 and 42.7 percent in the consumption of Wheat, Milk and Sugar respectively, while the private consumption of other food and agricultural commodities increases after removing food and energy subsidies.

Table 12: Income Elasticities of the LES Demand by Rural and Urban Household Type

	ε_{i1}		ε_{i2}		ε_{i3}		ε_{i4}		ε_{i5}		ε_{i6}		ε_{i7}		ε_{i8}		ε_{i9}		ε_{i10}	
	RH1	UH1	RH2	UH2	RH3	UH3	RH4	UH4	RH5	UH5	RH6	UH6	RH7	UH7	RH8	UH8	RH9	UH9	RH10	UH10
Agri-products	0.26	1.30	0.36	0.87	0.39	1.48	0.69	0.65	0.92	0.58	0.63	0.48	0.86	0.80	0.94	0.37	0.84	1.00	0.10	0.71
Coal	1.66	0.58	1.70	0.66	0.10	0.32	0.14	0.46	0.34	0.78	0.27	0.33	0.30	0.33	0.92	0.02	0.58	0.32	0.60	0.10
Dairy Products	1.10	0.93	1.29	1.15	0.95	0.45	0.98	0.54	1.14	0.67	1.31	1.40	0.12	1.33	0.85	0.60	0.63	0.71	0.24	0.06
Electricity	0.98	0.81	0.91	0.74	1.48	0.83	0.97	1.11	1.64	1.19	2.06	1.39	1.15	0.99	0.89	1.04	1.06	1.56	0.19	0.10
Gas	0.97	1.28	1.33	1.27	1.17	0.35	1.51	1.15	1.28	0.48	0.58	0.04	1.77	0.43	0.54	0.84	0.86	0.94	0.33	0.14
Meat	1.73	0.91	0.91	1.00	1.12	1.24	1.45	1.03	0.52	0.89	1.06	1.35	0.59	0.90	1.21	1.16	0.94	0.98	0.33	0.07
Milk	1.83	1.16	2.41	0.20	0.62	1.07	0.32	0.65	0.51	1.31	0.92	0.42	1.33	2.08	0.73	0.46	0.99	1.55	0.08	0.08
Oil	3.00	1.54	3.78	1.24	3.03	1.54	2.76	0.82	1.93	0.54	1.62	1.02	2.09	0.24	1.95	0.27	0.80	1.30	0.13	1.38
Others	0.79	0.96	0.94	1.03	0.99	0.70	0.75	0.99	0.94	1.03	1.06	0.99	1.04	1.04	0.86	1.12	0.98	0.92	2.04	1.45
Processed-agri products	0.87	0.58	0.75	0.40	0.75	3.25	1.20	0.14	1.31	1.08	0.63	0.69	0.96	0.69	1.31	0.74	1.11	1.33	0.10	1.11
Petroleum Products	6.86	0.33	4.51	3.68	5.42	2.19	2.27	4.76	4.37	3.48	2.10	3.23	2.96	2.49	0.94	1.29	2.36	1.85	1.97	0.23
Services	0.90	1.28	1.22	1.22	0.90	1.16	1.17	1.56	0.77	1.06	1.27	1.12	1.11	0.91	1.06	1.49	1.16	1.19	0.25	0.23
Sugar	1.12	0.93	1.60	0.15	1.48	0.24	1.55	1.38	0.06	1.81	1.17	0.99	1.34	0.25	1.26	1.38	1.59	0.54	0.21	0.11
Transport	1.09	1.02	0.97	1.01	1.16	0.95	1.15	1.21	1.29	1.04	1.00	1.01	1.23	1.16	1.08	0.84	1.11	0.99	0.61	0.68
Vegetable Oil	1.09	0.90	0.51	0.69	0.86	0.44	0.90	0.95	1.47	1.78	0.85	1.67	1.01	1.16	1.15	1.08	1.22	0.92	0.23	0.06
Wheat	0.69	0.52	0.83	0.61	0.31	0.33	0.74	0.79	0.07	0.14	0.21	0.12	0.43	0.89	0.28	0.60	0.49	0.43	0.02	0.02

Sources: author's calculation.

It is also worth noting that, the more a sector is benefiting from food and energy subsidy programme, in counterfactual, the more expensive is its product and the more decline is accrued in private consumption of its product. Given the high subsidy rates of the GTAP7 energy commodities in the benchmark, the reform, as expected, leads to a large decrease in the private consumption of Gas, Electricity and the Petroleum Products, accounting for about 56.1, 29.0 and 59.9 percent respectively. As shown in Table 13, most of energy intensive sectors suffer significant output declines because of the rise of input prices. However, the consequence of removing consumption subsidies is a significant increase in the production of Fuel Oil. Given that the reform causes the domestic consumption of food and energy commodities to fall drastically, it, as expected, brings a significant increase in exports of subsidized commodities except Sugar and Gas. However, the reform results in an increase in imports of all agricultural commodities, Electricity and Gas.

Table 13. Aggregate Effects of the consumption Subsidy Reform

	Output by Sector (% changes)	Exports (% changes)	Imports (% changes)	Consumption (% changes)	Price Level	
					Benchmark	Counterfactual
Wheat	-1.7	28.5	54.1	-3.5	0.85	2.11
Meat	6.9	43.7	62.4	8.7	1.27	2.11
Milk	3.8	20.0	70.6	-75.1	0.10	2.10
Vegetables	0.5	32.7	56.7	9.8	1.28	2.11
Dairy Products	6.0	34.1	71.1	7.1	1.22	2.10
Sugar	-26.0	-10.5	29.9	-42.7	0.40	2.11
Agri Products	-3.8	18.3	68.6	3.4	1.16	2.11
Processed-Agri Products	6.2	35.6	70.0	9.9	1.24	2.11
Coal	-14.0	81.4	-8.8	11.6	1.88	2.14
Oil	-9.9	51.5	-28.9	0.0	2.19	2.12
Gas	-34.5	-21.8	17.1	-56.1	0.22	2.11
Electricity	-9.6	31.1	29.2	-29.0	0.59	2.12
Gasoline	-33.1	0.0	-27.8	-68.9	0.23	2.12
Diesel	-35.0	30.8	0.0	-65.8	0.25	2.12
Kerosene	-47.2	6.2	0.0	-60.7	0.25	2.12
Fuel oil	36.8	156.2	0.0	-44.5	0.39	2.13
	Welfare effect of Reforming Food Subsidies (% changes)			CPI (% changes)		
Overall	2.9			97.8		

Sources: author's calculation.

The effect of the targeted subsidy reform on the real returns to primary factors of production is reported in Table 14. Finding show that, the real return to Unskilled Labour and Capital falls, accounting for about 3.4 and 11.0 percent respectively, after eliminating food and energy subsidies. However, households who provide skilled labour will benefit from the reform as their real wage rates rise by 11.7 percent. Counterfactual results also suggest that the real return to Land in GTAP7 food and agricultural sectors Meat, Milk and Dairy Products increases by an

average of 7.0 percent, implying that owners of Land in these sectors will gain from the reform. As shown in Table 13, there is a positive output response of these sectors as a result of eliminating food and energy subsidies, so the real return to Land which is specific to production of these commodities increases. However, the percentage changes in the real return to Land in other food and agricultural sectors Wheat, Vegetables and Agricultural Products falls by an average of 14.3 percent. In addition, the government revenue from the ownership of Natural Resources in Coal, Oil and Gas sectors falls significantly, accounting for an average of 66.7 percent. As the reform leads to activity deterioration in Coal, Oil and Gas, the real returns to Natural Resources which is specific to production of energy goods also fall in these sectors.

Table 14. Real Return to Factors with Reforming Consumption Subsidies (% change)

	Land	Natural Resources
Wheat	-13.6	
Meat	6.6	6.6
Milk	12.5	
Vegetables	-5.5	
Dairy Products	2.0	
Agri Products	-23.9	
Coal	0.0	-79.5
Oil	0.0	-67.2
Gas	0.0	-53.4
Others	0.0	-8.7
Mobile factors		
Unskilled Labour	-3.4	
Skilled Labour	11.7	
Capital	-11.0	

Sources: author's calculation.

Table 15 reports percentage changes in government savings and government revenue from different sources in counterfactual. It is expected that the elimination of food and energy subsidies results in a significant increase in the government revenue because of the fact that food and energy subsidization has caused a heavy budgetary burden for the government. Findings indicate that the consumption subsidy reform results in an increase in the aggregate government revenue because of the fact that the reform produces a significant increase in the government revenue from the ownership of Capital and government tax revenue from intermediate inputs, primary factors of production and imports. Another reason for this increase is that, the elimination of consumption subsidies increases the government tax revenue from private consumption drastically. Additionally, government tax revenues from primary factors of production increases significantly after eliminating food and energy subsidies. However, the value of government savings falls by 56.2 percent as a result of the change in prices of investment goods. In addition, the government revenue from Natural Resources falls by about 34.5 percent. The main reason for this reduction can be the fact that, as removing government subsidies to food and energy products results in activity deterioration in some of food sectors and

all energy sectors; it results in a fall in the government revenue from the ownership of Natural Resources which is specific to the production of energy goods.

Table 15. The Change in Government Revenue

	Initial value	Counterfactual value	% changes
Total Income	14362.4	44291.9	208.4
Natural Resources	47321.6	31007.9	-34.5
Capital	49337.6	86612.8	75.6
Government Savings	-59101.7	-92288.3	-56.2
Government Tax Revenue from:			
Intermediate Inputs	4087.4	5964.3	45.9
Primary Factors			
Unskilled Labour	2156.3	4108.5	90.5
Skilled Labour	927.7	2042.3	120.1
Capital	220.8	387.6	75.6
Exports	-550.5	-830.0	-50.8
Imports	9172.9	14371.1	56.7
Private Demand	-33796.7	673.9	102.0

Sources: author's calculation.

The economic impacts of the consumption subsidy reform on households in both rural and urban areas depend on a number of factors such as the expenditure shares of subsidized commodities, price and income elasticities of demand and the magnitude of the price change (IEA, OPEC, OECD and World Bank, 2010). To study the socio-economic benefits and costs of subsidy policy reform in Iran, the model applies a willingness-to-pay measure known as Hicksian equivalent variation (EV). Ki-Whan Choi (2006) notes that Hicksian equivalent variation (EV) which computes changes in money metric utility between an equilibrium with subsidy and one without subsidy is an appropriate measure to calculate and compare welfare levels in the benchmark and counterfactual scenario across different income households. According to Shoven and Whalley (1992), the value of EV between a benchmark and counterfactual scenarios can be defined as Equation (3), where p_i^b (p_i^c) denotes the price vector in benchmark (counterfactual) equilibrium, and $SNUM_{(h,n)}^b$ ($SNUM_{(h,n)}^c$) indicate the supernumerary or uncommitted income by household types in benchmark (counterfactual) equilibrium. As expected, a positive EV shows a welfare gain, while a negative EV shows welfare loss. In addition, the percentage change in the value of EV must be equivalent to the sum of real percentage changes in household income from different sources.

$$EV_{(h,n)} = SNUM_{(h,n)}^c \prod_{i=1}^{n} \left(\frac{p_i^b}{p_i^c}\right)^{\alpha_{ih}} - SNUM_{(h,n)}^b \qquad (3)$$

Given that the expenditure shares of subsidized food and energy commodities in both rural and urban areas are significant, it is expected that the reform will change households' consumption patterns dramatically and have significant effects on the welfare of the vulnerable households.

Tables 16 and 17 report the nominal percentage changes in the private consumption by rural and urban household deciles respectively in the counterfactual equilibrium. Findings show that the reform causes the private consumption of Milk, Sugar, Gas and Petroleum Products to fall drastically across most of rural household deciles. However, the removal of consumption subsidies increases the private consumption of rest of commodities, except Electricity, across all rural and urban household deciles. As is evident from Table 16, if the focus moves from lower rural household deciles to higher ones, the combined reform causes the private consumption of Petroleum Products to fall monotonically, while the reduction in the private consumptions of Milk, Sugar and Gas is not monotonic. As shown in Table 17, the reduction in the private consumptions of Milk, Sugar, Gas and Petroleum Products is not monotonic across urban household deciles.

The income and welfare effects of eliminating food and energy subsidies for rural and urban household deciles are reported in Table 18. Counterfactual results suggest that the poorest rural households, the first and second income groups, benefit from the combined subsidy reform since the welfare levels in these groups increase significantly, while the rest of rural households will be worse off. As shown in Table 18, for most of rural households, incomes from Unskilled Labour, Land and savings decrease, while their incomes from Skilled Labour and Capital increase in counterfactual. It is also worth noting that the percentage changes in real income from Capital and savings are significant, while the reform does not affect the other source of household's income considerably. Finally, if the focus moves from lower income households to higher ones in rural areas, levels of welfare decrease monotonically. This implies that, the combined subsidy reform results in desirable outcomes for low-income households in rural areas due to the equity effects of compensation. Findings also suggest that the combined subsidy reform yields welfare gains for all urban household deciles, as the percentage changes in real income are positive for urban households in counterfactual. In urban households, the reform causes real incomes from Unskilled Labour, Skilled Labour, and savings to rise across most of household deciles. However, most of urban household deciles experience a significant decrease in their income from Capital, ranging from a minimum of about 1.3 percent to about 19.1 percent. Additionally, low-income households in urban areas lose relatively more than high-income households from the real return to capital. Overall, all urban households benefit from the reform.

5 Conclusion

Iran plans to implement a number of market-oriented reforms to deal with existing distortions such as heavily subsidized food and energy commodities, and many of the required reforms are presented in the Five-Year Development Plans. The government of Iran had decided to initiate a subsidy phase out policy on some subsidized food and key energy items such as Wheat, Milk, Sugar, Gas, Electricity and Petroleum Products. In this paper we have analyzed the effects of targeted subsidies reform on all economic agents in general, and on different income groups of rural and urban households in particular. For this purpose, the GTAP7inGAMS static CGE model with 20 household types in rural and urban areas, grouped according to income is employed. The model is calibrated using a rich set of data including the Urban and Rural Households' Income and Expenditure Survey of 2004 conducted by the SCI and the GTAP 7 database. Given that the initial levels of subsidies on Petroleum Products are significant and

different from each other, in this research we disaggregated the Petroleum Products (p-c) into four energy commodities: Gasoline, Diesel, Kerosene and Fuel Oil. Using protection data prepared by Iranian statistical centers, we altered consumption tax rates in the GTAP 7 database as subsidy data available for Iran in the GTAP7 database were underestimated for most of commodities.

Counterfactual results indicate that the removal of food and energy subsidies improves the overall welfare. In addition, the reform results in a large decrease in the consumption of Wheat, Milk, Sugar, Gas, Electricity and the Petroleum Products, while the private consumption of other food and agricultural commodities increases after removing food and energy subsidies. The reform causes the real return to Unskilled Labour and Capital to fall, while households who provide skilled labour will benefit from the reform. Counterfactual results also suggest that, land owners in the most of GTAP7 food and agricultural sectors Meat, Milk and Dairy Products will benefit from the subsidy reform. However, land owners in other food and agricultural sectors Wheat, Vegetables and Agricultural Products will lose from the reform. Given that the reform leads to activity deterioration in Coal, Oil and Gas, the government revenue from the ownership of Natural Resources in these sectors falls drastically. However, the reform results in an increase in the aggregate government revenue because of the fact that the reform produces a significant increase in the government revenue from the ownership of Capital in energy sectors and government tax revenue. Finally, most of rural income groups, except the poorest ones, will be worse off after eliminating consumption subsides, as their welfare decrease monotonically by moving from lower household deciles to higher ones. However, the reform yields welfare gains for all urban household deciles, as the reform caused real incomes Unskilled Labour, Skilled Labour, and savings to rise across most of household deciles.

Table 16. Private Consumption Impacts of Subsidy Reform by Rural Households in Deciles (Real % change)

	Rural1	Rural2	Rural3	Rural4	Rural5	Rural6	Rural7	Rural8	Rural9	Rural10
Wheat	61.4	58.0	54.0	48.4	54.4	51.7	47.4	48.3	39.2	54.6
Meat	103.7	70.3	69.6	72.4	60.1	66.0	60.0	63.0	59.7	51.3
Milk	-66.4	-69.4	-39.1	-19.2	-53.2	-68.3	-76.4	-65.4	-77.8	13.7
Vegetables	76.6	56.3	60.1	59.6	68.9	58.6	60.0	58.3	57.8	47.6
Dairy Products	94.8	87.9	77.1	75.4	76.1	76.8	65.5	68.3	65.8	60.8
Sugar	19.5	11.7	-4.1	-12.9	40.9	-17.3	-22.4	-26.1	-44.3	18.9
Agri Products	77.6	76.9	75.5	77.3	77.3	75.0	75.8	72.3	69.6	69.9
Processed-Agri Products	87.5	77.6	72.7	75.7	75.9	67.8	70.2	68.8	65.5	57.9
Coal	0.0	66.7	20.0	20.0	40.0	14.3	20.0	50.0	20.0	33.3
Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas	-2.6	-9.8	-22.9	-42.0	-52.5	-12.3	-61.0	-14.0	-48.6	14.4
Electricity	30.8	31.8	10.1	15.3	-16.0	-21.8	-2.0	0.8	-14.0	33.5
Gasoline	-44.7	-30.6	-44.7	-46.2	-59.0	-61.7	-63.1	-57.0	-67.6	-68.8
Diesel	-46.1	-33.5	-46.4	-47.8	-59.8	-62.3	-63.6	-57.9	-68.0	-69.1
Kerosene	-46.2	-33.8	-46.5	-48.0	-59.9	-62.4	-63.6	-58.0	-68.0	-69.2
Fuel oil	-53.8	-48.0	-55.3	-56.4	-64.0	-65.8	-66.7	-63.1	-70.2	-71.4
Metal	68.9	65.1	65.0	59.8	67.2	68.2	66.8	61.3	64.9	57.3
Transport	61.1	47.2	52.5	52.6	66.6	53.2	59.6	54.0	59.4	35.4
Service	99.7	97.6	87.7	89.0	83.6	87.5	85.1	80.5	77.9	73.9
Others	77.7	73.8	72.7	67.7	73.2	73.9	72.6	67.3	69.2	57.3

Sources: author's calculation.

Table 17. Private Consumption Impacts of Subsidy Reform by Urban Households in Deciles (Real % change)

	Urban1	Urban2	Urban3	Urban4	Urban5	Urban6	Urban7	Urban8	Urban9	Urban10
Wheat	52.1	43.7	56.0	44.8	54.1	54.2	35.4	43.4	47.5	55.1
Meat	91.9	83.7	76.6	80.3	73.6	86.6	74.1	78.9	74.2	54.4
Milk	-79.1	-81.9	-52.2	-73.1	-62.2	-47.6	-43.0	-56.3	-12.0	7.5
Vegetables	86.1	68.3	55.3	72.9	94.2	92.3	77.0	72.4	68.1	49.0
Dairy Products	100.8	95.5	73.4	76.5	77.9	94.8	91.3	74.8	76.8	64.6
Sugar	-14.1	-13.8	24.8	-1.4	-2.9	-13.0	18.8	11.7	3.4	31.0
Agri Products	118.9	89.0	95.2	83.2	80.6	79.1	82.2	76.0	85.0	73.5
Processed-Agri Products	83.9	72.2	131.6	66.3	84.4	76.2	75.0	75.3	87.7	71.6
Coal	48.0	53.8	18.5	37.5	50.0	23.1	26.7	10.5	23.8	14.3
Oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gas	-58.5	-62.9	-12.9	-40.1	-3.6	12.4	-18.3	-12.0	5.3	54.7
Electricity	7.3	2.0	28.9	-2.5	-0.7	-8.4	-8.9	-6.1	-17.8	39.4
Gasoline	-62.7	-66.7	-42.8	-68.6	-68.7	-66.9	-75.0	-70.1	-62.7	-60.3
Diesel	-63.1	-67.1	-44.5	-68.8	-68.9	-67.2	-75.0	-70.3	-63.2	-61.0
Kerosene	-51.8	-34.6	-26.8	-26.8	-25.1	-13.6	-17.0	-12.7	-11.8	-10.0
Fuel oil	-58.1	-49.2	-45.2	-45.6	-44.9	-40.0	-41.5	-39.3	-39.0	-38.3
Metal	102.0	88.7	67.7	83.4	79.8	80.0	86.6	85.8	76.6	86.5
Transport	97.9	85.5	48.7	86.5	67.6	68.5	88.2	61.5	67.8	49.9
Service	130.8	109.0	96.6	115.1	97.7	99.4	93.1	103.7	97.6	77.9
Others	106.4	92.7	75.9	88.6	85.5	85.5	89.7	89.4	81.9	86.5

Sources: author's calculation.

Table 18. The Change in Factor Income and household welfare by Rural and Urban Households in Deciles (% change)

	Rural1	Rural2	Rural3	Rural4	Rural5	Rural6	Rural7	Rural8	Rural9	Rural10
% Change in Household welfare	34.7	18.2	-2.3	-6.4	-12.4	-11.0	-19.4	-19.3	-22.2	-29.6
Change in Households Income										
Mobile factors										
Unskilled Labour	4.7	-3.2	-6.3	-6.3	-5.2	-4.7	-9.0	-6.3	-4.8	-3.3
Skilled Labour	7.2	5.1	1.5	1.2	0.4	0.7	-1.2	-0.3	-0.4	-0.1
Capital	7.6	12.1	10.4	11.7	2.0	4.6	13.7	11.4	3.4	7.7
Specific factors										
Land	-0.3	-1.5	-1.8	-1.7	-1.2	-1.2	-2.0	-1.5	-1.2	-1.2
Savings	15.5	5.8	-6.1	-11.3	-8.4	-10.4	-20.9	-22.7	-19.3	-32.7
	Urban1	Urban2	Urban3	Urban.4	Urban5	Urban6	Urban7	Urban8	Urban9	Urban10
% Change in Household welfare	15.0	4.9	29.6	10.0	12.7	14.6	7.3	9.7	11.2	11.9
Change in Households Income										
Mobile factors										
Unskilled Labour	-0.8	-0.9	3.4	-0.4	0.8	1.8	0.9	1.3	1.5	5.0
Skilled Labour	2.0	1.7	7.1	2.8	4.1	4.1	3.0	3.1	3.2	4.8
Capital	-19.1	-12.4	-7.0	-12.2	-10.3	-8.0	-9.0	-7.5	-5.8	-1.3
Specific factors										
Land	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.1	0.0
Savings	32.9	16.5	26.0	19.8	18.1	16.6	12.4	12.8	12.4	3.4

Sources: author's calculation.

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