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Potential Economic and Environmental Implications of Diesel Subsidy: A Computable General Equilibrium Analysis for Turkey

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ABSTRACT

This paper is aimed at addressing three interrelated main issues: First is the role of fuel subsidies role in different parties' election campaigns in the June 7, 2015 general election in Turkey. Second is the impact of agricultural diesel subsidies on both macroeconomic indices and carbon emissions. Third is the distinction between neutrality and non-neutrality of indirect tax revenues when the diesel is subsidized. Each issue is designed as to the policy scenario to employ multi-sectoral general equilibrium model which investigates the short-run impacts of policy scenarios. The short run simulation results suggest that all shocks are beneficial for the entire economy due to the increase in GDP and welfare with varying degrees. All agricultural sectors gain from the expanding domestic output and exports because of low diesel prices. The scenario followed by non-neutrality of revenue greatly increases in output and consumption, and nevertheless emission level of carbon as well.

Keywords: Computable General Equilibrium, Subsidy, Energy, Carbon Emission
JEL Classifications: C68, H71, Q43, Q54

1. INTRODUCTION

This paper offers a general equilibrium analysis of how fuel-subsidies can impact the agricultural sectors from an economic and political economy perspective. In the June 7 general elections in Turkey, the prominent opposition parties including Republican People's Party (CHP), the Nationalist Movement Party (MHP) and the Peoples' Democratic Party (HDP) made important economic promises including higher minimum wages, free electricity for poor people with limited incomes, and reducing retail prices of diesel used in agriculture despite deteriorating fiscal discipline.

Compared to previous national election in Turkey, it is said to be that recent energy subsidy policy became more prominent than traditional macroeconomic policy related to trading-off between inflation and economic growth or other important political issues such as the promotion of democracy, protection of human rights etc.

One of the most important energy promises by the opposition was free electricity for the lower income groups below a specified level. The main opposition party, namely CHP, offered 230 kWh of free electricity for the families of four below the poverty line[1]. The other opposition party, MHP, promised to repay 75% of the electricity bills of the households below the poverty line. The value added tax (VAT) on electricity used in irrigation and agricultural sectors will be removed and also cheaper electricity is provided for farmers by this party[2]. On the other hand, the HDP's manifesto includes the purge of electricity bills of small villagers who are also small producers. In the context of fundamental assurance package, 10 cubic meter of water and 180 kWh of electricity per month will be distributed free of charge to every household[3].

The other prominent promise of opposition parties is to reduce the price of diesel by means of removing sales taxes imposed on it. The main opposition party offered to reduce the retail price of one liter of diesel used by farmers for production to 1.5 TL. The MHP also offered a liter of diesel decrease down to 1.75 TL in order to support farmers besides fertilizers, pesticides, seeds, feed and seedlings in line with agricultural support programs. Similarly the HDP also offered removal of sales taxes on diesel

1 See more detail in https://www.chp.org.tr
2 See more detail http://www.mhp.org.tr
3 See more detail in http://www.hdp.org.tr

and fertilizers used by small-scaled farmers; water and electricity will be provided free of charge.

In Turkey, the diesel is being currently subsidized by 3.3 TL to 4.75 TL per decares, along with many other agricultural subsidy items under the ruling Justice and Development Party (AKP). The current consumer price of diesel is around 4 TL, while refinery output price is around 1.50 TL.

The focus of the paper is solely on "cheap diesel used by farmers" by removing sales taxes including special consumption tax and VAT in the context of fuel subsidy. It is assumed that the reducing the price of diesel used by farmer is achieved by elimination of sales taxes including of special consumption tax and VAT on it.

Turkey's major opposition parties should take negative economic consequences into account, while they offered fuel subsidies. In the first instance, fuel subsidies create fiscal burden on budgets. This causes government budget cuts in other areas such education and health. In some countries, tax subsidies for fossil fuels exceed education expenditure in government budget (Bridle at al., 2014; Roberts, 2003). However by reducing the cost of fossil fuels compared to the renewable energy sources, subsidies also may prevent to the deployment of renewable energy capacity (Bridle and Kitson, 2014). Briefly, subsidizing fossil fuel can make renewable energy uncompetitive. Moreover, subsidies increase wasteful consumption by encouraging fuel consumption inefficiently. In addition to wasteful consumption, they distort market by exacerbating price volatility. In spite of these disadvantages, opposition parties attempt to change behavior of voter in favor of them by using energy subsidies to support farmers or small-scale villagers as vulnerable groups in a society. Despite the fact that fossil-fuel subsidies are frequently justified on the basis that they provide support and protection to the poor, through lowering direct and indirect fuel costs, evidence from IMF studies reported that the benefits of subsidies accrue disproportionately to the wealthier sections of society and are frequently ineffective in meeting social goals (IMF, 2013). For example, fuel subsidies deteriorate income distribution in Indonesia since most of them are enjoyed by well-doing groups rather than poor groups (Dartanto, 2013).

Energy subsidies are widespread around the world but they vary greatly in importance and type of fuel and country (Bazilian and Onyeji, 2012) It is apparent from recent estimation that the total value of all energy subsidies across all 37 countries has increased to over $ 500 billion. Subsidies on oil products is the largest share of total. Moreover 34 countries of all these countries have subsidies on oil products of which 21 are net oil exporting and 13 are net oil importing countries (IEA, 2014).

It is known that Turkey is oil-importing country, the oil production has not been increasing, while fuel consumption has increasing steadily. In the energy sector including of electricity, natural gas, oil products, and LPG, the Turkish government has been followed a reform liberalized the sector and setting up an independent regulator named as energy market regulatory authority (EMRA) since 2001. The EMRA supervises and regulates all energy sectors. This is because fuel prices in Turkey are determined by market mechanisms under the supervision of EMRA.

Following the reform of energy sectors, it is now generally considered that the majority of fossil-fuel subsidies are granted to the coal sector. However, there is a range of non-quantifiable subsidies that also confer significant financial and non-financial benefits on the sector. In addition, Turkey has also recently begun to subsidize renewable energy, providing a feed-in tariff and some additional support measures to developers (Simsek and Simsek, 2013; Kaplan, 2015). On the other hand, there are significant subsidies $ 0.01 per kWh for coal in Turkey. In 2013, total estimated subsidies for the coal industry is about $730 million (Acar at al.,2015).

A large number of empirical studies (Naqvi, 1997; Lin and Ziang, 2011; David, 2009; Ellis, 2010; Farajzadeh and Bakhshoodeh, 2015) have been carried out on the issue of fuel subsidy reform both in developed and developing countries in the world. However, large number of empirical studies (Bazilian and Onyeji, 2012; Dartanto, 2013) were about the issue of removal of fuel subsidies in many countries in recent years, especially concerning the wasteful consumption caused by inefficient subsidies (IEA, 2011). However there are only a few studies (Acar et al., 2015; Hope and Singh, 1995) focusing on the impacts of energy subsidies in Turkish economy.

The rest of the paper is organized as follows: The model section introduces a general equilibrium model and it features in order to analyze the removal of sales taxes on diesel used by farmers. The simulations analysis section design policy scenarios and apply computable general equilibrium model to simulate the impact of diesel subsidy on macroeconomic indices and environmental variable. The conclusion section includes several policy recommendations.

2. MODEL STRUCTURE AND DATA

2.1. General Characteristics

The aim of this article is to analyze economic and environmental impacts of cheap diesel used in agriculture by constructing a multi-sectoral Computable General Equilibrium (CGE) model of energy and economy interactions in Turkey. The model is rooted in the ORANI model and it has been extended in line with ORANI model which is an applied general equilibrium model for the Australian economy (Dixon et al., 1982) and has been widely used by academics and economist in government and private sector.

Model is linearized type of CGE model, therefore it belongs to Johansen class of model. It has been extended and designed specifically for analyzing energy and carbon abatement policies. It is built around a social accounting matrix based on input-output table and income-expenditure accounts of 4 types of institutions including households, government, firms and rest of world.

Some important assumptions are used in the model; the supply and demand equations for households and firms, which are known as private sector agents, are derived from the solutions for the neoclassical constrained optimization problems (cost minimization, profit maximization and utility maximization). All agents are assumed to be price-takers (a perfect competition), and because of the fact that producers are assumed to operate in competitive markets, zero profit conditions are assumed to all industries. The input demand equations for the agents are also derived from the solutions to the cost minimizations problems. The treatment of commodities produced by private sector and public sector agents are differentiated by modelling taxation.

Each industry uses multiple-inputs from produced inputs (domestic and imported intermediate commodities) and non-produced inputs (capital, labor, and land) while industry produce only single output except that refinery industry. Refinery industry uses crude oil as input and produces various oil products. In another words, most industries produces just one commodity but the oil refinery industry produces 4 fuel goods; diesel, gasoline, LPG and other products. This exception of refinery industry in production allows to make simulations related with lowering price of diesel in favor of farmers.

2.2. Production Structure

Properties of multi-input and multi-output in production structure are implemented by series of separability assumptions illustrated by the nesting shown in Figure 1. Production function can be generalized by employing of input-output separability assumption for each industry. F(inputs, outputs) = 0 may be written as G (inputs) = X_1TOT = H(outputs) where X_1TOT is an index of industry activity. This type of assumptions reduces the number of estimated model's parameters. H function is derived from a constant elasticity of transformation aggregation functions, while the G function is broken into a sequence of nests (Horridge, 2003).

Figure 1: Production structure

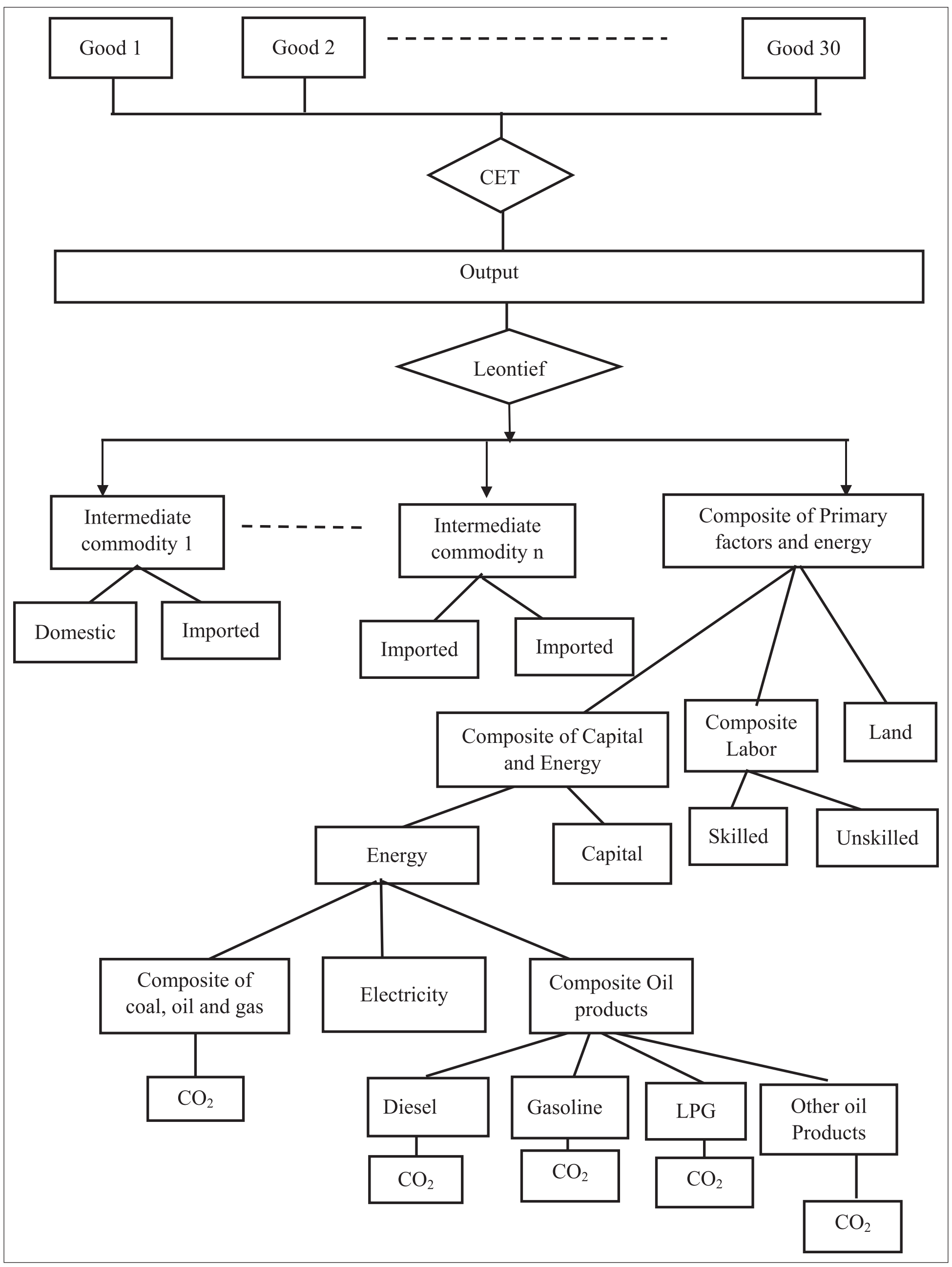

Figure 1 shows that the production function is made up of five-layer nested Leontief-CES function. Two forms of energy substitution have been incorporated into the model: (a) substitution within energy sources by means of parameter named as SIGMA1ENR, and (b) substitution between primary factors and energy by means of a parameter named as SIGMA1EPRIM.

We begin at the bottom of nests and work upwards. The composition of input refinery or oil products is CES aggregation of 4 products; diesel, gasoline, LPG, other oil products. At the fourth level, the composite of input energy is CES aggregation of extraction or mining (oil, gas and coal), oil products and electricity. At the third level, the composite of capital and energy is CES aggregation of capital and composite energy. The composite labor is CES aggregation of skilled and unskilled labor. At the second level the composite primary factor and energy is CES aggregation of composite energy and capital and composite labor, and land. Moreover, each commodity composite is a CES aggregate of its supply from domestic and foreign sources. At the top level the output of commodity is Leontief aggregation of composite commodity and composite of primary energy and energy. Consequently, depending on properties of Leontief production function, they are all demanded in directly proportional to X_1TOT.

Each industry employs two types of labor in terms of occupations; skilled and unskilled. The possibility of substitutions in labor demand an industry is only between skilled and unskilled labor. A change in the relative prices for two kinds of labor induces substitution in favor of relatively cheaper occupations. Model contains no theory of labor supply. Users of the model have the option of setting employment exogenously, with market-clearing wage rates determined endogenously, or setting wage rates (real or nominal) exogenously, allowing employment to be demand determined.

As in demand for intermediate inputs by source, we follow the Armington (1969) assumption that imports are imperfect substitutes for domestic intermediates. Since the total cost of each imported and domestic goods is minimized subject to the production function, the lowering a source-specific price, relative to the average, induces substitution in favor of that source.

In order to analyze the environmental impacts of lowering the price of diesel used by farmers, carbon emissions stemming from burning of fossil fuels including coal, natural gas, oil and oil products are incorporated into the model. Therefore, it is assumed that carbon emissions are closely related to energy consumption and it is assigned that user, fuel, and source specific emissions coefficients (carbon dioxide per dollar) and prorate the fuel specific national carbon dioxide inventories among users.

2.3. Final Demand Structure

The final demands used in the model are very similar to ORANI model. In capital formation, the production of new units of fixed capital is assumed to be produced with inputs of domestically produced and imported commodities. The production function has the same nested structure as to what governs intermediate inputs to current production. Primary factors are not used directly as inputs to capital formation. Production of new units of fixed capital is a nested Leontief-CES function. Demand for investment goods are derived from the solutions to the investor's cost minimization problem. This problem is handled with two stages; In the first stage, the total cost of input for capital formation, from the domestic and imported sources, is minimized subject to the production function ($X2_{i,s,j}$). Here ($X2_{i,s,j}$) is the intermediate input demand for capital information in industry j. In the second stage, total cost of inputs (aggregated by sources) is minimized subject to the Leontief production function.

The nesting structure for household demand is similar to that of the capital formation demand. The household demand for commodity composites are aggregated by a Klein-Rubin (instead of Leontief) leading to the linear expenditure system.

Export demand depends on the price of export commodities with an assumption of a constant elasticity of export demand. It is assumed that government consumption is directly proportional to private consumption in the absence of any exogenous shift variable (i.e., in the model, f5tot and f5 are kept all exogenously to zero). In another words, government expenditure is exogenously determined.

2.4. Data and Dimension of Model

The data of model is compiled from two sources; Turkish input-output table with base year of 2002 published in 2008 by Turkish Statistical Institute (2002) and latest GTAP database with version 9. It has an updated form of Turkish input-output table base year of 2011 (Narayanan et al., 2015). The 57 commodities and 57 sectors in GTAP database are disaggregated into 27 commodities and 27 sectors for Turkish economy. Commodity and industry classification used in the model is given Appendix Table 1. There are 16 agricultural sectors which are thought to be essential for implementing cheaper diesel used by farmers. Oil products obtained from refinery industry is further disaggregated into 4 goods (diesel, gasoline, LPG, other oil products) by using auxiliary energy data. 27 sectors of Turkish economy produce 30 commodities due to the multiple production is confined to the refinery industries. Moreover, sectors should be classified into two broad categories: Energy commodities (extraction, diesel, gasoline, LPG, other oil products, and electricity), and non-energy commodities. Commodities should also be classified into "bad" commodities (oil, gas, diesel, gasoline, LPG, other oil products) which release carbon dioxide emission to atmosphere when they are burning and "non-bad" commodities in order to analyze environmental impacts of low price of diesel used by farmers. Furthermore there are six energy commodities in the model: Extraction including coal, oil and gas, diesel, gasoline, LPG, other oil products, and electricity, but only diesel is subsidized in the model.

Elasticity parameters used in the model explains the behavioral responses of economic agents. The parameter value of Armington elasticity, substitution elasticity between primary factors, different types of labor, and between energy inputs obtained from GTAP database and outside of model i.e., from literature. For example, parameter values import-substitutions elasticity and Frisch (1959) parameter are obtained from studies of Vincent (1986). The substitution between energy inputs and capital in primary factors illustrated the flexibility of the Turkish economy's ability to adopt and utilize energy saving technology as the energy input costs are affected by the application of the carbon price mechanism. The substitution elasticity between capital and energy composition is still assumed to be positive indicates energy and capital are substitutes. However, provided the value of capital and energy parameter is set at a level lower than value added (labor and land) and energy parameter, the overall substitution elasticity between capital and energy may still be negative. The elasticity of substitution between energy and capital is small (Okagawa and Ban, 2008; Truong et al., 2007; Burniaux and Truong, 2002), Burniaux, et al. (1992) indicated that energy and capital are complementary in the short to medium term, and substitutable in the long run (Keller, 1980). As explained above, composite energy and capital are quite difficult to substitute especially in the short run, so the substitution elasticity between composite energy and capital is assigned the value of 0.1. The substitution elasticity between energy commodities is assigned the value of 0.25 in the model.

3. SIMULATION ANALYSIS

3.1. Design of Policy Simulations

In Turkey, taxation system is divided into two broad categories: First is the direct taxation system and it consists of two main taxes named as income tax and corporate tax. Second is the indirect taxes. There are several indirect taxes levied in Turkey, but most important indirect taxes are the VAT and special consumption taxes (SCT) and customs duties or import duties. These taxes also known as sales taxes. Motor vehicle tax, stamp taxes, communication tax, education contribution tax. etc. are known as other indirect taxes.

In both categories some commodities are taxed at specific rates and the other commodities at ad valorem rates. For example, special consumption tax is imposed on fuels at specific rate, while VAT is taxed on commodities at ad valorem rates. But some of commodities such as oil products had both SCT and VAT. In this model we simply assume that there are three types of indirect taxes: VAT, SCT, and import duty. Moreover, due to the lack of detailed data and for the sake of simplicity we also assume that all taxes are charged at ad valorem rates.

In this article we should focus on VAT and SCT imposed on fossil fuel i.e., diesel in order to design policy simulation. That's why we define indices of the power of sale taxes for producers, investors, household and government in the model. An indices of the power of sale tax for each user category is defined using following five types of sale taxes as user-specific sales taxes: (1) "t_1" for producers, (2) "t_2" for investor, (3) "t_3" for household and (4) "t_4" for export, and (5) "t_5" for government. But we need to define sub-user and sub-commodity tax variable to simulate the impact of removing the user-discriminating taxes on diesel in detail. For this reason, sectors are divided into agriculture and non-agriculture, and commodities are divided into subsidy commodities (diesel) and non-subsidy commodities. Now we simply make sale tax for diesel used in agriculture, t1(subscom,src,agr)[4] exogenous variable to shock in the model. Power of tax on domestic/imported diesel are obtained from by dividing agent price of agricultural products to market prices including margin values in GTAP databases. The policy shock values are given 5th and 7th column in Table 1.

After constructing model structure and its database and determining the policy shock values, we can set up experiments (simulations) in accordance with removing diesel sales taxes on agricultural products by arranging closure of model choosing which variables are to be exogenous or endogenous. In order to analyze the economic and environmental impacts of lowering diesel prices in favor of farmers, we design policy scenarios under short-term macro-economic environment. It should be determined that the macroeconomic environment assumed for the simulation by choosing exogenous variable, together with values prescribed them. We are interested in the effects of sale taxes in the short term, since the adjustment cost of sales taxes is generally perceived is to be high. In line with the assumption of short term simulation period, the important assumptions made about the macroeconomic environment are as follows.

Consistent with short term focus, industry-specific capital stocks, real government spending, supplies of labor, technological parameters, household preference, industry-specific land stocks, direct tax rates are assumed to be unaffected by the changes in energy. The rates of various types of indirect taxes are exogenous with zero change except for energy product of diesel. The taxes of energy products are exogenous and are given policy shocks which are given 5 and 7 columns of Table 1. In all simulation, we assume that prices of all commodities are determined endogenously. The list of all exogenous variables is presented in Appendix Table 2.

In order to examine and focus mainly on the economic and environmental impacts of removing sales tax on diesel used in agricultural sector in Turkish economy, we introduce three simulations described as follows:

- Simulation 1: Removing sales taxes on diesel with non-neutrality of indirect tax revenue. The elimination of the sales taxes (special consumption tax and VAT) on diesel used only by farmers lower purchaser's prices that was promised in the election manifesto. The removing tax directly affects the revenue of indirect tax. The indirect tax revenue is a major source of government income. We can observe the result of removing tax on diesel with non-neutrality of indirect tax revenue by choosing indirect tax revenue as endogenous variable in this simulation.
- Simulation 2: Removing sales taxes on diesel with complete neutrality of aggregate revenue from all indirect taxes (delV0tax_csi). In this simulation, we remove sales taxes on diesel used in agriculture but we do not change revenue from aggregate indirect taxes stemming from producers, investor, household and exports. To do this, we should make aggregate revenue from all indirect taxes, delV0tax_csi exogenous variable instead of uniform change in powers of taxes on all, f0tax-csi, so that indirect tax revenue do not allow to change.
- Simulation 3: Removing sales taxes on diesel with partially neutrality of aggregate revenue from indirect taxes on intermediate (delV1tax_csi). This simulation is very similar

4 "Subscom" represents sub set of commodity, "src" represents source (imports/domestic) of commodity, and "agr" represents sector of agriculture.

Table 1: Values for exogenous powers of sale tax on domestic diesel used in agriculture

No code	agricultural commodities	Domestic		Imported	
		Power of tax in base year	Percentage change in power of tax	Power of tax in base year	Percentage change in power of tax
PDR	Paddy rice	1.91	−47.62	1.75	−42.86
WHT	Wheat	2.02	−50.50	2.02	−50.50
GRO	Cereal grains nec	2.02	−50.49	2.02	−50.49
V_F	Vegetables, fruit, nuts	2.02	−50.49	2.02	−50.49
OSD	Oil seeds	2.02	−50.54	2.01	−50.32
C_B	Sugar cane, sugar beet	2.02	−50.52	2.02	−50.42
PFB	Plant-based fibers	2.02	−50.50	2.02	−50.50
OCR	Crops nec	2.02	−50.51	2.01	−50.36
PCR	Processed rice	2.17	−53.85	2.00	−50.00
CTL	Bovine cattle, sheep and goats	2.02	−50.60	1.93	−48.15
OAP	Animal products nec	2.03	−50.85	2.00	−50.00
RMK	Raw milk	2.02	−50.45	2.00	−50.00
WOL	Wool, silk-worm cocoons	1.00	0.00	1.00	0.00
CMT	Meat products	1.77	−43.48	2.00	−50.00
FRS	Forestry	2.02	−50.53	2.01	−50.26
FSH	Fishing	2.02	−50.49	2.02	−50.46

*The power of tax is one plus the ad valorem tax rate. Source: GTAP database version 9 and author calculations

Table 2: Percentage change in macroeconomics variables

Macroeconomic variables	Removing sales taxes on diesel		
	With non-neutrality of revenue	With neutrality of all tax	With only neutrality of intermediate tax
Quantity variables (%)			
Utility	0.16	0.03	0.10
Nominal GDP	−0.17	−0.05	−0.13
Real GDP	0.07	0.02	0.03
Aggregate employment	0.16	0.06	0.07
Import volume index	0.03	−0.05	0.03
Export volume index	0.07	−0.05	−0.02
Aggregate primary output	0.11	0.05	0.05
Real household consumption	0.09	0.02	0.05
Aggregate real government demands	0.09	0.02	0.05
Contribution of BOT to real GDP	0.00	0.01	−0.02
Trade Balance	0.04	0.00	−0.05
Price variable (%)			
GDP price index	−0.24	−0.07	−0.16
Terms of trade	−0.02	0.01	0.01
Aggregate investment price index	−0.04	0.15	0.05
Consumer price index	−0.28	−0.17	−0.23
Exports price index	−0.02	0.01	0.01
Government price index	−0.14	−0.04	−0.08
Price of primary factors (%)			
Average capital rental	0.45	−0.04	−0.17
Average nominal wage	−0.28	−0.17	−0.23
Real Wage	0.00	0.00	0.00
Average land rental	2.88	2.56	2.56
Average primary factor price	0.15	−0.08	−0.18

Source: Results of simulations

to the second simulation. The only difference is that revenue from indirect taxes on intermediate (delV1tax_csi) do not allow change by choosing it as exogenous instead of uniform change in powers of taxes on intermediate usage (f1tax_csi).

Next sub-sections report the results of simulations together with their analysis. The model is implemented and solved for these scenarios using the RunGEM of GEMPACK[5] software packages.

3.2. Impacts of Removing Sales Taxes on Diesel Used by Farmers on Macroeconomics Indices

Macroeconomic variables are categorized into quantity variables and price variables. The results shown in Table 2 indicate that there is a decrease in the nominal GDP of 0.17% and an increase in real GDP of 0.07% in simulation 1 due to the decrease in GDP price index of 0.24%. The quantity of percentage increase in real GDP can be estimated by the difference between nominal GDP

5 RunGEM or more generally GEMPACK is developed by the Centre of Policy Studies, Monash University, Australia. See more in detail Harrison, W. J., Pearson, K.R., 1996, Harrison, W. J., Pearson, K.R., 2002.

(−0.17%) and GDP price index (−0.24%). The removing of sales taxes on diesel used in agriculture directly reduces the purchasing price of diesel. This causes a decrease in the GDP price index. The similar results are also valid for other simulations which removes tax with all indirect or intermediate tax neutrality. It is said to be that there is a smaller increase in real GDP depending on the degree of (no, partially, and completely) neutrality of indirect tax revenue.

The results reported in Table 2 show that the elimination of sales taxes on diesel leading to a fall in its purchasing price has positive effect on real household consumption. The reason is that due to the removal of tax, households have more money to spend, thus leading to an increase in household consumption in all simulation to the varying degree of neutrality of indirect tax revenue.

As for international trade, with the closure assumption of the fixed import price, the terms of trade are reflected only by the change in export prices. As shown in Table 2 terms of trades in all scenarios are equal to the change in export prices. It is known that the retail price of diesel used in agriculture decreases when the sales tax on it is eliminated. A significant share of diesel is used as an intermediate input in agricultural sectors. A share of diesel in total production cost of these industries is an average of 30%. The fall in purchasing price of diesel used in agriculture reduces the production cost of agricultural goods. This leads to reduction in domestic costs of agricultural production and thereby domestic cost of all commodities in the economy. The removing sales tax with non-neutrality policy improves the export competitiveness due to lower export prices compared to other partially or completely neutrality policies, thus leading to an increase in export volume. In contrast, all other revenue neutrality policies experience reduction in export levels. Moreover, this reduction is the highest in complete revenue neutrality policies due to the higher export price increases. In addition, the import-competing industries also become more competitive and expend.

The elimination of sale taxes on diesel used in agriculture alters the prices of goods and services, thus affecting household expenditure and utility indicates the welfare of household. The change in utility disregarding taste change terms is a measure of welfare effect of the price change. The positive values of utility as shown in Table shows the welfare gain in all simulation. The increase in utility (0.16%) is greater in non-neutrality of tax revenue policy than in both partially and completely neutrality scenarios.

As objective of producers is to minimize production costs, they attempt to adjust quantity of primary factors including capital and land rentals, and wages. This affects the primary factors' prices. In this article, the nominal wage is fully indexed to the consumer price index, thus the nominal wage is the same as the CPI. In the short run, the real wage is assumed to be fixed, so the percentage change of real wage is set to be zero and producers' demand for capital and land are fixed, so their percentage changes are set to be zero.

Under the non-neutrality tax policy, the returns of capital and land increases at 0.45% and 2.88%, respectively. The nominal wage, reflecting the CPI decreases by 0.28%. Aggregate primary factor price increases by 0.15%. However, under the all tax revenue neutrality policy, prices of all primary factors decrease except land rental. This cause the payments to aggregate primary factors to decrease by around 0.08%. Similarly, aggregate primary factors decrease by around 0.18% in simulation-3. Under all scenarios, nominal wages decreases to varying degrees in line with CPI.

The changes in primary factors' prices affect the income of household, because the income from labour, capital and land are the main sources of the household income. It is said to be that the household income raises by 0.15% under the non-neutrality policy scenario.

3.3. Impacts of Removing Sales Taxes on Diesel Used by Farmers on Indirect Tax Revenues

In this article we mainly focus on economic effects of fuel subsidy or removing sales taxes on diesel used in agriculture. To this we define commodity and user specific tax variables are introduced to simulate the impact of removing the user discriminating taxes on energy products in three different tax revenue policies: In case of tax neutrality, the government may impose low taxes for one particular group of society, but may impose high taxes for another group of society. This allows the revenue that they receive to remain unchanged i.e., neutral.

The results of simulation-1 shows a big negative effect on total indirect tax revenues when we abolish sales taxes on diesel used in agriculture. In second simulation, the model computes a uniform change in the existing powers of taxes on all commodities and users to make up the loss in total indirect tax revenues which result from the elimination of sales taxes on diesel used in agriculture. Similarly, in third simulation, the model computes a uniform change in the existing powers of taxes on only all intermediate commodities to make up the same loss.

Column 1 and 2 in Table 3 compares the effects of the elimination of sales taxes on diesel used by farmers with their effects when combined with a uniform tax on all commodities. Table 3 shows that an increase of 0.18% on all commodities increases in revenue from indirect taxes on investment by $426 million, on household by $798 million, on export by $217, and on government by $149 million, and in turn, off-setts the decline in revenue from indirect taxes on intermediate (diesel used in agriculture) by $1.555 million.

Comparing the effects of the elimination of sales taxes on diesel used by farmers (in column 1) with their effects when combined with a uniform tax on only intermediate commodities (in column 3). The results reported in column 4 of Table 3 show that an increase of 0.52% is required in power of indirect tax on intermediate commodities to compensate for the loss in revenue from indirect taxes on diesel. Results indicate that the revenue gain in additional tax of 0.52% on all intermediate commodities wipe out the revenue loss of decrease in sale taxes on diesel of about 50% which is given in Table 1.

3.4. Impacts of Removing Sales Taxes on Diesel used by Farmers on Carbon Emissions

The other macroeconomic variables are known as environmental variables which are given as percentage change carbon emissions in Table 4. In this section we aim to measure the effects of fuel subsidies or removal of sale taxes on carbon emission. It is clear that the removing sale taxes on diesel results in decrease in the purchaser's price of it. This, in turn, causes to increase in usage of diesel. As is known, carbon emissions are closely related to energy consumption. Thus, carbon emissions are associated with all emitting activities, including current production, capital formation, and household and government consumption. The carbon emission growth rate is directly related to the weighted average rate of intermediate usage, capital formation usage, private, and government consumption.

In the model, diesel as an important fuel in agricultural sector emits carbon into the atmosphere when it is burned all fossil fuels do. Therefore, It is assumed that emissions are proportional to demand: For instance, emissions from firm's intermediate demand for domestic commodities can be formulated as; gco2fd (i,j) = qfd (i,j) where i is badcom and j is industries. The "badcom" including oil, gas, coal, petroleum products is defined in the model as energy commodities which release carbon emissions.

The change in growth rate and in carbon emissions level resulting from the removal of three sale taxes policy scenarios are given in below Table 4. One can see that removal of sales taxes with non-neutrality have more significant negative effects on abatement of carbon emissions due to more diesel consumption.

3.5. Impacts of Removing Sales Taxes on Diesel used by Farmers on Sectoral Output

As shown in Table 5, the industry-level results indicate that there is an increase in the output of the agricultural sectors in all simulation. Furthermore, the biggest increase is in the output of wheat (1.51%) percentage, plant-based fibers (4.07%), oil seeds (1.68%), fishing (1.25%) which uses diesel intensively.

4. CONCLUSION AND POLICY IMPLICATIONS

Despite the fact that the call for removing fuel subsidies among both developed and developing country governments have become increasingly important in recent years for several reasons, Turkish major opposition parties promise to decrease the price of diesel used in agriculture by eliminating sales taxes against the ruling Justice and Development Party (AK Party). They have three policy options; (1) removal of taxes without indirect tax revenue neutrality, (2) removal of taxes with all commodity and user indirect tax revenue neutrality, and (3) removal of taxes with only intermediate goods indirect tax revenue neutrality.

Irrespective of the policy indirect tax revenue neutrality, the elimination of sale taxes on diesel is a considerable option as it is expected to increase in GDP by about 0.07% and to decrease in GDP price index by about 0.24% and in CPI by about 0.28% relative to the baseline equilibrium. The industrial output composition increases in favor of agricultural sector and agricultural based industries because they are more dependent on diesel. All other macroeconomic variables, except the carbon emissions and indirect tax revenue which deteriorates national budget, are expected to have desirable changes as a results of removing sales taxes without tax revenue neutrality compared to with revenue neutrality.

As such subsides act as a negative fuel tax, they work both as a negative revenue on national budgets and negative price on carbon. Diesel subsidy exert pressure on national budgets, crowding out expenditure in other areas such as education and health. In the long run, this is expected to have a negative impact on the long-run productivity. Furthermore, low prices of fossil-fuel-derived energy encourages over consumption, gives rise to the excess

Table 3: Percentage change in indirect tax revenues

Indirect tax revenues	Removing sale taxes on diesel		
	With non-neutrality of revenue	With neutrality of all indirect tax	With only neutrality of intermediate tax
Total fuel tax revenue change	−2331	−2307	−2269
Tariff revenue	−17.12	−20.47	−16.25
Revenue from all indirect taxes	−2361.5	0.00	−13.18
Change in all industry production tax revenue	17.53	−14.51	10.23
Revenue from indirect taxes on intermediate	−2354	−1555	0.00
Revenue from indirect taxes on investment	0.01	426	−0.40
Revenue from indirect taxes on households	−8.17	798	−5.23
Revenue from indirect taxes on export	−0.17	217	−1.97
Revenue from indirect taxes on government	0.32	149	0.45
Uniform percent change in powers of taxes on all	0.00	0.18	0.00
Uniform percent change in powers of taxes on intermediate	0.00	0.00	0.52

Source: Results of simulations

Table 4: Percentage change in carbon emission

???	Removing sales taxes on diesel		
	With non-neutrality of revenue	With neutrality of all indirect tax	With only neutrality of intermediate tax
Growth rate of CO_2 emission	0.48	0.43	0.42
CO_2 emission level	1.24	1.10	1.08

Source: Results of simulations

Table 5: Percentage change in industrial output

Sectors	Removing sales taxes on diesel		
	With non-neutrality of revenue	With neutrality of all indirect tax	With only neutrality of intermediate tax
Paddy rice	0.93	0.9	0.88
Wheat	1.51	1.47	1.46
Cereal grains nec	1.04	0.99	0.98
Vegetables, fruit, nuts	0.19	0.13	0.16
Oil seeds	1.68	1.63	1.63
Sugar cane, sugar beet	0.15	0.11	0.1
Plant-based fibers	4.07	4.00	3.99
Crops nec	0.83	0.78	0.79
Processed rice	0.07	0.06	0.06
Bovine cattle, sheep and goats	0.23	0.18	0.17
Animal products nec	0.32	0.26	0.23
Raw milk	0.21	0.16	0.16
Wool, silk-worm cocoons	0.23	0.15	0.11
Meat products	0.07	0.04	0.02
Forestry	0.49	0.45	0.46
Fishing	1.25	1.23	1.24
Other non-agricultural sectors (average output)	0.04	−0.01	−0.05

Source: Results of simulations

environmental impacts, and damages energy efficiency. The diesel subsidies increase the level of carbon emissions by a range from 1.1% to 1.24% depending on the increasing consumption of diesel.

The diesel subsidies cause market distortions in the energy sector. By lowering the cost of fossil fuels as opposed to that of renewable energy, subsidies also act as a barrier to the deployment of renewable energy capacity. In other words, diesel subsidies could not encourage deployment of renewable energy, with associated environmental benefits. Given that Turkey is currently a net importer of fossil fuels, there would be budgetary savings that can be made by increasing renewable power in the generation mix, especially wind energy in recent years.

As to the policy recommendation for policy makers who have to consider fuel subsidies by removing sales tax without giving up fiscal discipline as an ultimate target, we can say the following: We need to uniform change in the existing powers of taxes on all commodities or only for intermediate commodities to make up the loss in total indirect tax revenues which result from the elimination of sales taxes on diesel used in agriculture. As the Turkish government is facing greater challenges from the fiscal burden of the energy subsidies and pollutant emissions, energy subsidies have become a matter of great debate.

Finally, the removal of the sales taxes on diesel used only in agriculture creates a sectoral tax rate differences and it should be expected to lead to tax evasion. Currently, Turkish economy experiences serious issues of tax evasion. It is clear that Turkey needs to construct a well-justified and well-designed tax system and widen the base for direct taxpayers through fighting with the informal economy seems to be essential to ensure all segments of society to contribute to and supervise it in a consistent manner.

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APPENDIX

Appendix Table 1: Commodity and Industry classification

Commodity description	Elements of set COM	Industry description
Paddy rice	PDR	Paddy rice
Wheat	WHT	Wheat
Cereal grains nec	GRO	Cereal grains nec
Vegetables, fruit, nuts	V_F	Vegetables, fruit, nuts
Oil seeds	OSD	Oil seeds
Sugar cane, sugar beet	C_B	Sugar cane, sugar beet
Plant-based fibers	PFB	Plant-based fibers
Crops nec	OCR	Crops nec
Processed rice	PCR	Processed rice
Bovine cattle, sheep and goats	CTL	Bovine cattle, sheep and goats
Animal products nec	OAP	Animal products nec
Raw milk	RMK	Raw milk
Wool, silk-worm cocoons	WOL	Wool, silk-worm cocoons
Meat products	CMT	Meat products
Forestry	FRS	Forestry
Fishing	FSH	Fishing
Coal, oil, gas and min. nec	EXTRACTION	Coal, oil, gas, min. nec
Processed food	PROCFOOD	Procced food
Light manufacturing	LIGHTMNFC	Ligth manufacturing
Diesel	REFINARY PRODUCTS	Refinery products
Gasoline	HEAVYMNFC	Heavy manufacturing
Liquefied petroleum gas	UTIL_CONS	Utility construction
Petrol products nec	OTP	Transport nec
Heavy manufacturing	WTP	Water transport
Utility construction	ATP	Air transport
Transport nec	TRANSCOMM	Communic. and trans.
Water transport	OTHSERVICES	Other services
Air transport		
Communication and transact		
Other services		

Appendix Table 2: List of exogenous variable in model closure

Exogenous	a1	COM*SRC*IND intermediate basic tech change
Exogenous	a1cap	IND capital-augmenting technical change
Exogenous	a1ener	IND energy-using tech change
Exogenous	a1lab_o	IND labor-augmenting technical change
Exogenous	a1lnd	IND land-augmenting technical change
Exogenous	a1prim	IND all factor augmenting technical change
Exogenous	a1tot	IND all input augmenting technical change
Exogenous	a1_s	COM*IND tech change, intermediate imp/dom composite
Exogenous	a2	COM*SRC*IND investment basic tech change
Exogenous	a2tot	IND neutral technical change – investment
Exogenous	a2_s	COM*IND tech change, investment imp/dom composite
Exogenous	a3	COM*SRC household basic taste change
Exogenous	a3_s	COM taste change, household imp/dom composite
Exogenous	delPTXRATE	IND change in rate of production tax
Exogenous	del_unity	1 special variable always exogenous and set to 1
Exogenous	f0tax_csi	1 uniform % change in powers of taxes on all
Exogenous	f0tax_s	COM general sales tax shifter
Exogenous	f1	COM*SRC*IND
Exogenous	f1lab	IND*OCC wage shift variable
Exogenous	f1lab_i	OCC occupation-specific wage shifter
Exogenous	f1lab_io	1 overall wage shifter
Exogenous	f1lab_o	IND industry-specific wage shifter
Exogenous	f1tax_csi	1 uniform % change in powers of taxes on intermedia
Exogenous	f2tax_csi	1 uniform % change in powers of taxes on investment
Exogenous	f3tax_cs	1 uniform % change in powers of taxes on household
Exogenous	f4p	COM price (upward) shift in export demand schedule
Exogenous	f4p_ntrad	1 upward demand shift, collective export aggregate
Exogenous	f4q	COM quantity (right) shift in export demands
Exogenous	f4q_ntrad	1 right demand shift, collective export aggregate
Exogenous	f4tax_ntrad	1 uniform %change in powers of taxes on non-trd exports
Exogenous	f4tax_trad	1 uniform % change in powers of taxes on trad. exports
Exogenous	f5	COM*SRC government demand shift
Exogenous	f5tax_cs	1 uniform % change in powers of taxes on government
Exogenous	f5tot2	1 ratio between f5tot and x3tot
Exogenous	f×6	COM*SRC shifter on rule for stocks
Exogenous	gco2	BADCOM growth of emissions by fuel
Exogenous	invslack	1 investment slack variable for exogenizing aggregate inv.
Exogenous	pf0cif	COM C.I.F. Foreign currency import prices
Exogenous	Phi	1 exchange rate, local currency/$world
Exogenous	Q	1 number of households
Exogenous	t0imp	COM power of tariff
Exogenous	w3lux	1 total nominal supernumerary household expenditure
Exogenous	x1cap	IND current capital stock
Exogenous	x1lnd	IND use of land
Exogenous	x2tot	IND investment by using industry

Exogenous f1(NONSUBSCOM, src, ind);Uniform % change in powers of tax on non-subsidy commodities in all industry, Exogenous f1(SUBSCOM, src, noenagr); Uniform % change in powers of taxes on subsidy commodities in non-agricultural sectors, Exogenous t1(subscom, src, agr); Uniform % change in powers of taxes on subsidy commodities in agricultural sectors