LIBERALIZATION IN THE TURKISH ELECTRICITY MARKET: A CGE ANALYSIS

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ABSTRACT

One of the most important and popular policy discussions recently in Turkish economy is the restructuring of natural monopoly markets. New legislation has been introduced after 2001 to liberalize these markets in an attempt to enhance competition. Since the establishment of the Electricity Market Regulatory Agency in 2001, deregulation in the market is still undergoing and the reforms are not yet completed.

The aim of the current study is to measure the impact of the regulatory reforms in the market on the economy as a whole and on particular agents in the economy. For this purpose, a static computable general equilibrium (CGE) model is constructed. The model specifies the working of the economy and all transactions in it in a Walrasian framework. A social accounting matrix with the base year 2003 is used as the main database. The model runs two simulations. The first simulation measures the impact under liberalization of switching between alternative sources of energy used in production and consumption. It is found that the switching between energy sources does not produce significantly different results. The second simulation experiment is a counterfactual analysis that tests the impact of a system where no regulatory action is undertaken. The results show that there is a potential for welfare and productivity gains from the recent regulatory reforms.

1. Introduction

Liberalization of the electricity sector is an important policy discussion also in Turkey. The electricity sector was dominated by a vertically integrated state company until 1984. Since then, the government has undertaken structural reforms to regulate the sector with an ultimate aim of complete liberalization. With the establishment of a regulating agency in 2001 and the adoption of a strategy paper in 2004, deregulation of the sector has taken a start. Until then, different stages of electricity supply (generation, transmission, distribution, and trading) were restructured. Since the introduction of private ownership of electricity supply facilities first in 1984, various types of ownership-production structures were observed in the regulated electricity sector. The regulation of the sector was ensured by the high judicial organs of the state. Deregulation is still under way and the Turkish electricity sector is currently regulated by the regulatory agency to enable smooth implementation of deregulation.

A popular reason picked by regulators to justify regulation is large scale economies and characteristics of a natural monopoly. Due to entry barriers imposed by the regulatory agency, one may argue that this will cause inefficiency in the sector due to limitations on competition. The share of the public sector in Turkey has declined and the dominance of the public company in electricity generation was weakened in favor of private producers with the major reforms since 2001. Since then, the government has introduced competition in the generation stage of electricity supply to a significant extent whereas the distribution and transmission stages are highly regulated and controlled virtually entirely by public entities.

With regards such institutional and organizational changes under way in the electricity sector, one expects the establishment of the market mechanism, ultimate aim of the current regulatory agency, to enhance efficiency and reduce and eliminate over time the distortions brought about by the regulation. These distortions may be in the form of higher prices for end-users due to inefficiency and biases in resource allocation as represented by the well-known Averch-Johnson effect. Inefficiency in electricity supply in Turkish electricity sector is yet an area to be examined but Bagdadioglu et al. (1996) found that private electricity utilities were more efficient than public utilities in Turkey. Furthermore, Bagdadioglu et al. (2007) found potential production efficiency gains (reduction in input usage by 16 percent) as a result of mergers among existing firms in the electricity distribution sector during the period 1999-2003. These studies suggest that there are potential benefits for firms and the industry as a whole from the electricity reforms in the form of cost reductions and the positive effect on firms' motives of production and profits through change of ownership.

Not only is the extent of inefficiency in the electricity sector but also a more macro-view on the reforms in the electricity sector in Turkey an area that deserves attention. To that end, this paper aims to examine the effects of liberalization on the Turkish electricity market from a general equilibrium perspective. The effects of the reforms can be quantified using a computable general equilibrium (CGE) model. In light of previous CGE studies on electricity market reforms, first a CGE model will be constructed and then some policy simulations will be run to examine the potential impacts on the sector and on the economy. CGE models can capture the impacts of a given policy change on the target sector and the economy as a whole and allows for macroeconomic interpretations. Therefore, they are used widely in assessing policies.

The organization of the paper is as follows. The second section reviews the recent reforms in the Turkish electricity sector. Section 3 presents the salient features of the model with important differences from the standard CGE models and similar others. Section 4 presents the results of the simulation experiments. Finally, Section 6 concludes with some policy discussions and recommendations.

2. Recent Reforms in the Turkish Electricity Sector

Several studies in the recent past have provided reviews of the organizational and legal changes in the electricity sector in Turkey, such as Atiyas and Dutz (2005), Hepbasli (2005), Yilmaz and Uslu (2005), Erdogdu (2007), Cetin and Oguz (2007), and Ulusoy and Oguz (2007). A review of these studies is presented below.

Until 2001, the electricity sector in Turkey was dominated by a vertically integrated public company, Turkish Electricity Authority (TEK), which undertook generation, transmission, and distribution. TEK was granted a full-monopoly status in 1982, but as part of the liberalization effort of the government during the early 1980s and as a step to prevent the recurrence of the energy crisis of the late 1970s, the government initiated significant changes in the electricity sector and the monopoly status of TEK was abolished in 1984. Consequently, private investors were allowed to engage in electricity generation activities. TEK was restructured into a vertically integrated public company which undertook generation, transmission, and trading. At the same time, with legal amendments, domestic and foreign private entrepreneurs were allowed to build electricity production facilities and operate the existing production and distribution facilities without ownership rights (which still remained with TEK). Ten private firms entered the market after the mid-1980s.

Early attempts of the government to privatize the electricity sector suffered from legal obstacles. The constitution deemed electricity supply as public service and did not let private entrepreneurs own production facilities. The government in the early 1980s, which dedicated itself to the liberalization of the economy, found a solution to this obstacle by introducing various ownership rights for the existing and newly built facilities. The most important of these were (i) build-own-transfer (BOT), (ii) build-operate-own (BOO), and (iii) transfer-of-operation-rights (TOR). In the BOT system, the private investor builds and operates the facilities for a period of about 20 years and after that returns the facilities to the state. In the BOO system, the ownership right remains with the private investor and all generated electricity is bought by TEK. Finally, TOOR system allows for full private ownership and operation of the facilities. On the other hand, private manufacturing companies (called autoproducers) were allowed to generate electricity for their own needs in their production activities. Two private companies, Cukurova Electricity Corporation and Kepez Electricity Trading Company, were also granted concessionary rights to generate and sell electricity to consumers in their respective regions (Adana and Antalya regions in the southern part of Turkey). The period until 1994 is therefore characterized by strong regulation.

TEK went into restructuring in 1993 and was split into Turkish Electricity Generation and Transmission Company (TEAS) and Turkish Electricity Distribution Company (TEDAS), both of which enjoyed the status of state-owned-enterprise. TEAS, autoproducers, abovementioned concessionary companies, and other private generation facilities (with transferred ownership rights and private production companies) were allowed to generate electricity but only TEAS and concessionary companies were allowed to sell electricity from the generators. The concessionary rights of Cukurova and Kepez companies were granted to a large private business group in 1994 for a period of ten years. In short, the interim period 1994-2001 is characterized by a restructuring attempt where the previously integrated state monopoly was still at the center with a new role as the main buyer of generated electricity.

During the period 1994-2001, there were discussions about privatizing the electricity generation and trading sectors. In 1999, the Constitution was amended to allow international arbitration in electricity production. Prior to this amendment, electricity production was regarded by high judicial organs as a strategic issue for the nation and international arbitration was not allowed. Following this step, the Electricity Market Regulatory Agency (EMRA) was established in 2001 and TEAS was split again into three companies, Turkish Electricity Generation Company (TEUAS), Turkish Electricity Transmission Company (TETAS), and Turkish Electricity Trading and Contracting Company (TEIAS). In addition, TEDAS was privatized into regional distribution companies. The unbundling of the public companies allowed the separation of the supply process of electricity to be undertaken by separate entities. EMRA has been undertaking its main duty of implementing the reforms towards privatization since 2003. In 2003, EMRA granted generation licenses for premises with installed capacity larger than 3000 MW to private investors. Entry of private investors into the sector led to a reduction in the share of the public sector from more than three fourths at the end of the period 1994-2001 to around six tenths in 2003 (see Table 1). With such changes, competition in the generation and trading sector was enhanced substantially but the transmission sector is still dominated by the state company (TETAS) due to the importance of this sector for safe and effective transmission of electricity and difficulties associated with allowing private entry in this sector due to such technical issues. In the distribution sector, TEDAS and regional distribution companies and Kayseri Electricity Company dominate the sector.

An important milestone is the preparation of the Strategy Paper which set the guidelines for privatization of the electricity sector in March 2004. The Strategy Paper envisaged substantial privatization of the public facilities in generation and distribution stages until 2009 and setting of a tariff system that purely reflects costs. Both of these stages are characterized by strong position of the public companies. Strategy Paper reports that the privatization needs to be implemented gradually. The ultimate aim of these reforms is to enable competitive, free market principles.

The establishment of EMRA is an important milestone in the liberalization history of the electricity sector because it is well known that without a regulatory organ, privatization efforts cannot be monitored effectively. EMRA, an autonomous state organ, acts mainly as a policy-making agency as well as a regulating agency. The most important regulatory roles of EMRA are the preparation of secondary legislation, the monitoring of the participants in the sector, and settling of disputes. An objective of this agency is revenue generation through license sales. Electricity tariffs are regulated by the state. A major principle in setting the tariffs is that tariffs should reflect costs. Therefore, costs that do not arise from the operation of facilities are not included in the tariffs. When necessary, state provides direct payments to consumers but the tariff rates remain untouched.

Liberalization of the electricity sector has long been and still an ongoing debate in Turkey. Proponents of full liberalization argue that there is a need to establish a fully competitive market and minimize the technical obstacles to realize this aim. They argue that such moves will successfully call for private investments in this sector and contribute to improvements in overall efficiency. Privatization involves not only electricity generation and transmission facilities but also distribution and trading as well.

Liberalization is generally expected to reduce costs of production through efficient operation of generation and distribution facilities, improving the quality of services through induced competition, and ensuring the continuity of electricity production in an environment with increasing demand for electricity through upgrading of existing facilities or undertaking such investments needed. Despite the high-level of authority enjoyed by EMRA during the reforms process, liberalization efforts are not continuing smoothly. A counter argument against the liberalization of the electricity sector is that state bureaucracy is not familiar with the working of a competitive market. Furthermore, the private sector criticizes the government for incomplete privatization of the sector. Such critiques generally point to inexperience of top management of the public company in managing private firms, persisting dominance of the public company in the market, and high bureaucratic costs.

The figures in Table 2 reveal the importance of the electricity sector for Turkey and how rapidly the sector has grown over years. Rapid urbanization and rapid growth of national industries throughout the 1960s, 1970s, and 1980s led to rapid growth in electricity demand. A glance at recent data shows that during the period 1995-2005, average annual growth rates of electricity consumption and electricity production were 6.0 and 5.7 percent, respectively, and installed capacity grew by 5.6 percent. Per capita installed capacity and net consumption of electricity grew annually by 4.2 and 4.6 percent, respectively. Considering the importance of electricity as an important input in various production sectors and as an important final product for consumers with a presumably low price elasticity of demand, this sector is of vital importance to the economy. To meet the need for investments in the sector as a response to projected large increases in electricity demand, the government launched a liberalization program in the electricity sector in 2001.

Table 1 Market shares of major producers in electricity generation

Unit: percent	1984-1993	1994-2001	2002-2006
Public sector	77.8	81.3	60.4
Concessionary companies [a]	3.5	2.0	-
Independent producers	0.0	4.0	25.1
Others	18.7	12.7	14.5

Note: [a] 1994-2003

Table 2 Electricity Production and Consumption in Turkey

Year	Installed capacity (MW)	Electricity generation (GWh)	Consumption (GWh)
1980	5119	23275	20398
1985	9119	34219	29709
1990	16315	57543	46820
1995	20954	86247	67092
2000	27264	124922	98296
2001	28332	122725	97070
2002	31846	129400	102948
2003	35587	140581	111766
2004	36824	150698	121142
2005	38844	161956	130263

Source: State Planning Organization, *Economic and Social Indicators 1950-2006* and State Statistical Institute, *Statistical Indicators 1923-2004*

3. The Structure of the CGE Model

3.1. Standard Features of the Model

In large part, the basic CGE model follows the standard CGE models used in policy analysis. Major differences from the standard models are explained in detail below. One of the major differences of the current model is its treatment of energy and non-energy goods.

The CGE model consists of 10 production and commodity sectors, government, one representative household, and two production factors (capital and labor). A list of these sectors is provided in Table 3. Electricity sector is not decomposed into generation, distribution, and transmission sector in the Turkish input-output tables. Therefore, there is only one sector that represents all these activities.[1] Three of ten sectors included in

[1] In an earlier draft of this paper, the electricity sector was separated into distribution, generation, and transmission sectors using data from the financial reports of the electricity distribution, generation, and transmission companies. However, due to data limitations and unavailability, the results from the model that was solved previously were not reliable. At the current stage, we resort to the findings from this model and consider the separation of the electricity sector as a research question to be dealt with in future research. At the time of writing, the 2002 input-output tables of Turkey were

the model (electricity, coal mining, and petroleum and gas) are energy sectors and the rest are classified as non-energy sectors. The energy goods for the households below consist of these three products.

On the production side, there are two factors, capital (*K*) and labor (*L*). Capital is immobile across sectors while there is perfect mobility of labor. No adjustment cost is assumed for capital. Production technology is represented by constant-returns to scale Cobb-Douglas production function:

$$Q_i = \alpha_{Qi} L_i^{\alpha_i} K_i^{1-\alpha_i}$$

Gross output is made up of value-added (*VA*) and intermediate inputs (*MI*):

$$Q_i = VA_i + MI_i$$

We make an assumption about the substitution of intermediate inputs in production. Intermediate inputs are made up of non-energy and energy inputs. In the energy-producing sectors (coal mining, petroleum and natural gas, and electricity), energy inputs are not substitutable because of the nature of these sectors. Much of the energy used in the electricity sector is obtained from natural gas. In other sectors, energy inputs are substitutable.

Value-added is a fixed proportion (b_{ji}) of gross output:

$$VA_i = \sum_j b_{ij} Q_j = \sum_{F=K,L} p_{Fi} F_i$$

Value-added is equal to the sum of factor payments. Factor payment is computed by the product of factor price (P_F) and factor quantities (*F*) where *F* = *K*, *L*. Optimum factor demand is derived from the first order conditions.

Total intermediate input demand is formulated as follows:

$$MI_i = \min\left(\frac{Q_{ji}}{a_{ji}}\right)$$

Substitution of intermediate inputs is not allowed. The fixed input-output coefficients a_{ji} are obtained from the input-output table and their sum is equal to unity. Intermediate inputs make up a fixed proportion of composite material input.

$$MI_i = \sum_j a_{ij} Q_j$$

Gross output is either sold in the domestic market or exported. The transformation of exports (*X*) and domestic sales (*D*) in this way takes the form of a constant elasticity of transformation (CET) function:

$$Q_i = \alpha_{Ti}\left[\beta_{Ti} X_i^{-\rho_{Ti}} + (1-\beta_{Ti}) D_i^{-\rho_{Ti}}\right]^{\frac{1}{\rho_{Ti}}}$$

Domestic goods and imports (*M*) form the Armington composite good (*E*) with a production relation characterized by the Armington-type of constant elasticity of substitution (CES) function:

$$E_i = \alpha_{Ei}\left[\beta_{Ei} D_i^{-\rho_{Ei}} + (1-\beta_{Ei}) M_i^{-\rho_{Ei}}\right]^{-\frac{1}{\rho_{Ei}}}$$

It should be noted that production sectors are characterized by constant-returns to scale production function except the electricity sector. As explained below, the electricity sector is subject to regulation and regulation is generally justified on the ground that there are increasing returns to scale in the regulated sector. Therefore, we assume increasing returns to scale.

Households consume composite goods with a Cobb-Douglas type of utility (*U*) function. Following Hosoe (2006), government consumption and investments are fixed in order to measure the pure impact of the regulatory reforms on household utility. The government collects direct and indirect taxes from households and uses these revenues to finance its expenditures (*G*):

$$\sum_i p_i G_i = \sum t_{Mi} M_i + \sum t_{Di} p_i Q_i + \sum t_{IDi} p_i Q_i$$

Indirect taxes and direct taxes are computed as the multiplication of indirect tax rate (t_{ID}) and direct tax rate (t_D) by output. Import revenues are found by the product of import tariffs (t_M) and imports.

Foreign exchange market is assumed to clear with flexible exchange rate adjustments: The sum of exports, foreign savings (S_F), and net transfers from abroad (TRN_F) equals imports:

$$\sum_i p^*_{Mi} M_i ER(1+t_{Mi}) = \sum_i p^*_{Xi} ERX_i + S_F + TRN_F$$

Exports and imports are treated as in standard CGE models with constant elasticities. Optimal level of exports and imports relative to domestic supply and the optimal level of exports relative to domestic goods are calculated from the first order conditions using the prices and elasticities of CET and Armington functions above:

$$\frac{M_i}{D_i} = \left(\frac{\beta_{Ei}}{1-\beta_{Ei}} \cdot \frac{p_{Di}}{p_{Mi}}\right)^{\frac{1}{1+\rho_{Ei}}}$$

$$\frac{X_i}{D_i} = \left(\frac{\beta_{Ti}}{1-\beta_{Ti}} \cdot \frac{p_{Xi}}{p_{Di}} \right)^{\frac{1}{\rho_{Ti}-1}}$$

Export prices (p_X) and import prices (p_M), are defined as:

$$p_{Mi} = p^*_{Mi}(1+t_{Mi})ER$$

$$p_{Xi} = p^*_{Xi}ER$$

The prices with an asterisk (*) are world prices and *ER* is the exchange rate defined as the price of US dollar in terms of New Turkish Lira.

The equilibrium conditions for the goods market, factor market, and investment and savings are specified as follows. In the goods market, aggregate demand equals gross output:

$$MI_i + C_i + G_i + I_i = Q_i$$

Aggregate demand comprises of household consumption demand (*C*), public consumption (*G*), intermediate input demand (*M*I), and investment demand (*I*). In the factor market, sectoral factor demands sum up to total factor supply:

$$F = \sum_i F_i$$

Total savings made up of household savings (S_H), foreign savings (S_F), and public savings (S_G) equal total investments:

$$I = S_F + S_H + S_G$$

The CGE model computes relative prices of the system. There is a need to normalize prices. This is done by normalizing with the prices of gross output, i.e., supply prices are set exogenously, as follows:

$$PI = \sum_i \Omega_i P_i$$

where Ω is the share of each sector in total gross output, *PI* is the general price level (price index) and *P* is an index of producer (gross output) prices.

Rate of return regulation

There is a rate-of-return regulation electricity sector. The earnings of the firms in the electricity sector are subject to regulation on capital earnings. In Hosoe (2006), a markup is introduced on the residential electricity charge to keep the electricity charge constant against the consumer prices. He does this to exclude the households from the beneficiary group of reform as he assumes that the incumbent firms in the electricity sector maintain their market power in electricity supply to residential users, i.e., households. We do not make such assumption in this study as the official reports of EMRA state that ensuring the provision of cheap and safe electricity to residential users is an important aim of the recent reforms. In full liberalization simulation we assume that there is no markup. With regulation, there is a control on return to capital.

3.3. Data and Calibration

Some parameters are provided from outside, such as the shares of labor and capital in production (distribution parameters in the production function), indirect tax rates, import tariff rates, income tax rate and tax rate of capital income. All these are calculated from the social accounting matrix (SAM). Armington and CET elasticity parameters are also provided exogenously as best guesses. Using the data from the SAM and the behavioral equations of the CGE model, numerical values of the remaining parameters in the CGE model are computed easily.

The main database used in numerical solutions is the 2003 social accounting matrix (SAM), which is obtained from Telli et al. (2006). The original SAM is unbalanced, so first the SAM is balanced and then injected into the model. The aggregated SAM and input-output flows are presented in the appendix tables A.1 and A.2. .

Table 3 List of sectors in the model

AGR	Agriculture, forestry and animal husbandry
COA	Coal mining
PGA	Petroleum and gas
PAP	Paper and printing
OIL	Refined petroleum
CEM	Cement
IST	Iron and steel
ELE	Electricity
TRN	Transportation
OTH	Other activities

4. Policy Simulations

We run two simulation experiments. The first experiment examines the impact of the switching between different energy sources under liberalization in the electricity sector. For this purpose, we assume first that all generation in the electricity sector is realized by using coal only. Then we assume that all generation is realized by natural gas only. In this way, we measure the impact of these two extreme cases to see the "pure" effects of choosing one energy source t the other. In doing this, we manipulate the intermediate input flows and rebalance the resulting SAM. Then we compare the changes brought about by the switches.

The second experiment is related to the impact of the full liberalization of the electricity sector. We expect the deregulation of the electricity sector to enhance cost efficiency, i.e., total factor productivity. Enhanced cost efficiency is brought about by improvements in factor use. The counterfactual analysis that examines the impact of the removal of all distortions in the electricity sector corresponds to the full liberalization of the sector. The model allows us to measure the macroeconomic impact of such liberalization using the structure of the economy and the behavior of the agents around 2003. The behavioral assumptions of the model were explained in the preceding section. We expect to find that deregulation of the electricity sector to reduce the prices to the consumers, reduce energy input costs for the production sectors, and reduce the factor demand due to enhanced efficiency.

5. Results of Simulations

Macroeconomic results of the simulations are reported in Table 4. Sectoral results for the variables of interest are reported in the appendix tables A.3 and A.4 for the first simulation and in Table A.5 for the second simulation.

The results of the first simulation show that switching to coal or petroleum and natural gas does not make much difference in macroeconomic impact of liberalization. It can be said, on the other hand, that the switch to coal has a slightly smaller macroeconomic impact on the economy whereas the macroeconomic impact of the switch to petroleum and natural gas has a slightly larger impact in comparison with the full liberalization with the prevailing energy use in the electricity sector. Therefore we rather focus on the general conclusions that can be drawn from the economic impact of the full liberalization of the electricity sector which we examine in the second simulation. The results of the first simulation with switching between alternative energy sources are comparable to the results from the second simulation with only minor differences at the sectoral level.

Full liberalization in the electricity sector increases the supply prices in the electricity prices largely. This is most possibly due to the prevailing inefficiency in the market. Removing the regulation leads directly to increases in electricity supply prices. This is an important source of the negative change in the utility level, though small. Since the consumers cannot perfectly substitute electricity with other sources of energy, the increase in electricity prices are reflected in the declining consumption of energy by households and hence declining utility levels.

The results imply that full liberalization of the electricity sector has a negligible impact on utility level and GDP. GDP contracts by about 0.2 percent and equivalent variations amount to 0.2 billion YTLs, which are negligible figures. The impact on unemployment level is positive, though small, about 0.03 percent. These two findings imply that overall labor productivity in the economy decreases by 0.18 percent. at the sectoral level we see that the signs of the changes in employment and value-added are the same. In a previous study for the Latin American countries, Chisari et al. () found that the less effective are the regulators, the larger are the gains in labor productivity after liberalization of the energy sector. The reasoning goes as follows: When employment rises in a sector, marginal productivity declines and when output shifts to more labor-intensive sectors, average labor productivity declines. If there are efficiency gains in the regulated sector after liberalization, the decline in labor productivity is possible only if efficiency gains lead to more use of labor, i.e., production in shifts to more labor-intensive sectors. The same explanation can be adopted here and it can be said that the decline in average labor productivity points to effective regulation of the electricity sector. Looking at the sectoral results, we see that the change in employment in the electricity sector is larger than the change in value-added. Both rise.

In the case of factor demand and prices, we see that wage levels rise by 10 percent and the rate of return to capital increases by more than three tenths in the electricity sector. Switching to petroleum and natural gas reduces the return to capital in the coal industry largely whereas the switching to coal reduces the rate of return to capital in the petroleum and natural gas industry by a smaller amount.

In the case of trade, it is found that imports of energy sectors increase. This is most probably due to the increase in electricity prices. Unlike consumers, producers can substitute electricity with other energy sources despite the presumably low degree of substitution.

These preliminary findings imply that at the current stage of regulation in the electricity sector, regulation offers a higher welfare and productivity in comparison with the full liberalization of the sector. In other words, current regulatory framework works for the benefit of the economy and the electricity sector needs effective regulation of this type. The timing of full liberalization seems yet to come. All these findings lead us to conclude that with effective regulation, the gains from full liberalization can be increased. For the time being, the sector still demonstrates natural monopoly characteristics and the regulation needs to carried out for some more time. Depending on some previous studies which were reviewed above, current inefficiencies need to be improved within the regulatory framework.

Table 4 Macro results (percentage changes)

	Switch to Coal	Switch to petroleum and natural gas	Full liberalization
Energy prices for households	13.5	17.5	16.9
Equivalent variations	-0.2	-0.2	-0.2
Public savings	-2.6	-2.6	-2.6
Savings	-15.6	-15.6	-15.6
GDP	-0.15	-0.18	-0.15
Employment	-0.03	-0.02	0.03

Concluding Remarks

The aim of this study is to measure the impact of the regulatory reforms in the electricity sector on the economy. For this purpose, a static computable general equilibrium (CGE) model is constructed. The model specifies the working of the economy and all transactions in it in a Walrasian framework. Two simulations were also run. The first simulation experiment measures the impact under liberalization of switching between alternative sources of energy used in production and consumption. It is found that the switching between energy sources does not produce significantly different results. The second simulation experiment is a counterfactual analysis that tests the impact of a system where no regulatory action is undertaken. The results show that there is a potential for welfare and productivity gains from the recent regulatory reforms.

The model does not distinguish different stages of electricity supply (transmission, distribution, generation). A more thorough analysis including these three stages may add another dimension to the analysis in this study for policy discussions. Furthermore, the distributional implications of liberalization are not dealt with in this study. The impacts on different ages and different household groups may also have some implications for policymakers. These and some other considerations may further improve the model findings and future line of research should focus on such issues as well. The current study is a preliminary exercise.

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APPENDIX

Table A1. Input-output flows for 2003 (Unit: million New Turkish Liras)

	AGR	COA	PGA	PAP	OIL	CEM	IST	ELE	TRN	OTH
AGR	17882.5	19.3	0.0	91.9	0.0	0.0	0.3	5.1	76.4	18471.8
COA	16.6	0.1	0.0	1.2	1.8	235.0	304.6	705.9	4.7	414.0
PGA	0.0	0.0	0.0	0.0	6793.0	84.7	0.0	880.9	19.6	677.2
PAP	107.8	0.1	1.7	907.5	2.1	104.8	85.3	1.7	68.6	3865.7
OIL	2053.5	89.2	10.7	93.8	12.3	181.0	496.4	482.7	10726.7	4620.9
CEM	50.0	0.1	1.0	0.5	0.3	318.4	10.1	0.0	0.0	4299.3
IST	0.0	4.3	16.2	0.0	2.5	34.0	3789.1	3.6	2.3	10738.2
ELE	248.1	62.2	15.9	129.4	123.9	554.4	1014.1	150.2	86.5	6421.6
TRN	1271.0	26.3	23.3	201.3	757.7	285.9	958.4	307.6	3444.9	14568.6
OTH	13014.8	223.1	69.3	760.3	393.6	822.3	2436.1	514.1	13372.0	126751.8

Table A2. Aggregated SAM for 2003

	Activities	Commodities	Households	Government	Rest of the world	Investment	Tariffs	Indirect taxes	Value-added tax	Capital	Labor	*TOTAL*
Activities	0.0	510677.2	0.0	0.0	98496.3	0.0	0.0	0.0	0.0	0.0	0.0	*609173.5*
Commodities	278878.2	0.0	245085.5	44682.3	0.0	82323.0	0.0	0.0	0.0	0.0	0.0	*650969.0*
Households	0.0	0.0	198359.1	83619.8	8286.8	0.0	0.0	0.0	0.0	169864.6	112903.8	*573034.2*
Government	0.0	0.0	38043.1	0.0	0.0	0.0	1001.3	47526.8	28956.2	0.0	0.0	*115527.4*
Rest of the world	0.0	110334.4	4744.6	6624.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*121703.2*
Investment	0.0	0.0	86801.9	-19398.9	14920.1	0.0	0.0	0.0	0.0	0.0	0.0	*82323.0*
Tariffs	0.0	1001.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*1001.3*
Indirect taxes	47526.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*47526.8*
Value-added tax	0.0	28956.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*28956.2*
Capital	169864.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*169864.6*
Labor	112903.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*112903.8*
TOTAL	*609173.5*	*650969.0*	*573034.2*	*115527.4*	*121703.2*	*82323.0*	*1001.3*	*47526.8*	*28956.2*	*169864.6*	*112903.8*	

Table A.3 Simulation 1: Switch to coal, sectoral results (percentage changes)

	AGR	COA	PGA	PAP	OIL	CEM	IST	ELE	TRN	OTH
Domestic sales	-14.7	-4.9	-0.6	-4.1	-9.2	1.3	1.7	-1.0	-18.1	-12.7
Energy intermediate	-7.9	0.0	0.0	-1.8	-8.0	3.0	9.7	0.0	-0.3	1.3
Energy prices	10.9	0.0	0.0	13.1	6.5	1.9	4.1	0.0	10.5	10.6
Imports	-27.6	5.6	-7.1	-4.7	-4.8	6.9	4.9	0.0	0.0	-11.2
Intermediate inputs.	-3.2	13.0	-6.8	0.7	-0.4	1.3	3.5	-0.4	0.6	0.5
Labor demand	-28.3	-5.6	-15.6	-8.3	-38.3	12.8	31.7	20.8	-1.3	2.6
Rental price of capital	-21.0	3.9	-7.1	1.0	-32.1	24.2	45.1	33.0	8.7	13.0
Supply prices	-13.7	5.9	-6.2	-1.5	0.6	7.5	8.4	13.5	3.4	1.7
Value-added	-7.9	-4.8	-0.6	-1.8	-8.0	3.0	9.7	4.2	-0.3	1.3
Wages	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1

Table A.4 Simulation 1: Switch to petroleum and natural gas, sectoral results (percentage changes)

	AGR	COA	PGA	PAP	OIL	CEM	IST	ELE	TRN	OTH
Domestic sales	-14.5	-34.2	-0.4	-4.1	-6.7	1.3	1.3	-0.5	-17.8	-12.6
Energy intermediate	-7.7	0.0	0.0	-1.7	-5.1	2.9	9.0	0.0	0.1	1.3
Energy prices	17.2	0.0	0.0	17.4	-7.5	13.6	16.4	0.0	12.5	14.8
Imports	-27.3	-17.9	-1.5	-4.5	-11.9	8.7	5.3	0.0	0.0	-11.0
Intermediate inputs.	-3.1	5.0	-1.5	0.7	-0.2	1.3	3.3	0.3	0.7	0.5
Labor demand	-27.7	-38.5	-10.4	-8.1	-26.2	12.3	29.5	23.4	0.6	2.7
Rental price of capital	-20.3	-32.2	-1.2	1.3	-18.6	23.8	42.8	36.1	11.0	13.3
Supply prices	-13.5	0.9	-1.2	-1.4	-8.4	9.4	9.1	17.5	3.3	1.9
Value-added	-7.7	-34.1	-0.4	-1.7	-5.1	2.9	9.0	4.7	0.1	1.3
Wages	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3

Table A.5 Simulation 2: Full liberalization, sectoral results (percentage changes)

	AGR	COA	PGA	PAP	OIL	CEM	IST	ELE	TRN	OTH
Domestic sales	-14.6	-17.8	-0.5	-4.1	-7.8	1.3	1.5	-1.0	-18.0	-12.7
Energy intermediate	-7.8	0.0	0.0	-1.8	-6.4	3.0	9.3	0.0	0.0	1.3
Energy prices	15.3	0.0	0.0	16.6	-1.7	8.4	11.1	0.0	12.3	13.7
Imports	-27.5	-4.4	-3.7	-4.6	-9.0	7.9	5.1	0.0	0.0	-11.1
Intermediate inputs.	-3.2	10.9	-3.6	0.7	-0.3	1.3	3.4	-0.2	0.6	0.5
Labor demand	-28.0	-20.4	-12.5	-8.3	-31.6	12.5	30.5	20.8	-0.2	2.7
Rental price of capital	-20.6	-12.2	-3.5	1.1	-24.6	24.0	43.8	33.2	10.0	13.2
Supply prices	-13.6	3.9	-3.2	-1.5	-4.7	8.5	8.8	16.9	3.4	1.8
Value-added	-7.8	-17.8	-0.5	-1.8	-6.4	3.0	9.3	4.2	0.0	1.3
Wages	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2