THE IMPACT OF PHASING OUT SUBSIDIES OF PETROLEUM ENERGY PRODUCTS IN EGYPT

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Abstract

This study assesses the expected short- and medium-run impact of phasing out subsidies of energy products in Egypt. To capture this impact on the most relevant economic variables and sectors, the study conducts an input-output analysis and a computable general equilibrium (CGE) model based on an estimated social accounting matrix (SAM) for the Egyptian economy for 2006/2007. The structure of the SAM will enable an explicit presentation of the impact of energy products, especially those receiving the greater amounts of subsidy. Households are also disaggregated according to expenditures level, so that effects of different policies on poor households can be determined. Following a brief overview of the main approaches to energy pricing, international experience in mitigating the impact of energy pricing reform and characteristics of the petroleum sector in Egypt, the study assesses the relative effect of each petroleum product under different scenarios reflecting various levels of increases in energy prices. The results of CGE analysis—which measures the overall effects of phasing out subsidies subject to alternative scenarios in the medium run (five years projections)—are then considered. They include estimation of the effect of raising prices of various energy products on relevant macroeconomic variables, namely, prices, investment, growth rates of GDP and of sectoral value added, deficit in government budget, resource gap and welfare of different expenditure groups of urban and rural households.

ملخص

تسعى هذه الدراسة إلى تقييم تأثير الخفض التدريجي للدعم المقدم لمنتجات الطاقة في مصر في الأجلين القصير والمتوسط. ولرصد هذا التأثير على المتغيرات الاقتصادية والقطاعات ذات الصلة، تُجري الدراسة تحليلا للمدخلات والمخرجات، ونموذجا للتوازن العام المحسوب (CGE) في إطار مصفوفة المحاسبة الاجتماعية المقدرة للاقتصاد المصري للعام المالي 2007/2006. حيث يتيح هيكل مصفوفة المحاسبة الاجتماعية عرضا واضحا لتأثير منتجات الطاقة، وخاصة تلك التي تتلقى المستويات الأكبر من الدعم. كما يتم تقسيم القطاع العائلي وفقا لمستوى الإنفاق، حتى يمكن تحديد آثار السياسات المختلفة على الأسر الفقيرة. وبعد استعراض المناهج الرئيسية لتسعير الطاقة، والخبرة الدولية في الحد من التأثير السلبي المصاحب لإصلاح نظام تسعير الطاقة، وخصائص قطاع البترول في مصر، تقوم الدراسة بتقييم الأثر النسبي لكل منتج من المنتجات البترولية، وذلك في إطار سيناريوهات مختلفة لزيادة أسعار الطاقة. بعدها يتم النظر في نتائج تحليل نموذج التوازن العام المحسوب، والذي يقيس الآثار الكلية للخفض التدريجي للدعم وفقا لسيناريوهات مختلفة في الأجل المتوسط (توقعات لخمس سنوات). ويتضمن ذلك تقدير أثر رفع أسعار منتجات الطاقة المختلفة على المتغيرات الاقتصادية الكلية ذات الصلة، وهي: الأسعار، والاستثمار، ومعدلات النمو في الناتج المحلي الإجمالي وفي القيمة المضافة على المستوى القطاعي، وعجز موازنة الحكومة، وفجوة الموارد، ورفاهة فئات الإنفاق المختلفة من الأسر في الريف والحضر.

1. INTRODUCTION

Subsidies on energy petroleum products in Egypt increased from LE 40 billion in 2005/2006 to LE 60 billion in 2007/2008, and were expected to reach near LE 62 billion in 2008/2009 (before the decrease in world prices, which will reduce the subsidy bill). These subsidies impose a heavy burden on the government budget and lead to excessive consumption of energy products. This requires revising the system of energy pricing to ensure efficient resource allocation and reduce the rate of depletion of these increasingly scarce resources.

The issue of energy pricing in Egypt is critical and deserves in-depth analysis. There is no clearly documented policy for energy pricing in Egypt and hence for subsidy estimation. World oil prices were subject to dramatic changes in 2008; they went up to $120 per barrel and in a few months decreased to less than $70, and further to less than $40 per barrel because of the global financial crisis. Little is known about the terms of contracts of imports and exports in Egypt and their time horizon and mechanisms of price revision according to changes in world prices, and hence, estimation of real domestic costs and the subsidy bill is not an easy task. Reviewing the pricing policy of energy requires building an accurate system for measuring energy costs. Moreover, it requires clear specification of the society's goals concerning the economic and social aspects of energy. The World Energy Council[1] highlighted the necessity of applying suitable systems of estimating the costs in the context of reforming the energy pricing system.

Revising policies of energy pricing towards phasing out subsidies would produce several impacts on the economy. Direct impacts in the short run are likely to occur on prices of energy products; cost of production of various products and cost of transport services; general level of prices; government budget and household consumption. In the longer run, indirect impacts would spread throughout other economic and social variables, such as investment, sectoral structure of production, balance of trade and would ultimately reflect on growth and welfare. Estimation and assessment of these impacts, according to some alternative scenarios, would help the government design and undertake appropriate measures

[1] World Energy Council (2001).

to minimize unfavorable impacts of revising the system of energy pricing on growth and welfare of vulnerable groups.[2]

The main objective of this study is to assess the expected impacts of phasing out subsidies of energy products in the short and medium runs. In order to capture these impacts on the most relevant economic variables and sectors, the study uses an input-output analysis and a computable general equilibrium (CGE) model based on an estimated social accounting matrix (SAM) of the Egyptian economy for 2006/2007.[3] The structure of the SAM will enable an explicit presentation of the impacts of energy products, especially those receiving the greater amounts of subsidy. Households are also disaggregated according to expenditure level, so that impacts of different policies on poor households can be analyzed.

The structure of the study is as follows: Section 2 presents a brief overview of the main approaches to energy pricing; the domains of government intervention in energy markets and the international experience in mitigating the negative impact of energy pricing reform. Section 3 describes the features of the petroleum sector in the Egyptian economy and its interactions with the main economic variables. In Section 4, an input-output analysis is conducted to measure the direct impact of raising prices of petroleum products on costs of production of different sectors in the economy. The analysis shows the relative effect of each petroleum product under different scenarios of various levels of increases in energy prices. The results of CGE analysis—which measures overall impacts of phasing out subsidies subject to alternative scenarios in the medium run (five-year projections)—are considered in Section 5. They include estimation of the effects of raising prices of various energy products on relevant macroeconomic variables, namely, prices, investment, growth rates of GDP and of sectoral value added, deficit in government budget, resource gap and welfare of different groups of urban and rural households. Section 6 concludes.

[2] The Egyptian government announced in October 2008 that until 2009 there would be no change in domestic energy prices in an effort to contain the likely negative impact of the global financial crisis.

[3] 2006/2007 refers to the fiscal year, which starts July 1st and ends June 30th of the following year.

2. APPROACHES TO PRICING ENERGY AND FORMS OF GOVERNMENT INTERVENTION

The basic objectives of pricing energy are to achieve economic efficiency, to observe social equity and to ensure financial viability. The World Energy Council (WEC) suggested some principles to be applied based on "the recovery of the long-run marginal cost, and including environmental and other externalities where they are identified and measurable, and of providing commercial energy access for everyone."

2.1. Main Approaches to Pricing Energy[4]

The main approaches to pricing energy include the following:

(a) *Marginal cost pricing* is the most commonly applied in countries where energy utilities are publicly owned and the enterprise is run so that the revenue generated is sufficient to cover the operating costs of the utility. This approach provides consumers with an accurate evaluation of the cost of their decision to consume an extra unit of energy. There are two types of marginal cost pricing. The *short-run marginal costs* comprise the cost of crude fuels and other materials, labor costs and maintenance, but do not include capital costs, which are assumed to be fixed. While the *long-run marginal costs* include, in addition, the cost of increasing output by expanding capacity. The former is usually preferred as it is less problematic to estimate and does lead to an efficient use of existing capacity.

(b) *Historical cost recovery pricing:* the price of an energy product is set at a level that allows recovery of past expenditures, and also permits an acceptable market rate of return to be earned. This approach is widely used and has a number of positive attributes. However, this pricing mechanism can send incorrect economic signals, particularly when the set price does not equal marginal cost. It further gives fewer incentives to producers to seek efficiency as the rate of return is fixed.

(c) *Market pricing* involves trading energy between suppliers and consumers at the market price, depending on supply and demand. Bids are accepted in the market from producers of energy to produce at a given price. This leads to competition among producers and encourages efficiency. However, in practice some problems may arise such as market

[4] This section is based on the background paper prepared by Al-Nashar (2008) on pricing energy in Egypt.

dominance and monopolistic behavior, which would reduce efficiency and induce high levels of variability that increases uncertainty.

(d) *Discriminatory energy pricing* is used by suppliers as a means of extracting higher revenues by differentiating prices according to consumer groups' preferences and capacity to pay. This can only be applied whenever it is possible to differentiate between user groups such as residential, commercial and industrial customers. Price discrimination permits income redistribution and may foster economic development through low energy pricing to specific sectors. It can also facilitate the operation of plants with excess capacity and encourage economically efficient development. Discriminatory pricing is common in pricing electricity and natural gas. However, it is less common for other types of energy supplies (petroleum products) because of difficulties in preventing resales and arbitrage.

(e) *Opportunity cost pricing:* is based on the value energy would have if it could be offered and purchased outside the country rather than consumed domestically. The World Energy Council highlighted the limitations of the opportunity cost methodology, which tends to use international prices to measure the cost of energy and its local price accordingly, because this methodology exposes domestic prices to instability and does not take into consideration the differences in social, economic and natural circumstances between countries.

2.2. Policy Options Available to the Government to Influence Energy Pricing

There is a range of policy measures available to governments to influence energy prices.

(a) *Energy taxation* has been used by governments as a cost-effective method of raising revenues in situations where the demand for energy resources is relatively inelastic, that is, higher energy prices do not lead to a significant decrease in consumption.

(b) *Cross subsidies* involve excess charges (prices greater than the cost of supply) being paid by some users in order to subsidize other users of the same product (who face prices that are less than the cost of supply). Cross subsidies result in allocative inefficiency.

(c) *Setting lower rates of return:* Publicly owned energy utilities are sometimes required to maintain lower rates of return. Confusion may arise over the degree to which the rate of return has been lowered to directly benefit consumers.

(d) *Direct subsidies* involve government funding for selected beneficiaries directly.

2.3. Energy Pricing in Egypt

Oil and gas pricing in Egypt depends on the world price of imported products and/or products purchased from the foreign partners of the Egyptian General Petroleum Corporation (EGPC) and other local investment companies; in addition to all related direct and indirect costs, such as the costs of refining, transportation, storing, import duties and taxes (Shehata 2008). As to the share of Egypt from crude oil and natural gas it is considered to have zero cost. Egypt's oil and gas pricing policy does not take into consideration the foregone opportunity cost of EGPC's share that is sold entirely in the domestic market under the subsidized price.

Domestic prices of petroleum products were kept almost constant since 1991 until 2004, when the government started to increase prices of some products at different points of time ending with the latest increases in May 2008 (details are highlighted later in Section 4).

2.4. International Experience in Mitigating the Impact of Energy Pricing Reform[5]

Attempts to reduce subsidies to fuel prices through a price differential in points of sale, only for a category of consumers, have proved largely ineffective in most countries that have experienced it. They led to the development of informal/black fuel markets and smuggling.

More generally, beyond an exclusive emphasis on the poor, it is important to identify more desirable uses for budgetary savings from the reduction of fuel subsidies. Targeting of fuel subsidies to the very poor means that it should be possible to identify *more effective social protection mechanisms* that protect the poorest households from increases in fuel prices, and still have substantial savings left over to allocate to higher priority expenditures or tax cuts that benefit the population more broadly. To counter the impact of energy price subsidy reforms, some countries adopted unconditional cash transfers either directly: cash transfers, or indirectly: coupons coupled with smart cards providing certain quantities of petrol/LPG at subsidized prices.

[5] This section is based on Coady, Grosh, and Hoddinott (2004); Coady and Newhouse (2006); Coady et al. (2008); and World Bank (2008).

(a) *Direct cash transfers*

Direct monetary transfers include an administrative mechanism of transfer from the government to consumer bank accounts established for beneficiaries; magnetic cards were used to collect periodically coupons at discount window transfers. This mechanism was implemented in some countries like Chile, China and Indonesia.

Conditional cash transfers (CCTs) are increasingly being used to ensure greater social protection in development. Countries using CCT reforms to offset subsidies to fuel prices include Brazil, Chile, Indonesia and Turkey.

(b) *Transfers through smart cards or coupon systems*

Coupon systems (e.g., coupons providing preferential rates) have been used for limited purchases of kerosene in some countries. The coupon entitles the identified households to a limited supply at a subsidized price. Malaysia, Indonesia and Iran have all experimented with the use of smart cards.

(c) *Short-term indirect mitigation measures*

In Ghana, which lacked a comprehensive safety net, the government packaged fuel price increases with a set of compensatory measures. These measures included *elimination of fees for attending primary and junior secondary school*. *Extra funds* were also made available to an existing program—the Community Health Compound Scheme—to enhance primary health care in the poorest areas. In Jordan, *the minimum wage was increased*, as were the *salaries of low-paid government employees simultaneously with energy price increases*. Table A.1 sums up examples of such indirect measures.

(d) *Managing energy prices*

To avoid wasteful public expenditures on distortionary and badly targeted fuel subsidies, it may be best to *insulate price setting as much as possible from political pressure*. Both Ghana and Jordan have made moves in this direction. In mid-February 2005, when the Ghanaian government increased petroleum prices by 50 percent on average, it also announced its intention to introduce a new pricing formula in order to remove the government from pricing decisions.

Table A.2 presents a summary of the experience of some countries with reforming energy subsidies.

3. CURRENT SITUATION OF THE EGYPTIAN PETROLEUM SECTOR

The petroleum sector plays an important role in the production process and in Egypt's external trade.

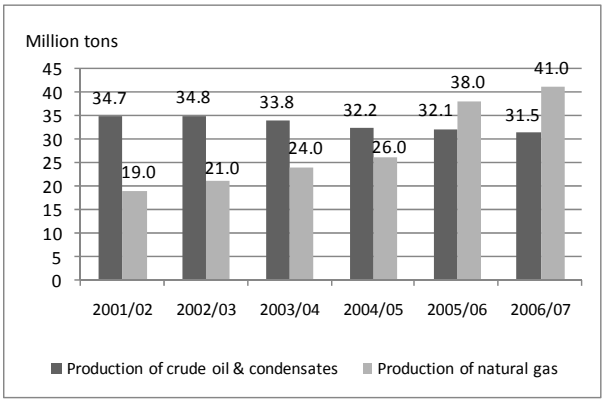
3.1. Production, Reserves and Consumption of Crude Oil and Natural Gas

Published data on production and reserves show that production of crude oil and condensates in Egypt decreased from 34.7 million tons in 2001/2002 to 31.5 million tons in 2006/2007, while production of natural gas increased from 19 million tons to 41 million tons in the same period.

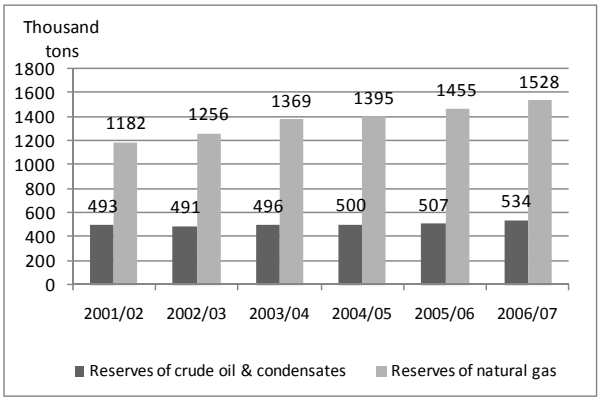
Reserves of crude oil and condensates increased from 493 thousand tons to 534 thousand tons, while that of natural gas increased from 1182 thousand tons to 1528 thousand tons in the same period (Figure 1). Egypt's share in production of oil is about 62 percent, its share in production of natural gas is about 50 percent,[6] while the rest goes to foreign partners. The sharp increase in natural gas production, especially starting 2005/2006, narrowed the gap between the share of Egypt in production of natural gas and domestic consumption from 9 million tons in 2001/2002 to 6 million tons in 2006/2007, while the gap increased in the case of crude oil and consumption of petroleum products from 0.8 milion tons to 8.2 milion tons during the same period (Figure 2).

Figure 1. Development of Production and Reserves of Crude Oil and Natural Gas

a. Production of oil and natural gas



b. Reserves of oil and natural gas

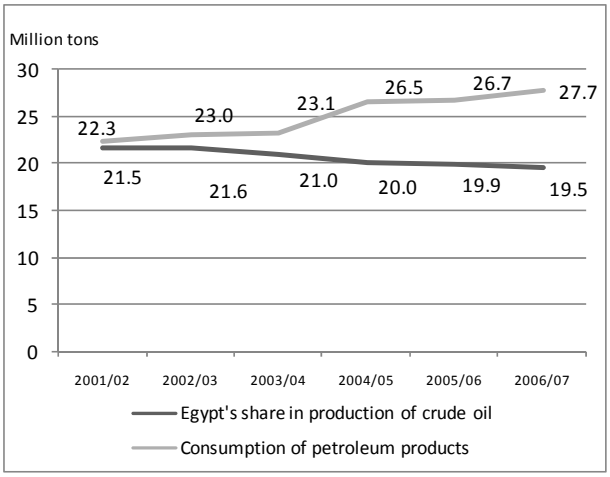


Source: INP (2008).

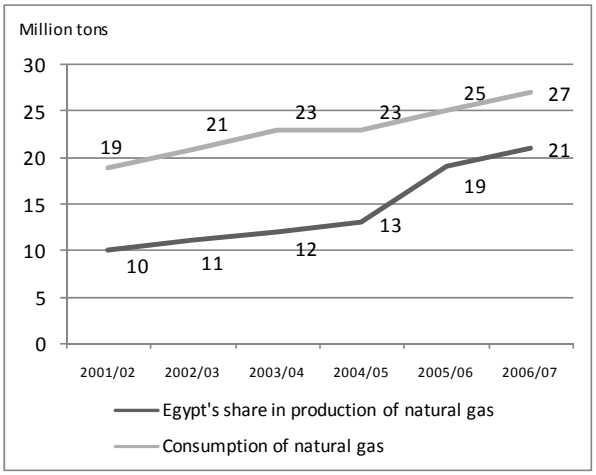
[6] INP (2008).

Figure 2. Egypt's Share in Production and Consumption of Petroleum and Natural Gas

a. Petroleum



b. Natural gas

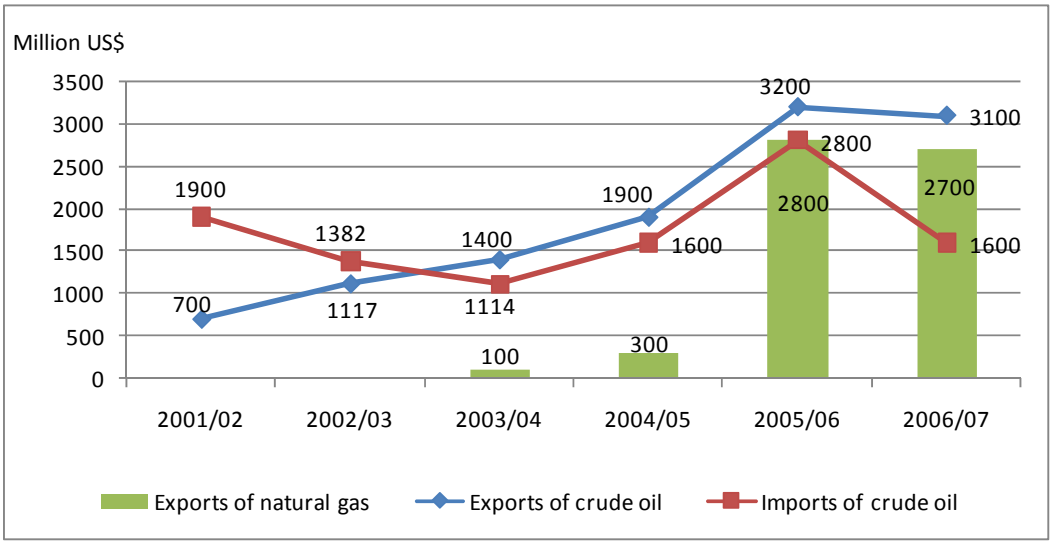


Source: INP (2008).

3.2. External Trade

In spite of the existing gap between production and consumption of natural gas, the trade balance does not record any imports of natural gas, because the deficit is covered through buying locally from foreign partners.

Figure 3. Exports and Imports of Petroleum Sector



Source: CBE (2008).

Balance of trade figures show a drastic increase in exports of natural gas in 2005/2006, reaching $2800 million, compared to $300 million in 2004/2005. However, the proceeds of exports of crude oil always exceed those of natural gas. Imports of crude oil increased to reach $2800 million in 2005/2006 and then decreased to $1600 million in 2006/2007. The

trade balance of oil has been positive since 2003/2004 (Figure 3). Proceeds of exports of oil, petroleum products and natural gas represented about 45 percent of total merchandise exports in 2006/2007, and more than 20 percent of exports of goods and services.

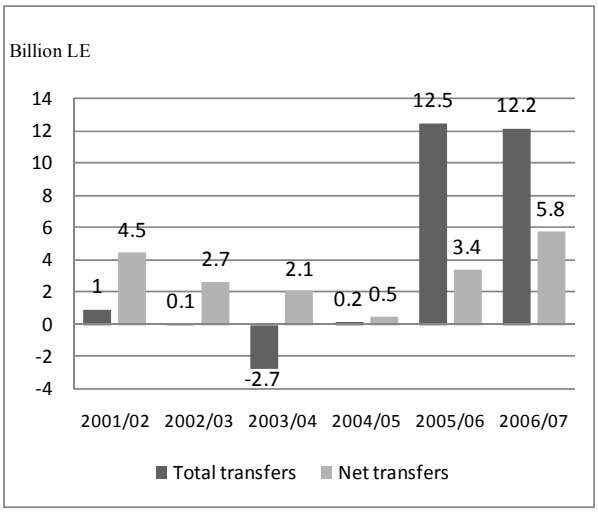
3.3. Subsidies of Petroleum Products and Natural Gas

Petroleum product subsidies are recorded explicitly in government budget since 2005/2006. Before that date total transfers from the Egyptian General Petroleum Corporation (EGPC) were declining, especially in 2003/2004 as they recorded a negative value.

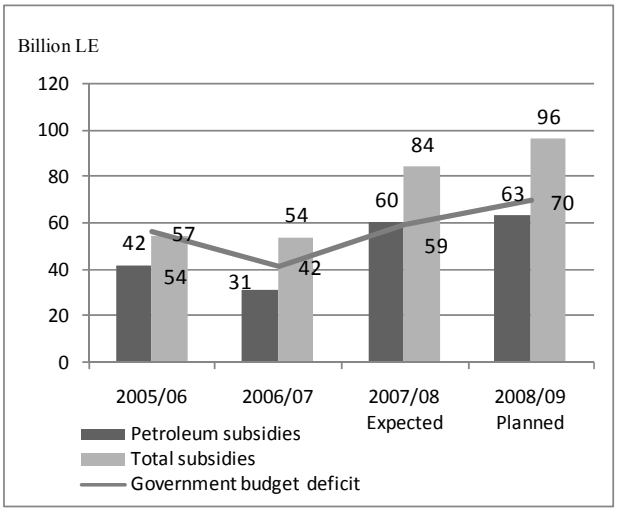
Net transfers take into consideration other transfers between government budget and EGPC, such as taxes and subsidies. Starting 2005/2006, as EGPC has been receiving subsidies, total transfers increased substantially; however, net transfers were much lower (Figure 4). Petroleum subsidies exceeded 70 percent of total subsidies in 2007/2008.

Figure 4. Subsidies of Petroleum and Transfers from EGPC to Government Budget

a. Transfers from EGPC to government budget



b. Subsidies and budget deficit



Source: Ministry of Finance (MoF), Government Budgets, www.MOF.gov.eg.

Subsidies of energy petroleum products are subject to varying estimations and revisions from different sources such as the Ministry of Petroleum, Ministry of Finance and individual researchers. The main reason for these variations is the nature of production of the petroleum sector, and difficulties in measuring costs accurately. Refineries receive domestically produced crude oil almost free of charge, thus adding to unaccounted for implicit subsidies to petroleum products. Some crude oil is imported either from abroad or from the share of foreign partners, which is valued at actual paid price. As mentioned earlier, there is no

documented and officially published data about the cost structure of petroleum; different approaches are used to assign values to different cost items of production, which is affected by world prices of crude oil and changes in prices of other cost items. Table 1 presents domestic prices of petroleum products in 2007/2008 and unofficial estimates of actual domestic cost of these products and their world prices. Accordingly, subsidies for each product are measured twice: first as the difference between estimated actual cost and domestic price; and then as the difference between world prices and domestic prices.

Table 1. Costs, Prices and Subsidies of Petroleum Products (LE), 2007/2008

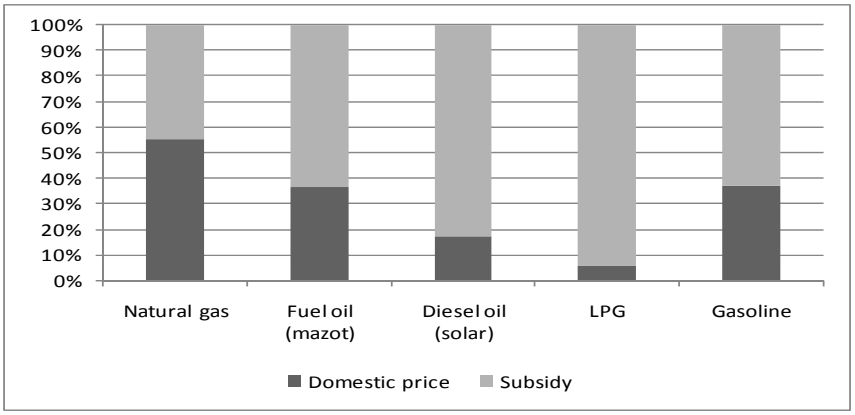
Unit	Petroleum products	Domestic price	Actual cost	World price	Subsidy per unit according to actual cost	Subsidy per unit according to world prices
M3	Natural gas	0.26	0.47	*	0.21	*
Ton	Fuel oil (mazot)	750	2043	3180	1293	2430
Liter	Diesel oil (solar)	0.75	4.4	5.33	3.65	4.58
Cylinder	LPG	2.5	46.2	54.3	43.7	51.8
Liter	Gasoline	1.17	3.15	3.88	1.98	2.71

Source: Ezz (2008).

* There is no documented world price for natural gas.

Increases in prices of some petroleum products, which were decided by the government at different points of time, and increases in costs due to increases in world prices, induced changes in the amounts of subsidy to these products, and accordingly in total amount of petroleum subsidies. Figure 5 presents the shares of domestic price and subsidy in actual costs of various petroleum products. Shares in consumption (intermediate and final consumption) are calculated from the updated input-output table for 2006/2007.

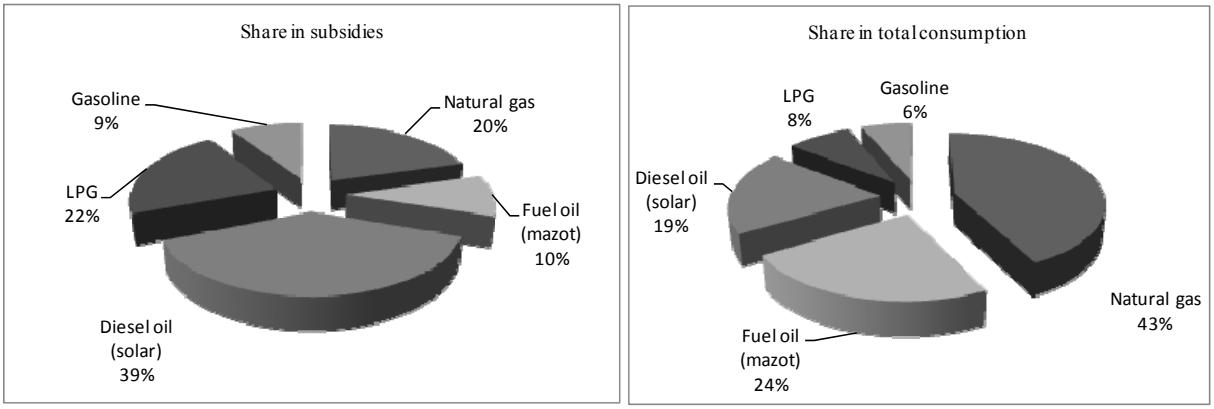
Figure 5. Ratios of Domestic Prices and Subsidies to Actual Costs of Petroleum Products in 2007/2008



Source: Table 1.

Figure 6 shows that natural gas has the highest share in consumption (42.6 percent) and receives 20 percent of subsidies. Diesel oil receives the highest share of subsidies (39.1 percent), while accounting only for 19.2 percent of total consumption. LPG is heavily subsidized, its price is constant at LE 2.5 per cylinder and its actual cost reaches LE 46.2, its share in total consumption is 8.1 percent, while its share in subsidies is 21.8 percent. Diesel oil and LPG receive about 60 percent of total subsidies. Gasoline is the least subsidized and least consumed petroleum product.

Figure 6. Structure of Subsidies and Consumption of Petroleum Products



Source: Shares in subsidies are calculated from data in detailed government budget 2006/2007.

3.4. Recent Change in World Prices of Petroleum Products

World crude oil prices increased from around $70 per barrel in July 2007 to $127 in July 2008, and then started to decline reaching less than $40 in December 2008. Prices of all petroleum products continuously declined from August 2008 until December 2008 as a result of the world financial crisis as shown in Table A.3.

However, in spite of the recession in the US and in most of Europe, the US Energy Information Administration (EIA) published long-term projections (used in Section 5 for the reference path) of oil prices and petroleum products suggesting further decreases in 2008/2009 followed by increases until 2030 at varying rates. Projections of annual percentage changes of world prices of petroleum products in medium term projections until 2012/2013 are shown in Table 2. CGE projections are based on these percentage changes in world prices. These projections indicated that prices of oil products will resume their increase after declining in 2008/2009.

Table 2. Annual Percentage Changes in World Prices of Petroleum Products (Medium-Term Projections until 2012/2013)

Petroleum products	2008/09	2009/10	2010/11	2011/12	2012/13
Diesel oil	-28.02	0.68	10.78	8.84	6.27
Fuel oil	-26.46	-1.73	11.55	9.55	6.75
LPG	-10.32	16.85	9.50	9.60	5.62
Gasoline	-26.77	19.95	8.62	7.12	5.45
Natural gas	-18.83	3.54	0.93	2.97	1.53

Source: Energy Information Administration (2008).

4. ESTIMATION OF DIRECT IMPACTS OF PHASING OUT PETROLEUM ENERGY SUBSIDIES

Subsidies assigned to each energy petroleum product are calculated as the difference between domestic price and (estimated) actual domestic cost (as shown in Table 1 above) multiplied by the amount consumed of each product.[7] Domestic prices of all petroleum products are controlled by the government. Removing subsidies, partially or totally, is implemented through administrative changes of prices of petroleum products. Thus, removing subsidies is directly translated into an increase in prices of energy products. These increases in energy prices induce direct and indirect effects on prices of all goods and services, which in turn exert various effects on other economic and social variables. All these effects are to be measured and analyzed by a general equilibrium model.

This section of the study focuses on measuring the impacts of changing prices of energy petroleum products on consumer price indices of all other sectors of the economy and on the inflation rate at the national level as expressed by the consumer price index (CPI). These impacts depend on:

- the initial increase in price of each petroleum product,
- the weight of each petroleum product in total cost of various production sectors in the economy,
- the weight of each petroleum product in total final household consumption, and
- the structure of interrelations between various production sectors.

[7] Estimated domestic cost rather than world prices of petroleum products is used to evaluate energy product subsidies. This approach is preferred, as evaluating subsidies on the basis of world prices subjects these estimates to instability in addition to ignoring differences in social, economic and natural circumstances between countries.

An input-output analysis has been used to estimate the impact of raising prices of petroleum products on prices of various activities, as well as at the macroeconomic level. The updated input-output table for 2006/2007 consists of 23 sectors. However, to facilitate the interpretation of results, sectors were regrouped into 7 sectors as follows:

- *Petroleum products* which include: natural gas; fuel oil; diesel oil; liquefied petroleum gas (LPG); and gasoline. This list is not exhaustive; there are some other petroleum products that are not included in this sector, because of their minor influence on subsidies and prices. These products are: kerosene, and bunker and jet fuels. They are included under the sector "other chemicals," which also includes non-energy petroleum products, such as:
    - *petrochemicals,*
    - *electricity, and*
    - *transport and communications.*
- *Energy intensive industries*, which include: food and tobacco; fertilizers; cement; other chemicals; iron and steel; aluminum; and other industries. The criterion lying behind grouping these sectors in one category is their energy intensity (only for petroleum and not electricity) and their share in consumption of energy products.
- *Other industries*, which include: agriculture; crude oil and extractive industries; textiles; metal industries; and engineering industries.
- *Hotels and restaurants,* as a proxy for tourism.
- *Other services*: construction; trade and finance; housing; infrastructure; government activities; and other social and personal services.

4.1. Structure of Consumption of Energy Petroleum Products

Before proceeding to the analysis of the impacts of changing prices of petroleum products, it may be useful to analyze the structure of consumption of petroleum products among different sectors, as it gives initial insight into the degree of the sensitivity of various sectors to changes in energy prices.

Table 3 shows that electricity utilizes 63.7 percent of total consumption of natural gas, while households consume 3 percent; and that hotels and restaurants utilize relatively more natural gas than other petroleum products. The table also shows that natural gas is the only petroleum product that is used as input for other petroleum products.

Fuel oil is mainly used by energy intensive industries (83.2 percent), and is not consumed by households. Transport and communications use 66.7 percent of diesel oil and about 86 percent of gasoline consumption, the rest is consumed by households for private cars. Households consume 41.1 percent of LPG, while other services consume 44.2 percent.

Concerning consumption of total energy petroleum products, data reveals that energy intensive industries utilize 32.7 percent, while electricity utilizes 27.5 percent, and households consume 5.5 percent. Electricity has the highest energy intensity (69.5 percent), measured as the ratio of the value of its energy consumption to its total output value. Energy intensity of transport and communications is 21.4 percent, while it amounts to 11.2 percent for energy intensive industries. Households allocate 1.12 percent of their consumption expenditures to petroleum products. The average petroleum energy intensity for all activities is 7.5 percent, as shown in Table A.4.

Table 3. Structure of Consumption of Energy Petroleum Products across Sectors

Sectors	Natural gas		Fuel oil (mazot)		Diesel oil (solar)		LPG		Gasoline	
	Value (million LE)	%	Value (million LE)	%	Value (million LE)	%	Value (million LE)	%	Value (million LE)	%
Petroleum products	3984	8.9	0	0.0	0	0.0	0	0.0	0	0.0
Electricity	28460	63.7	292	1.2	95	0.5	0	0.0	0	0.0
Transport and communications	2598	5.8	1526	6.1	13413	66.7	0	0.0	5699	85.9
Energy intensive industries	6883	15.4	20749	83.2	5648	28.1	998	11.7	0	0.0
Other industries	103	0.2	2348	9.4	932	4.6	99	1.2	0	0.0
Hotels and restaurants	1284	2.9	3	0.0	4	0.0	157	1.8	0	0.0
Other services	28	0.1	27	0.13	28	0.14	3755	44.2	0	0.0
Households	1346	3.0	0	0.0	0	0.0	3495	41.1	936	14.1
Total consumption	44686	100	24946	100	20120	100	8503	100	6635	100

Source: Updated input-output table for 2006/2007.

4.2. Measuring the Impacts of Changing Prices of Petroleum Products on the Consumer Price Level

Immediate removal of all subsidies on petroleum products would lead to increases in prices that are not tolerable to society. Alternatives to immediate removal of all subsidies are assessed according to their impacts on consumer prices. Alternative scenarios are based on different rates of increases in price of one or all petroleum products. Price increases are

alternatively applied to all users, or to producers only, or to energy intensive industries only. Table 4 illustrates three alternative scenarios.

Table 4. Percentage Increases in Prices of Energy Petroleum Products in Three Alternative Scenarios

Scenario / Petroleum product	Increase in prices of all petroleum products by 10%	Increases in prices decided in May 2008	Adjusting prices according to actual domestic costs
Natural gas	10	58.33*	80.8
Fuel oil (mazot)	10	100	106.4
Diesel oil (solar)	10	46.7	206.7
LPG	10	0	1320.0
Gasoline	10	28.2	86.3

Source: Authors' calculations.

* Only for fertilizers, cement, iron and steel, and aluminum.

Scenario 1 assumes an equal percentage increase in prices of all petroleum products by 10 percent of their level before the May 2008 increases decided by the government for some energy products. Scenario 2 considers actual increases in prices of petroleum products, applied by the government in May 2008. Scenario 3 assumes removing all subsidies by adjusting prices of all petroleum products to their actual domestic costs at their 2007/2008 level.

4.3. Analysis of Results

Table 5 shows successively the impact of increasing energy prices on sectoral prices and on the consumer price index (CPI) according to the alternative scenarios considered.

Increasing prices of all petroleum products by 10 percent would result in *increased inflation of CPI by 1.5 percentage points,* as shown in Table 5.

When considered separately, results show that *natural gas affects prices* more than other petroleum products; it raises the CPI by about 0.5 percentage points as shown in Table 6. Natural gas, as mentioned previously, is not the most heavily subsidized energy product, but it is the most utilized. Its effect on prices is amplified through electricity, which is the main consumer of natural gas. Also, electricity accounts for about 2.3 percent in consumption expenditure of households, which is more than the share of all energy petroleum products.

Table 5. Impacts of Energy Prices on Sectoral and Overall Prices: Results of Main Scenarios

Sectors	Increase in prices of all petroleum products by 10%		Increases in prices of petroleum products decided by the government in May 2008		Increases in prices of petroleum products in case of removing subsidies and adjusting prices to domestic costs	
	Percentage increase in consumer price index	Contribution of sector in percentage increase in CPI	Percentage increase in consumer price index	Contribution of sector in percentage increase in CPI	Percentage increase in consumer price index	Contribution of sector in percentage increase in CPI
Petroleum products	10.0	0.1	4.6	0.1	831.4	9.3
Electricity	7.1	0.2	1.3	0.03	59.6	1.4
Transport and communications	2.4	0.2	9.3	0.8	42.5	3.8
Energy intensive industries	1.6	0.7	9.4	4.0	29.9	12.9
Other industries	0.7	0.1	4.0	0.8	15.6	2.9
Hotels and restaurants	0.8	0.1	1.5	0.1	23.0	1.7
Other services	0.5	0.1	1.8	0.3	26.6	4.9
CPI at the national level	1.5	1.5	6.2	6.2	36.9	36.9
Reduction in subsidies (%)	7.7		20.9		100	

Source: Authors' calculations.

Increase in price of *fuel oil* by 10 percent would raise inflation, as measured by the increase in CPI, by 0.45 percentage point (Table 6). The same percentage increase in price of gasoline would raise CPI by 0.09 percentage points only. *Gasoline has the lowest effect on the price level*; this result is expected as it is the least consumed product. When considering the resulting changes in prices of different sectors, it appeared that *electricity price would increase by 6.9 percent for every 10 percent increase in the price of natural gas.* The impact of the price of diesel oil on transport and communications is more than double that of the price of gasoline.

Table 6. Percentage Increases in Case of Increasing Price of Each Petroleum Product Separately by 10%

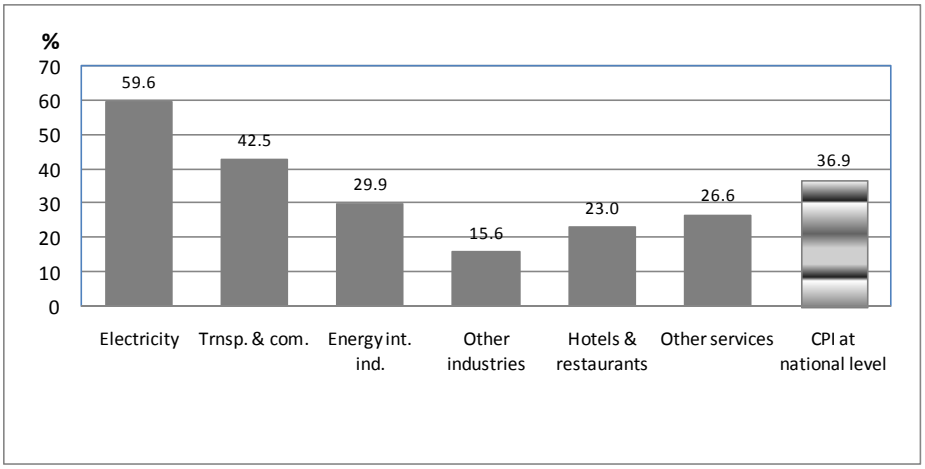
Petroleum products	Natural gas	Fuel oil (mazot)	Diesel oil (solar)	LPG	Gasoline
Petroleum products	2.33	0.00	0.00	6.05	1.62
Electricity	6.89	0.11	0.04	0.01	0.00
Transport and communications	0.41	0.18	1.28	0.01	0.54
Energy intensive industries	0.40	0.80	0.28	0.06	0.02
Other industries	0.20	0.33	0.14	0.04	0.02
Hotels and restaurants	0.50	0.11	0.09	0.10	0.03
Other services	0.11	0.12	0.11	0.13	0.03
CPI at the national level	0.49	0.45	0.29	0.14	0.09

Source: Authors' calculations.

Increases in prices of some petroleum products that were applied by the government in May 2008 (second scenario) are expected to *contribute to the rise of CPI by 6.2 percentage points.* Energy intensive industries contribute about 4 percentage points, as indicated in Table 5.

Adjusting all prices to domestic cost would remove all subsidies. The average price level of petroleum products would then increase by 831 percent (Table 5). This induces an increase in CPI at the national level by 36.9 percentage points. The price of energy intensive industries is expected to increase by about 30 percent and contribute 12.9 percentage points to CPI. Prices of transport and communications would increase by 42.5 percent. Price of electricity would rise by 59.6 percent as indicated in Figure 7.

Figure 7. Percentage Increase in Price Index in Case of Removing All Subsidies



Source: Authors' calculations.

Adjusting all prices to domestic costs only for producers and not households would reduce subsidies by 75 percent, but increasing the level of consumer prices by 27.6 percentage points, while adjusting prices of petroleum products to their actual cost only for energy intensive industries, is expected to increase the level of consumer prices by 9.9 percentage points, and reduce subsidies by 28 percent (results not shown).

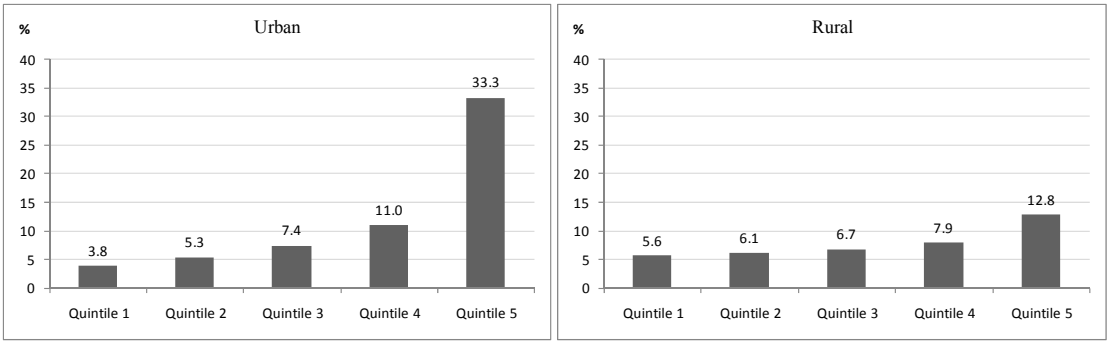
In all scenarios, the aggregated sector of "energy intensive industries" is the highest contributor to the increase in CPI. Within this sector, the food industry has the highest impact on CPI, because of its share in household consumption, which accounts for about 40 percent (results of the calculations are not shown).

4.4. Impacts of Alternative Scenarios on Consumer Price Level for Households in Various Expenditure Quintiles

It is worth noting that the shares of household quintiles in total consumption of energy petroleum products reflect their shares in benefiting from energy petroleum subsidies (Figure 8). The richest urban quintile benefits from 33 percent of these subsidies, while the poorest urban quintile benefits from only 3.8 percent. These figures give strong evidence of inequitable distribution of these energy subsidies. Similarly, in rural areas, the richest quintile benefits from 12.8 percent of petroleum subsidies while the poorest quintile benefits from 5.6 percent. This also indicates inequitable distribution of energy subsidies although to a lower extent.

The impact of increasing prices of all energy petroleum products on high expenditure quintiles slightly exceeds its impact on lower income quintiles, as higher income households allocate a bigger share of their spending to total energy consumption. However, this is not true when considering the impact of each petroleum product separately.

Figure 8. Distribution of Petroleum Subsidies by Expenditure Quintiles in Urban and Rural Egypt



Source: CAPMAS, HIECS, 2004/2005.

Increasing prices of natural gas and/or fuel oil affects lower expenditure groups more than the higher ones.

The share of spending on food industry products increases in lower income groups. This industry is among the energy intensive industries, which explains why increasing petroleum products only for energy intensive industries—including the food industry—affects lower expenditure quintiles more than the higher ones. The resulting increases in CPI in rural areas are slightly higher than in urban areas in the lowest two quintiles in all petroleum products.

The impact of initial increases in prices of petroleum products and the resulting final increases in prices of all goods and services on the pattern of consumption depends on price and income elasticities of petroleum products as well as of other goods and services.

All price and income elasticities are considered in the CGE model used in this study. It may be useful to mention here that estimates of price elasticities of petroleum products in Egypt are considerably low. Regression analysis of time series data on energy products estimated price elasticities of natural gas, LPG and gasoline as 0.078, -0.174 and -0.294, respectively.[8] These figures indicate rigidity in the response of consumption to changes in prices of these products. Final results will depend on the interaction of all prices and income elasticities of all goods and services. These are some of the parameters of the CGE model, which should also estimate their impact on other economic variables, such as investment and growth.

In conclusion, it appears that in the extreme case of removing all petroleum subsidies in one step (third scenario) the inflation rate, measured by the CPI, would rise by almost 37 percentage points. If this effect is not offset by an increase in incomes of households, it will mean that households would lose more than one third of their real income (purchasing power), which has detrimental effects on their living conditions. Mitigating measures should be considered before deciding levels and stages of phasing out subsidies of energy petroleum products. On the other hand, removing petroleum subsidies would save about LE 60 billion of government spending in the 2007/2008 budget, which in turn could be used to finance social compensatory measures.

[8] Abouleinein et al. (2005).

The analysis has also estimated the effects of every 10 percent increase in prices of each petroleum product on inflation rate both at the national level and for each expenditure quintile of households (Table 7). These estimates would help policymakers decide the tolerable level of price increase of each of these products in the process of phasing out energy petroleum subsidies.

Table 7. Impacts of Alternative Scenarios on Consumer Price Level for Households (%)

Scenario	Expenditure quintiles of households									
	Urban					Rural				
	1	2	3	4	5	1	2	3	4	5
1) Increase in prices of petroleum products by 10%										
All petroleum products	1.4	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5	1.5
Natural gas	0.52	0.50	0.49	0.49	0.49	0.49	0.48	0.48	0.47	0.45
Fuel oil (mazot)	0.46	0.45	0.44	0.44	0.43	0.50	0.48	0.47	0.46	0.47
Gas oil (solar)	0.24	0.25	0.26	0.28	0.30	0.28	0.29	0.30	0.31	0.32
LPG	0.12	0.12	0.13	0.13	0.17	0.13	0.12	0.12	0.12	0.12
Gasoline	0.06	0.06	0.07	0.08	0.10	0.08	0.08	0.09	0.09	0.10
2) Increase in petroleum products as of May 2008										
	5.9	5.8	5.9	5.9	6.0	6.6	6.4	6.3	6.3	6.5
3) Adjusting prices to domestic costs										
For activities and households	33.8	33.8	34.8	36.2	42.0	36.6	35.1	34.9	35.1	35.9
For activities only	26.6	26.7	27.1	27.5	28.6	26.9	26.9	27.1	27.3	27.9
For energy intensive industries only	10.0	9.8	9.7	9.6	9.3	11.0	10.4	10.1	9.9	10.3

Source: Authors' calculations.

5. Estimation of Overall Impacts of Phasing Out Petroleum Energy Subsidies Using a CGE Model

Over the past 25 years, computable general equilibrium (CGE) models have become a standard tool of empirical economic analysis. In recent years, improvements in model specification, data availability and computer technology have improved the payoffs and reduced the costs of policy analysis based on CGE models, paving the way for their widespread use by policy analysts throughout the world.

The standard model includes a number of features designed to reflect the characteristics of developing countries. Among the distinguishing features of the current model are a representation of the energy sector that is sensitive to Egypt's conditions, and the appropriate design of factor and macro closure rules given the focus of this study.

5.1. The Social Accounting Matrix and the Database

The model in this paper is built around an updated social accounting matrix (SAM) for 2006/2007, assembled and estimated for this study. A social accounting matrix (SAM) is a comprehensive, economy-wide data framework, typically representing the economy of a nation. More technically, a SAM is a square matrix in which each account is represented by a row and a column. Table 8 highlights the disaggregated sectors of the SAM.

As shown in Table A.5, crude oil and extraction, and natural gas exceed 15 percent of GDP, out of which crude oil represents about 44 percent, and natural gas represents 55 percent. Commodity subsidies amounted to LE 40.918 billion (5.60 percent of GDP). Energy subsidies accounted for 75 percent of total commodity subsidy.

Table 8. Disaggregated Sectors of SAM

Sets	Elements
Production activities (23)	Agriculture, food processing, textiles, crude oil, natural gas, fuel oil (mazot), gasoline, LPG, gas oil (diesel), chemical industries, aluminum and aluminum products, fertilizers, cement, iron and steel, non-metal industries, machinery, other industries, metal industry, electricity, transportation, construction, hotels and restaurants (tourism) and other services.
Factors of production (2)	Labor and capital.
Institutions (15)	Five urban households by expenditure quintiles, five rural households by expenditure quintiles, public companies, private companies, government, capital account and rest of the world.
Other institution accounts (tax) (4)	Direct taxes; tariffs; other indirect taxes; and subsidies.

Source: Constructed by the authors.

There are ten household types in the model: Five urban and five rural, all grouped according to expenditure quintiles. Rural households represent 52 percent of the Egyptian population with an equal number of households in each quintile (i.e., 10.4 percent). Similarly, each urban household type contains 9.4 percent of Egyptian households.

The pattern of spending on different commodities varies by quintile as reflected by their budget shares shown in Table A.6. Throughout the analysis, the poor are defined in relative terms as those belonging to the bottom 40 percent of the expenditure distribution (the two lowest expenditure quintiles) within each of the urban and rural regions. In addition, the table highlights disparities in consumption patterns between quintiles, especially in rural areas.

The observed disparity in the level of the welfare indicator for different quintiles reflects the sharp divergence in real per capita expenditure and in well-being. The welfare

indicator as measured by per capita expenditure for the richest quintile tends to be around five times that of the poorest quintile in urban areas and exceeds three times that of rural areas, as will be shown later in Table 9.

5.2. Policy Simulations

The CGE model was used to carry out selected policy-related simulation experiments to assess the effects of different energy petroleum pricing reform scenarios. The model was applied to assess the direct and indirect impacts of four alternative scenarios on the medium term performance of the Egyptian economy, with an emphasis on the following macroeconomic indicators: a) the level of economic growth, b) external balance, c) economic resource gap, d) welfare level of citizens, as measured by per capita consumption, and e) the performance of government sector and its deficit.

Four simulation experiments were conducted to address the impact of the following adjustment strategies:

Scenario 0: the "*reference path".* It assumes continuation and relative stability of economic policies and development trends applied or planned to be applied during the period 2007/2008-2012/2013, a six-year period that covers the five-year plan, 2007/2008-2011/2012 and one year beyond.

Scenario 1: adjustment of petroleum product prices. This simulation evaluates the socioeconomic impact of gradual elimination of petroleum subsidies within 5 years. At the end of this scenario, energy prices should reflect their actual cash cost. In the first year of this simulation, increases in energy prices that prevailed in May 2008 are applied. It is also assumed that domestic petroleum prices will not change in 2008/2009 as announced by the government. To implement this scenario, assumptions had to be made regarding the expected annual growth rates of domestic costs, and accordingly annual growth rates of price of each petroleum product, so that by the end of the 5th fiscal year 2012/2013, domestic price would equal actual domestic cost.

The calculations are based on the following assumptions: Prices of petroleum products will be raised at constant annual growth rates starting 2009/2010 and over the following four years so that by the end of 2012/2013 domestic price should equal domestic cost.

The assumption on which these growth rates are calculated is that domestic cost is expected to grow at the same growth rates as world prices, as statistical analysis shows that the correlation coefficients between domestic costs and world prices equal more than 99 percent for all petroleum products. Growth rates of world prices are computed using estimated projections to 2030 shown previously in Table 2 (Energy Information Administration 2008). Using an exponential formula, constant annual growth rates are computed so that the domestic price of each product reaches its targeted value in year 2012/2013.

Scenario 2: Introducing cash transfers (*CT1*). This scenario is similar to scenario 1, where energy subsidy is eliminated gradually with increased government cash transfers to the poorest two quintiles by 20 percent in both urban and rural areas.

Scenario 3: Introducing cash transfers (*CT2*). This scenario is similar to scenario 1, where energy subsidy is eliminated gradually and 50 percent of energy subsidy savings are transferred to all households *(untargeted).*

Scenario 4: Introducing cash transfers (*CT3*). This scenario is also similar to scenario 1, where energy subsidy is eliminated gradually and 50 percent of energy subsidy savings are transferred and *targeted* to the poorest two quintiles in both urban and rural areas.

Table A.7 presents percentage changes of exogenous and policy variables for each scenario.

5.3. Reference Path

Results of the main policy simulations are presented in the three tables (A.8a, b, c) in the Appendix. In the first column of each table, summary data are presented regarding the macroeconomic and sectoral variables in the base year as well as the fiscal situation and the resource gap. Nominal GDP (at market prices) in 2006/2007, the base year, exceeded LE 731.2 billion. According to the selected macroeconomic indicators, private and government investment represented 21.2 percent of GDP. The import and export shares in GDP represented 34.8 percent and 31.5 percent, respectively. The fiscal budget imbalance is reflected by the large government deficit share in GDP reaching around 5.7 percent.

Results of the benchmark scenario (reference path) are presented in the second column, where the benchmark reflects the most likely scenario in the following six years. Exogenous variables for this benchmark are assumed to match those in the revised five-year plan of

2007/2008-2011/2012,[9] after the turmoil that has shaken the global financial system since September 2008 and one year beyond. In this scenario, no change in energy subsidy is assumed. Impacts of different policies are reported as a percentage change of the main macro, sectoral and fiscal indicators, from the benchmark.

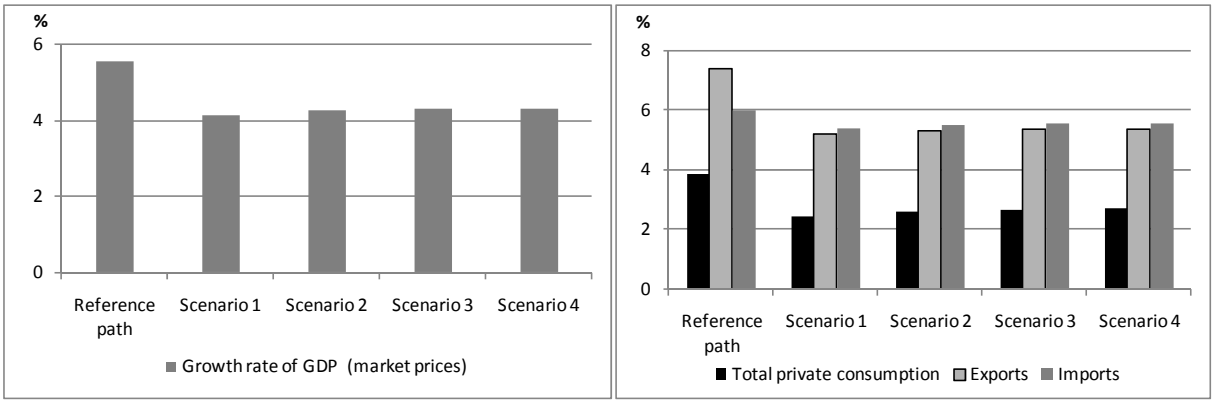
According to the revised five-year plan and the authors' assumption, investment will grow annually by 9 percent on average in real terms, with a 5 percent annual percentage change in real government consumption.

In the reference path, GDP at factor cost is predicted to grow on average by 4.8 percent per annum, exports by 7.4 percent; imports by 6 percent; and private consumption by around 3.8 percent as shown in Figure 9, and trends are equal across all quintiles as shown in Figure 10. The structure of the economy changes compared to the base year, as reflected by the increased share of the commodity sectors (other industries) to GDP compared to the base year from 22.5 percent to around 27.9 percent by the end of the simulation period. The share of petroleum products to GDP also increases slightly while the share of energy intensive industries declines insignificantly. The share of all services—regardless of their energy intensity—also declines, but at varying degrees as shown in Table A.8b. Total private consumption, as a share of GDP, declines from 70.5 percent in the base year, to 64.9 percent by the end of the reference path. This decline is compensated by a larger share of exports. As investment continues to grow by 7-10 percent annually, exports grow faster than imports and thus the resource gap declines. The budget deficit turns to a surplus by the end of the period (from -5.72 percent of GDP in the base period to 1.66 percent in 2012/2013) (Figure 11).

As to the energy subsidy bill, as a result of continuing subsidization of these products—selling them at lower prices than actual cost—the subsidy bill increases continuously to exceed 155 billion pounds in FY 2012/2013 (Table A.9), representing 8.6 percent of GDP (Table A.8b).

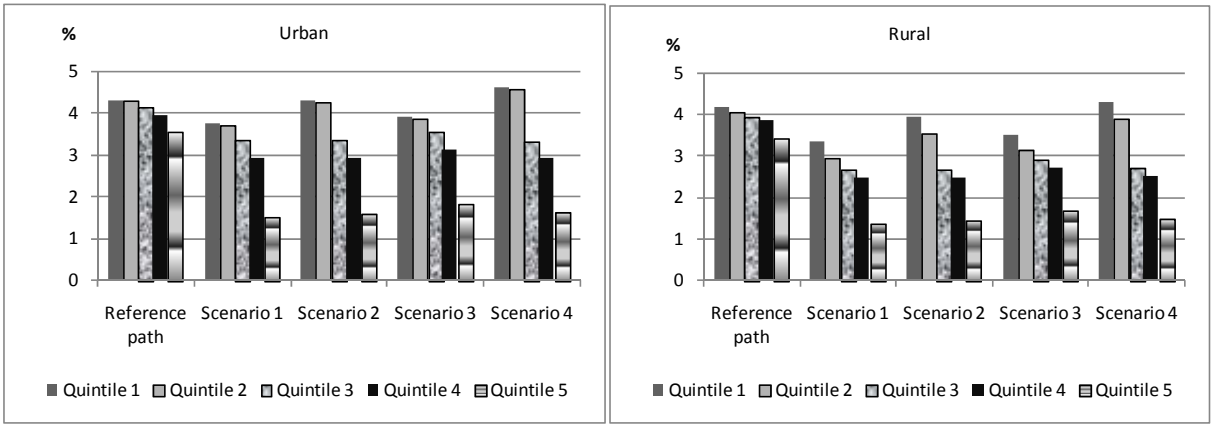
[9] Ministry of Economic Development (MOED): Egypt's Five-Year Plan, 2007/2008-2012/2013.

Figure 9. Average Annual Growth Rates (%)



Source: Derived by the authors from the CGE model simulations.

Figure 10. Average Annual Growth Rates of Consumption of Households by Quintiles



Source: Derived by the authors from the CGE model simulations.

5.4. Results of Alternative Scenario Simulations

Scenario 1: This scenario illustrates the option of eliminating energy subsidy by increasing domestic energy prices to equal actual costs within five years, starting in 2009/2010.

The medium-run macroeconomic effect of the elimination of energy subsidy is a general decline of average annual percentage growth rate of total private consumption compared to the reference path from 3.8 percent to 2.4 percent, and consequently GDP growth rate at market prices declines from around 5.6 percent to 4.1 percent. Meanwhile, GDP at factor cost shows a modest increase in growth rate (Table A.8a). The sector "other industries" grows at a faster rate than other energy intensive industrial sectors, electricity and most services, while GDP in tourism (proxied by hotels and restaurants) and transportation sectors declines, because of likely reduction in consumption.

Compared to the reference path, GDP grows at 1.44 percentage points lower, resulting from higher energy prices in domestic market. All sectors experience slower growth rate, especially energy intensive industries, electricity, services and petroleum sectors. Higher energy prices also affect the welfare levels of all household quintiles, especially the richer ones. As the richer quintiles consume a larger share of subsidized energy, the impact on their welfare level is much stronger, i.e., the difference in growth rate of consumption in this scenario compared to the reference path reaches 0.54 percentage point for the urban poorest quintile, while the corresponding figure for the richest quintile is 2.05 percentage points. It should be noted that rural households suffer a larger impact as LPG and diesel are their main energy sources, and prices of these two energy products witness the highest increase (around 50 and 18 percent per annum). Given the higher consumption levels of the rich, they lose more from the subsidy cuts than the poor, as shown in Figure 10 and Table A.10. At the end of the period, income distribution improves in both urban and rural areas, where the ratios of consumption of the richest quintile to the poorest quintile—as a measurement of inequality—decline by 2012/2013 from 4.90 in the reference path to 4.56 in urban areas and from 3.30 to 2.10 in rural areas, as illustrated in Table 9.

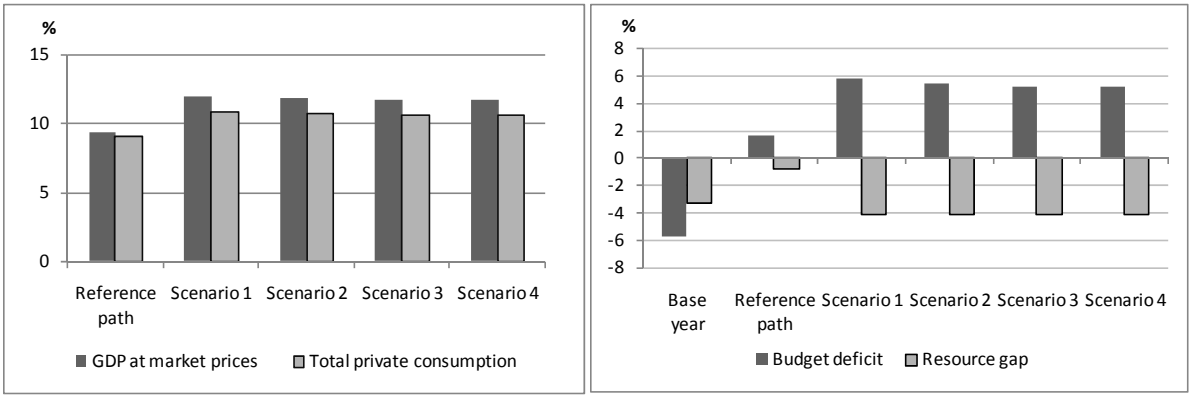
As in the reference path, the budget deficit turns positive (surplus), but this scenario exhibits in the final year a substantial budget surplus (5.8 percent of GDP in real terms), about three and a half times the surplus in the reference path.

Exports appear to grow at a slower rate, while imports maintain their momentum. As a result, the resource gap widens as a share of GDP compared to the reference year (-4.12 percent of GDP compared to only -0.74 percent in real terms, respectively) as shown in Table A.8b. GDP deflator is higher in this scenario compared to the reference path due to energy price increases. Electricity, energy intensive industries, other services and transportation experience the largest deflator, which is also higher than in the reference path. CPI increases as we move from poorer to richer quintiles; however, differences are small and CPI is higher than in the reference path scenario for all quintiles (not shown). The total private consumption deflator rises on average from 9.1 percent in the reference path to 10.9 percent in scenario 1 (Table A.8c)

Scenarios 2, 3, and 4: These scenarios are similar to scenario 1 but some of the savings resulting from elimination of energy subsidy are assumed to be transferred in cash to

households. *Scenario* 4 is superior to the other two alternatives with respect to economic growth, distributional impacts and total private consumption. Overall, GDP growth rate at market prices in scenario 4 (4.32 percent) is smaller than in the reference path, but higher than in all other scenarios, indicating that well targeted cash transfers have enhanced demand and hence increased GDP. Cash transfers to the poorest quintiles are reflected into higher consumption, where consumption growth for the poorest two quintiles reaches around 4.6 percent in urban areas, as opposed to only 1.6 percent for the richest quintile (Table A.10). Meanwhile, consumption growth for the poorest two quintiles in rural areas ranges between 4.3 percent and 3.9 percent whereas it is as low as 1.5 percent for the highest quintiles. Besides, by the end of the simulation period, the budget shows a surplus representing 5.31 percent of GDP, higher than in *scenario two but lower than in three*. Exports as a share of GDP have decreased (32.9 percent) compared to the reference path (37.4 percent), and similarly the share of imports has also declined. The resource gap widens to reach -4.1 percent of GDP. Overall, private consumption as a percentage of GDP (65.3 percent) exceeds the corresponding share in the reference path (64.9 percent), (Tables A.8a, b, c and Figure 11).

Figure 11. Inflation Rates and Shares of Budget Deficit and Resource Gap



Source: Calculated by the authors based on results of CGE model simulations.

The net result from a combined reform of energy subsidy cut associated with well targeted cash transfers favor the poor more than the rich, thus a large improvement is observed in income distribution measures. The ratio between consumption of the richest and poorest quintiles is used as a measure of inequality; the smaller the measure, the less income inequality is (Table 9).

Table 9. Inequality Measures: Ratio of Consumption Levels between the Richest and the Poorest Quintiles

		Base year	2007-08 actual	2008-09	2009-10	2010-11	2011-12	2012-13
Reference path	Urban	5.10	5.02	4.97	4.94	4.91	4.90	4.90
	Rural	3.43	3.38	3.34	3.32	3.30	3.30	3.30
Scenario 1	Urban	5.10	4.95	4.89	4.77	4.65	4.56	4.56
	Rural	3.43	3.34	3.30	3.23	3.16	3.10	3.10
Scenario 2	Urban	5.10	4.95	4.89	4.73	4.58	4.46	4.46
	Rural	3.43	3.34	3.30	3.20	3.10	3.03	3.03
Scenario 3	Urban	5.10	4.96	4.90	4.78	4.67	4.59	4.59
	Rural	3.43	3.35	3.31	3.24	3.17	3.12	3.12
Scenario 4	Urban	5.10	4.95	4.89	4.72	4.57	4.43	4.43
	Rural	3.43	3.34	3.30	3.20	3.10	3.01	3.01

Source: Calculated by the authors based on results of CGE model simulations.

Income distribution measures in both urban and rural areas are the smallest in scenario 4. In fact, inequality measures in all scenarios are smaller than in the reference path, reflecting that the current subsidy system prevailing in the reference path favors the rich.

Scenario 3 performed worse than other scenarios, although it exhibits untargeted distribution of 50 percent of savings resulting from eliminating petroleum energy subsidy. When the same amount of transfers is targeted to the poorest two quintiles (scenario 4), the living standards of the poor, as measured by their consumption levels, increase by around 4.6 in urban areas, compared to around 3.8 percent for scenario 3 (Figure 10 and Table A.10). Meanwhile, consumption of the richest quintiles increases in urban areas by around 1.6 and 1.8 percent for scenarios 4 and 3, respectively. This observation points to the effect of targeting in improving the living standards of the poor as well as reducing income inequality. The results of scenario 4 show a reduction in GDP deflator of 0.33 percentage points compared to scenario 1, when energy subsidies are eliminated and no compensation takes place.

To conclude, reform of the energy pricing system in Egypt is of prime importance, as it affects almost all economic variables and welfare of households as well as income distribution. Energy subsidies are supposed to relieve poor households from the high costs of

energy consumption. However, the results show that the rich benefit from subsidies more than the poor. Simulation results of the CGE model show that reducing subsidies would harm growth and welfare. However, efficiency gains from the combined subsidy cut and transfer programs targeting the poor are reflected in improved household welfare of the poorest two quintiles compared to the reference path. They also improved overall household welfare by 0.42 percent of GDP, leading to improved income distribution. In addition, this scenario (scenario 4) also provides higher benefits in terms of GDP growth compared with the three other scenarios.

6. Conclusion and Policy Implications

World oil prices were subject to dramatic fluctuations in 2008 ending in a considerable price decline, but long-term projections suggest increases in prices by the end of 2009 until 2030 at varying rates. Analysis of domestic costs of petroleum products and their corresponding world prices revealed a strong correlation (99 percent). However, domestic prices are substantially different from actual domestic costs.

The government budget recorded subsidies valued at LE 60 billion to petroleum products in 2007/2008, which exceed 75 percent of total subsidies. Diesel oil receives the highest share of subsidies (39.1 percent), and together with LPG they receive about 60 percent of total subsidies. Gasoline receives the lowest share (9.1 percent). There is also strong evidence of inequitable distribution of subsidies; figures reveal that the richest urban quintile of households benefits from 33 percent of subsidies, while the poorest urban quintile benefits only from 3.8 percent.

Results of input-output analysis of the structure of costs of different sectors and their interrelations show that adjusting all prices of petroleum products to their actual domestic cost in one step would remove all subsidies, but would induce a serious increase in CPI. Prices of energy intensive industries are expected to increase significantly. Prices of transport and communications and of electricity would rise by around 40-60 percent.

The impact of increasing prices of all energy petroleum products on high expenditure quintiles exceeds that on lower income quintiles. However, increasing prices of natural gas and/or fuel oil affects lower expenditure groups more than the higher ones. This is due to the fact that natural gas has the highest share in consumption (42.6 percent) of petroleum energy products, and the highest impact on prices of other sectors. Its effect on prices is amplified

through electricity, which is the main consumer of natural gas; electricity prices would increase by 6.9 percent for every 10 percent increase in the price of natural gas. The share of spending on food products increases in lower income groups—the food industry is among the energy intensive industries, which consume 83.2 percent of fuel oil.

Results also show that the impact of the price of diesel oil on transport and communications is more than double that of the price of gasoline, with the latter having the least effect on CPI.

The CGE model was applied to assess the medium-run macroeconomic effects of the elimination of energy subsidies gradually within four years starting 2009/2010. Results show that total private consumption relatively declines while GDP achieves around 4.14 percent growth rate in scenario 1 compared to 5.6 percent in the reference path, where no changes in subsidies are assumed. Annual GDP deflator is higher in this scenario (12.0 percent) compared to the reference path (9.3 percent) due to energy price increases. Exports grow at a slower rate than imports and the resource gap widens (-4.1 percent of GDP) compared to the reference path (-0.74). Higher energy prices also affect the welfare levels of all quintiles, especially the richer. The budget deficit turns to a surplus (5.8 percent of GDP) at the end of the period (2012/2013) and is estimated at more than three times its ratio in the reference scenario (1.7 percent).

Investigation of some alternatives for using savings from reducing subsidies as direct cash transfers to households revealed that introducing cash transfers—so that 50 percent of energy subsidy savings are transferred and targeted to the poorest two quintiles in both urban and rural areas—is superior to other alternatives with respect to economic growth and distributional impact. The government budget achieves a surplus, the resource gap declines, and GDP deflator (11.6 percent) is less than in the scenario that removes subsidies without compensatory and targeted cash transfers.

Policy Implications

Results of the analysis undertaken in this study reveal the interactions between prices of energy petroleum products and the main macro-economic and sectoral variables. These results may help in formulating adequate policies concerning subsidies and energy pricing with minimum negative impacts on growth, welfare and income distribution.

Reducing (or eliminating) subsidies is inevitable to reduce the government budget deficit. However, the negative impacts on inflation and welfare imply the need to satisfy certain preconditions to mitigate these effects:

- first, phasing out subsidies should be implemented gradually to avoid drastic increases in prices,
- mitigating measures should be considered in the form of cash transfers to households to avoid reduction of their welfare;
- targeting cash transfers only to the poorest two quintiles of urban and rural population is more favorable not only to income distribution but also to growth and the government budget.

Energy policies should not be considered separately, but should be integrated with other policies of economic development. Furthermore, adjusting energy prices and removing subsidies should not be considered as a once-and-for-all reform measure. Energy prices should either be allowed flexibility taking into consideration present and future supply and demand considerations, or should be revised periodically in light of domestic and international developments. Factors to be considered in this case include the increasing scarcity of petroleum and natural gas resources, availability of alternative sources of energy and efficient and equitable requirements for economic and social development.

APPENDIX 1. METHODOLOGICAL AND TECHNICAL NOTES

The Updated Input-Output Table for 2006/2007

On the basis of the input-output table for 2002/2003 constructed by the Ministry of Planning, an updated input-output table was estimated for 2006/2007 in the process of estimating a social accounting matrix for the same year.

In updating this table, petroleum products were disaggregated into five products: fuel oil (mazot), diesel oil, liquefied petroleum gas (LPG) and gasoline. Natural gas was separated from crude oil. Some energy intensive industries were separated from manufacturing: fertilizers and cement were separated from non-metal industries; iron and steel, and aluminum were separated from basic metal industries. While other industries and services were aggregated.

Data from many sources were used for updating and for including details of disaggregated sectors producing petroleum products and those consuming these products. The sources of data include: Ministry of Trade and Industry, Ministry of Petroleum, balance of payments of 2006/2007 as published by the Central Bank of Egypt, and the estimated input-output table for 1998/1999 consisting of 48 sectors.

The updated input-output table for 2006/2007 consists of 23 sectors; however, to facilitate interpretation of results, sectors were regrouped into seven sectors.

Technical Note

Analysis and measurement of the relation between subsidies and prices were considered in two ways:

1) The targeted reduction in subsidies is translated into corresponding increases in prices of petroleum products assumed to be determined administratively.

2) To assume initial rate of increases in prices of petroleum products and then calculate the corresponding reduction in subsidies.

In both cases, the input-output model is used to calculate direct and indirect impacts of initial changes in prices of petroleum products on the price level of different sectors. Technical coefficients of the model were calculated on the basis of both domestic and

imported inter-industrial flows to reflect that all consumed petroleum products, whether domestically produced or imported, are subject to the same administrative changes in prices.

Resulting changes in prices of different sectors are multiplied by the weights of these sectors in household consumption (of various expenditure quintiles) to estimate the expected change in the level of consumer prices at the national level and for each expenditure group in urban and rural households.

It should be noted that the price in input-output analysis refers to a price index rather than a nominal market price. Analysis of input-output simulations is conducted to evaluate short-term effects of changing energy prices on costs of production and then on sectoral prices. Resulting changes on consumer prices reflect only changes in supply conditions due to changes in costs of production and under the assumption of unchanged demand structure.

Main Assumptions of the CGE Model

The CGE model explains all payments recorded in the SAM. The model, therefore, follows the SAM disaggregation of factors, activities, commodities and institutions. It is written as a set of simultaneous equations, many of which are nonlinear. There is no objective function. The equations define the behavior of different actors. In part, this behavior follows simple rules captured by fixed coefficients (e.g., tax rates). For production and consumption decisions, behavior is captured by nonlinear, first-order optimality conditions, which reflect that production and consumption decisions are driven by the maximization of profits and utility, respectively. The equations also include a set of constraints that have to be satisfied by the system as a whole but are not necessarily considered by any individual actor. These constraints cover markets (for factors and commodities) and macroeconomic aggregates (balances for savings, investment, the government and the current account of the rest of the world).

Each producer (represented by an activity) is assumed to maximize profits, defined as the difference between revenue earned and the cost of factors and intermediate inputs. Profits are maximized subject to production technology. Value added is a constant elasticity of substitution (CES) function of primary factors, whereas the aggregate intermediate input is a Leontief function (fixed technical coefficients) of disaggregated intermediate inputs.

Each activity produces one or more commodities according to fixed yield coefficients. The revenue of the activity is defined by the level of the activity, yields and commodity prices at the producer level.

As part of its profit-maximizing decision, each activity uses a set of factors up to the point where the marginal revenue product of each factor is equal to its factor price (also called wage or rent). Factor prices may differ across activities, not only when the market is segmented but also for mobile factors. The factor market closure (mechanism for equilibrating supply and demand in factor markets) is as follows: the quantity supplied of each factor is fixed at the observed level. An economy-wide factor price variable is free to vary to assure that the sum of demands from all activities equals the quantity supplied.

Zero substitution between energy inputs and, most importantly, between energy inputs and other inputs are assumed. Regarding energy subsidies, we assume that consumers pay an artificially low and controlled price for energy products and that the government pays the difference, i.e., a subsidy, such that demand is met at the controlled price.

Prices paid by domestic consumers for energy products are fixed and they are policy variables. Thus, the subsidy rate is endogenous to policy changes, and the simulation results report the amount by which subsidies of petroleum energy products change in each scenario.

Household consumption is allocated across different commodities according to linear expenditure system (LES) demand functions.

As for commodity markets, domestic output is allocated between exports and domestic sales under the assumption that suppliers maximize sales revenue subject to a constant elasticity of transformation (CET) function. This specification of export supply interacts with a set of functions depicting world demand for exports, which depends on the ratio between world prices (the prices received by domestic producers adjusted for export taxes/subsidies and converted into foreign currency) and domestic prices.

To the extent that a commodity is imported, all domestic market demand is for a composite commodity made up of imports and domestic output, the demand for which is derived on the assumption that domestic demanders minimize cost subject to imperfect substitutability. This is also captured by a CES aggregation function. Total market demand is directed to imports for commodities that lack domestic production and to domestic output for non-imported commodities.

Compared with the alternative assumptions of perfect substitutability and transformability, the assumptions of imperfect transformability (between exports and domestic sales of domestic output) and imperfect substitutability (between imports and domestically sold domestic output) allow the model to better reflect the empirical realities of most countries.

The used assumptions give the domestic price system a degree of independence from international prices and prevent unrealistic export and import responses to economic shocks. For more details on the functional specifications of the model, see Jensen and Tarr (2002) and Lofgren, Harris, and Robinson (2002).

APPENDIX 2. TABLES: INFORMATION AND RESULTS

Table A.1. Illustration of Indirect Compensation Measures for Increases in Fuel Prices

Country	Indirect compensatory measures
Bolivia	Distribution of LPG through community-based organizations
China	Assistance to specific sectors (e.g., agriculture, transport and fisheries)
Malaysia	Low transport tariffs
Ghana	Support to education, health, transport and electricity in rural areas
Jordan	Support to salaries (e.g., officials, retired)
Sri Lanka	Grants and foodstuffs
Vietnam	Assistance for fishermen

Source: World Bank (2008).

Table A.2. A Summary of the Experience of Some Countries in Reforming Subsidy Systems

Country	Purpose	Key components of mitigation results
Brazil	Reducing the social impact of petroleum product price reforms. Improving equity and targeting of social programs. Improving targeting of electricity rates.	The previous social protection system involved a sophisticated mechanism, which was adjusted for conditional monetary transfers (Bolsa Familia), a database of beneficiaries for MTs to cover rising LPG prices (Auxilio Gas) completed in 2005. The System is still being improved for greater efficiency. Electricity sector reform is still underway.
Chile	Instituting market prices for all fuels. Mitigating the social impact of price hikes.	Social protection system with advanced database of beneficiaries (Ficha CAS) and money transfers to cover the loss of purchasing power for the poor; social consequences minimized; no social unrest; short-term subsidies eliminated in 2006.
Colombia	Instituting market prices for all fuels. Using the welfare system to cushion social impact.	Conditional and non-conditional cash transfers. The welfare system provides vouchers for food, health and education subsidies. No direct link with the removal of price subsidies. Rising fuel prices did not cause social unrest.
Indonesia	Reducing the budgetary impact of subsidies on petroleum products while minimizing the social impact.	Money transfers to increase access to health, education and targets as operators in the transport sector. Money transfers made through post offices. The reform of price subsidies has identified a budget to strengthen social protection.
Turkey	Raising the prices of petroleum products in the market; using the welfare system to absorb shocks.	Sophisticated mechanism of adjustment of fuel prices removed in 2005. Money transfers allocated to health programs and education; bank account opened for each beneficiary. Transfers indexed to the price level; rising prices occurred without violent social reaction.
Malaysia	Regulating oil prices. Reducing subsidies and their impact on the budget.	Launched an awareness campaign effective in 2004. Previously, efforts to grant the diesel or diesel-targeted direct subsidies to public transport, school buses and motor carriers experienced difficulties (embezzlement). Subsidies to fishermen (money transfers, e-diesel via smart cards). Smart cards introduced and used for identification, money transfers and payment of public services.
India	Instituting social measures to accompany petroleum product price reforms.	Several administrative measures; targeting imperfect impact on certain groups diminished; and searching for effective ways to mitigate other impacts.
China	Mitigating the impact of petroleum product price reforms.	Different tax (or subsidies) charges to cover the financial needs of certain subsidies.

Source: World Bank (2008).

Table A.3. Average Monthly Percentage Changes in World Prices of Petroleum Products

	Gasoline	Diesel fuel	Fuel oil	Natural gas
2007				
August	-6.72	-1.22	3.32	-4.68
September	2.00	5.84	-0.82	-4.92
October	1.05	4.52	8.48	11.41
November	10.82	11.21	14.62	1.92
December	-4.07	-3.67	2.16	2.51
2008				
January	1.57	-0.69	0.98	7.04
February	1.71	6.08	-3.17	8.01
March	8.37	15.38	7.38	9.80
April	8.26	6.30	2.53	7.84
May	10.99	10.54	7.51	9.73
June	7.72	3.96	14.12	10.30
July	-2.02	0.44	11.96	-1.85
August	-8.03	-13.85	-1.10	-21.66
September	-2.57	-5.33	-10.47	-12.62
October	-28.13	-31.73	-23.01	-12.52
November	-36.01	-17.74	-30.31	-6.13
December	-22.46	-21.80	-22.42	-1.68

Source: Energy Information Administration, EIA Short-term Energy Outlook, January 13, 2009 release.

Table A.4. Consumption of Energy Petroleum Products and Energy Intensity by Sector

	Consumption of total energy petroleum products		Energy intensity*
Sector	**Value**	**%5**	**%**
Petroleum products	3984	3.8	3.5
Electricity	28847	27.5	69.5
Transport and communications	23236	22.1	21.4
Energy intensive industries	34278	32.7	11.2
Other industries	3482	3.3	1.3
Hotels and restaurants	1448	1.4	1.8
Other services	3839	3.61	1.12
Total activities	99114	94.4	7.5
Households	5776	5.5	0.01**

Source: Updated input-output table for 2006/2007.

* Ratio of consumption of petroleum energy products to total output by sector.
** Ratio of consumption of energy petroleum products to total household consumption.

Table A.5. Sectoral Disaggregation of GDP

	Value added (million LE)	Share to GDP (%)	Subsidy (million LE)	% Share of commodity subsidy
Agriculture	94753.10	13.84	342.00	0.84
Crude oil and extraction	45968.50	6.72		
Natural gas	57752.00	8.44	6281.66	15.35
Food and tobacco	52010.20	7.60	9476.00	23.16
Textiles	14291.24	2.09		
Fertilizers	1976.90	0.29		
Other chemicals	9342.19	1.36	391.24	0.96
Fuel oil (mazot)	1457.19	0.21	2937.24	7.18
Gas oil (diesel)	2016.22	0.29	12015.72	29.37
LPG	92.39	0.01	6678.65	16.32
Gasoline	1532.85	0.22	2795.50	6.83
Cement	1623.17	0.24		
Non-metal industry	2919.48	0.43		
Iron and steel	7458.14	1.09		
Aluminum and its products	933.22	0.14		
Metal industry	2561.47	0.37		
Engineering and machinery	6684.74	0.98		
Other industries	9961.81	1.46		
Construction	32599.80	4.76		
Electricity	9880.00	1.44		
Transportation and communications	72236.50	10.55		
Hotels and restaurants (tourism)	24565.40	3.59		
Other services	231813.30	33.87		
GDP at factor cost	684429.80	100	40918	100

Source: Authors' construction.

Table A.6. Households' Budget Shares (%) by Quintile and Commodity Group

	Urban					Rural				
	1	2	3	4	5	1	2	3	4	5
Food and food products	50.20	48.41	46.35	44.13	36.12	56.07	53.38	51.51	49.76	50.02
Textiles	8.15	8.19	8.04	8.05	8.37	8.31	8.67	8.66	8.63	7.06
Energy	0.91	0.88	0.96	1.07	1.56	1.31	1.07	0.99	0.95	0.87
Manufacturing	5.95	6.13	6.68	7.24	9.84	6.51	6.42	6.60	6.92	7.51
Electricity	2.86	2.60	2.53	2.43	2.29	2.53	2.40	2.35	2.31	1.96
Transportation	4.58	5.54	6.74	7.86	9.99	7.39	8.67	9.55	10.58	11.19
Tourism	9.69	9.17	8.22	7.90	7.10	6.94	6.93	6.74	6.70	6.12
Other services	17.66	19.08	20.47	21.32	24.74	10.93	12.45	13.61	14.15	15.28
Total consumption	100	100	100	100	100	100	100	100	100	100

Source: Compiled from HIECS, 2004/2005, CAPMAS.

Table A.7. Annual Percentage Changes in Exogenous and Policy Variables for Different Scenarios

Scenario	Exogenous variable	2007/08 actual	2008/09	2009/10	2010/11	2011/12	2012/13
All	Government consumption	0.050	0.050	0.050	0.050	0.050	0.050
All	Numeraire-exchange rate	0.080	0.080	0.080	0.080	0.080	0.080
All	Investment	0.100	0.100	0.07	0.08	0.09	0.10
All	Domestic price of natural gas	0	0	0.1397	0.1397	0.1397	0.1397
All	Domestic price of mazot	0	0	0.16935	0.16935	0.16935	0.16935
All	Domestic price of LPG	0	0	0.4975	0.4975	0.4975	0.4975
All	Domestic price of diesel	0.467	0	0.1769	0.1769	0.1769	0.1769
All	Domestic price of gasoline	0.282	0	0.1258	0.1258	0.1258	0.1258
All	World price of fuel oil	0.120	-0.122	-0.003	0.036	0.008	0.032
All	World price of diesel oil	0.090	-0.097	-0.005	0.035	0.001	0.027
All	World price of LPG	0.030	-0.098	-0.007	-0.014	0.000	-0.004
All	World price of gasoline	0.090	-0.058	0.030	0.014	0.008	0.017
2	Government transfers to the first 2 quintiles	0.01	. 0	.0.2	0.2	o.2	0.2
3	50 percent of energy subsidy savings distributed equally to all households	0.03	0	0.0369	0.0445	0.0885	0.1001
4	50 percent of energy subsidy savings distributed equally to the poorest 2 quintiles	0.03	0	0.2003	.2086	0.3314	0.3526

Source: Authors' assumptions, Ministry of Economic Development, and Energy Information Administration, 2008.

Table A.8. Summary Tables of Alternative Simulations

a. Average annual percentage growth rate

	Base year*	Reference path	Scenario 1	Scenario 2	Scenario 3	Scenario 4
GDP at market prices	731228	5.58	4.14	4.26	4.31	4.32
GDP at factor cost	684819	4.79	4.93	5.04	5.09	5.10
GDP-energy intensive	86615	4.36	3.08	3.24	3.29	3.31
GDP-other industries	164258	9.94	11.42	11.39	11.40	11.41
GDP-petroleum	93560	5.86	1.62	1.81	1.85	1.86
GDP-electricity	9880	6.48	4.21	4.31	4.34	4.36
GDP-transportation	72237	3.45	-1.44	-1.26	-1.15	-1.16
GDP-tourism	24565	0.18	-4.68	-4.34	-4.19	-4.15
GDP-other services	264413	3.88	1.88	2.04	2.11	2.12
Total private consumption	515530	3.84	2.44	2.61	2.68	2.70
Government consumption	84400	5.00	5.00	5.00	5.00	5.00
Investment	155298	8.99	8.99	8.99	8.99	8.99
Exports	230600	7.40	5.23	5.33	5.38	5.39
Imports	-254600	5.99	5.41	5.50	5.53	5.53

* Values in this column are expressed in million LE.

Table A.8. Summary Tables of Alternative Simulations (continued)

b. Percentage share to GDP by the end of the simulation period in real terms

	Base year	Reference path	Scenario 1	Scenario 2	Scenario 3	Scenario 4
GDP-energy intensive	11.85	11.20	11.28	11.31	11.31	11.31
GDP-other industries	22.46	27.85	32.17	31.94	31.88	31.89
GDP-petroleum*	12.79	13.00	11.46	11.50	11.50	11.50
GDP-electricity	1.35	1.41	1.37	1.37	1.36	1.36
GDP-transportation	9.88	8.92	7.45	7.49	7.50	7.50
GDP-tourism	3.36	2.54	2.11	2.14	2.15	2.15
GDP-other services	36.16	32.81	32.12	32.21	32.24	32.23
Total private consumption	70.50	64.91	65.11	65.28	65.33	65.33
Government consumption	11.54	11.38	12.20	12.14	12.11	12.11
Investment	21.24	25.01	26.82	26.67	26.61	26.62
Exports	31.54	37.39	32.97	32.96	32.96	32.95
Imports	-34.82	-38.13	-37.09	-37.04	-37.01	-37.01
Budget deficit	-5.72	1.66	5.82	5.44	5.25	5.31
Resource gap	-3.28	-0.74	-4.12	-4.08	-4.05	-4.06
Energy subsidies	-4.20	-8.55	0.00	0.01	0.01	0.01
All subsidies	-5.60	-9.66	-1.22	-1.22	-1.22	-1.22

* Does not include crude oil.

c. Average deflators in various simulations

	Reference path	Scenario 1	Scenario 2	Scenario 3	Scenario 4
GDP at market prices	1.0932	1.1197	1.1176	1.1166	1.1164
GDP at factor cost	1.1029	1.1122	1.1102	1.1092	1.1090
GDP-energy intensive	1.1005	1.1133	1.1111	1.1101	1.1099
GDP-other industries	1.1013	1.0866	1.0860	1.0857	1.0856
GDP-petroleum	1.0914	1.0696	1.0699	1.0700	1.0701
GDP-electricity	1.1062	1.1255	1.1223	1.1208	1.1205
GDP-transportation	1.0961	1.1061	1.1040	1.1031	1.1029
GDP-tourism	1.0937	1.1004	1.0992	1.0986	1.0985
GDP-other services	1.1012	1.1492	1.1453	1.1434	1.1430
Total private consumption	1.0906	1.1087	1.1072	1.1065	1.1064
Government consumption	1.0938	1.1260	1.1236	1.1225	1.1223
Investment	1.1037	1.1276	1.1248	1.1235	1.1232
Exports	1.0737	1.0912	1.0912	1.0910	1.0910
Imports	1.0800	1.0826	1.0825	1.0825	1.0825

Source: Tables A.8.a, b, c are derived from results of CGE model simulations.

Table A.9. The Evolution of Energy Subsidies in Various Scenarios (in LE million)

	Base year	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
Reference path	-30709	-43890	-59539	-77520	-98980	-124720	-155857
Scenario 1	-30709	-29701	-46577	-38978	-29744	-17471	0
Scenario 2	-30709	-29749	-46613	-39123	-29906	-17544	146
Scenario 3	-30709	-29789	-46673	-39153	-29917	-17538	218
Scenario 4	-30709	-29755	-46621	-39129	-29909	-17536	232

Source: Authors' construction.

Note: Negative numbers refer to subsidies in the budget while positive figures refer to taxes on energy products, reflecting by the end of the simulation period (FY11 and FY12) that energy prices slightly exceed their actual cost.

Table A.10. Average Annual Percentage Growth Rate in Real Consumption by Quintiles

	Reference path	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Consumption of quintile 1, urban	4.28	3.74	4.31	3.89	4.62
Consumption of quintile 1, rural	4.16	3.34	3.95	3.52	4.28
Consumption of quintile 2, urban	4.28	3.69	4.25	3.84	4.55
Consumption of quintile 2, rural	4.03	2.93	3.54	3.14	3.87
Consumption of quintile 3, urban	4.13	3.37	3.35	3.55	3.34
Consumption of quintile 3, rural	3.94	2.68	2.69	2.90	2.70
Consumption of quintile 4, urban	3.95	2.92	2.92	3.14	2.92
Consumption of quintile 4, rural	3.86	2.47	2.50	2.72	2.51
Consumption of quintile 5, urban	3.57	1.52	1.59	1.83	1.63
Consumption of quintile 5, rural	3.45	1.36	1.44	1.70	1.48

Source: Authors' construction.

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