Analyzing Economic Pricing for Natural Gas and Petroleum Products in Egypt

Mennaa Ahmed Kamel

Teaching Assistant, Future University in Egypt (FUE)

Received: October 17, 2020 Accepted: November 30, 2020 Online Published: December 25, 2020

Abstract

This study discusses the two most famous methods to analyze the pricing process for petroleum products in Egypt. The study clarifies that using unreal prices for these products for more than 50 years caused depletion of these vital economic resources. The study chooses to apply Tehran method of pricing natural resources. Since 2015, the Egyptian government started initiating a program to liberalize the prices of petroleum products and Natural Gas to get rid of the heavy burden of subsidizing these products.

As a result, the main target for this study was to determine the price level that the Egyptian government should stop liberalizing at. Finally, the study determined the real prices as follows; LPG = 11111.2 per Metric Ton, Kerosene = 12418 per Metric Ton, Gas Oil = 11369 per Metric Ton, Fuel Oil = 5874 per Metric Ton, and Gasoline = 13072 per Metric Ton.

Introduction:

During the last three years, the Egyptian government has initiated an economic reform program that concentrated on liberalizing all prices. With the help from IMF experts, the Egyptian government has liberalized the exchange market and energy products in order to lower the burdens on both the budget and the Balance of Payments. On this road, it is important to determine the economic prices for these energy products to know the limit for this liberalization program.

Consequently, a clear strategy to remove energy subsidies in Egypt is needed. The starting point of this strategy is the setting of target levels for energy prices.

Consumers buy energy products in different forms. Primary energy sources like natural gas are typically converted in-house to heat, oil is converted to driving power in cars, while secondary energy carriers, such as electricity, are used for services like lighting, heating (e.g., conversion through heat pumps). This paper aims to estimate the economic prices for oil products (gasoline, diesel and heating oil), natural gas. Therefore, the paper will discuss the pricing principles of these products

The prices of energy products (such as oil and natural gas) are determined by supply and demand powers in the markets. Elements that affect the supply are the cost of extraction and transport costs, limited resource stocks and cartels. On the other hand, elements that affect demand are economic growth and the availability of substitutes. Expectations towards future developments on both sides (demand and supply) also play their role in setting the equilibrium (for example prospects on new undiscovered reserves, political stability, speculation, etc.). Transport costs will determine whether there will be strong price differences between regional markets or not. This study is a trial to determine the economic prices for Natural Gas and Petroleum Products in the Egyptian Economy in order to propose a gradual program to liberalize the prices of these products in Egypt across five years.

It is clear that removing energy subsidies would reduce the Egyptian budget deficit burden and generate significant government savings that could be used to fund other priorities, including more targeted assistance to the poor. Removing energy subsidies would also reduce energy overconsumption and encourage energy saving, make use of energy more efficient, and enhance energy security in the Egyptian Economy. Finally, energy prices reform would provide correct

pricing signals to producers, consumers and investors. Therefore, this reform will create the preconditions needed for a more competitive economy over the longer term, while resulting in a reduction of environmental pollution.

The paper aims to determine the economic prices for Natural Gas and Petroleum Products in Egypt now in order to give recommendations for the Egyptian government with regard to liberalizing these products prices. Therefore, the main objective of this study is to develop an energy pricing strategy for Egypt that creates pricing targets towards the prices of Natural Gas and Oil products levels that are based on the underlying economic costs for each product.

The paper is targeting to ask important questions related to determine the economic prices of these products such as; what is the optimal methodology to determine the economic prices for these products?, What are economic prices for these products in Egypt now?, What are the main recommendations for the Egyptian policy makers with regard to economic prices for Natural Gas and Petroleum Products?

Literature Review:

With regard to the literature of this topic, it is found Isfahani (1996) investigated government subsidies and the demand for petroleum products in Iran. The results suggest that price elasticities of demand are larger than previously thought. The results also indicate that price increases can control the over-consumption of these products in the Iranian Economy.

In another paper which is Onwioduokit and Adenuga (2001) examined the demand for petroleum products in Nigeria from the period of 1970-1996. The paper concluded that gas and petrol consumption are elastic in the urban areas. Therefore, as agricultural contribution to national income increases, consumption of oil products decreases, while the contribution of the manufacturing sector to income is positive elastic. However, the study did not provide any estimations for the prices of Natural Gas and oil products.

Also, there is (Rentizelas et. Al, 2013) that developed a linear programming model that included inventory analysis and based on “Cradle to Gravel Basis”. The model included all of the processing, foundation, operation and decommissioning of each technology. In addition, an estimation of emissions to the environment was considered. The model was applied for the case of Greece for the period of 2012-2050 to reach a decision that minimizes the cost of the power

generation. The results of that work showed that external costs of various technologies have a large contribution at the total costs.

For this literature in case of Egypt, (Khorshid, 2009) is found to be an important trial to estimate the economic prices of energy products in the Egyptian economy. This research paper developed an energy economy wide interaction model based on the Egyptian social accounting matrix for the fiscal year 2006/2007. This model follows the general equilibrium tradition with detailed energy sector (including crude oil, natural gas, gasoline, fuel oil, gas oil, LPG, other products and electricity). The model was developed to test alternative domestic energy pricing strategies, production policies of crude oil and natural gas, investment spending patterns, government expenditure policies as well as the impact of these policies on the performance of the Egyptian economy as a whole. The model was used to assess the economy wide impact of alternative medium term scenarios through the period (2006/2006 – 2011-2012) associated with domestic energy pricing and subsidy policies. Three energy pricing scenarios are tested using the issue-oriented economy wide model. The first scenario assumes the continuation of the currently adopted energy pricing and subsidy policies. The two other scenarios assess the economic impact of two pricing program, based on the actual cash cost pricing principle with 5 and 10 years application periods.

Also for Egypt, the most important paper in this literature and the nearest one to this study is the (World Bank, 2009) study that provided an energy pricing strategy for the Egyptian government to liberalize the prices of energy sector. This study estimated the prices for Natural Gas and Oil products in Egypt using the cost-reflective prices methodology.

The cost of supply across the value chain of electricity and natural gas was determined by assessing both current demand and cost levels, and the additional capital and operating costs that would be incurred in the future to meet growing customer demand. Subsequently, costs were aggregated and used to derive cost-reflective prices per customer category and sub-sector. The financial viability of each sub-sector was then verified using demand, price, and operating and capital cost data.

For international papers, there is (Passey et al., 2017) that used the methodology of cost reflective in order to price electricity. The study applied this methodology to a typical demand charge network tariff proposal within the Australian National Electricity Market and actual consumption

data of 3876 households in Sydney at Australia. The analysis found it to have low cost-reflectivity for clients' bills with during the periods of network peak demand.

Methodology:

This paper uses the hypothesis "Cost Reflective Method" in order to estimate the economic prices for Natural Gas and Oil products in Egypt in 2019.

Following (World Bank, 2009), this study will use the same methodology in determining the economic prices for Natural Gas and Petroleum Products. This methodology was used also in (Khorshid, 2009) to calculate these prices in Egypt. This study will update these calculations. Data needed for this research will be collected from Ministry of Finance and Ministry of Petroleum.

The cost reflective methodology essentially entails, firstly, the determination of a "revenue requirement" that ensures the recovery of all underlying costs i.e. fixed and variable operating costs, depreciation and a return on assets, with the latter being derived by multiplying the value of the asset base with the relevant weighted average cost of capital (WACC). The WACC used for all natural gas and oil products activities (i.e. oil generation, transmission and distribution, and natural gas transportation and distribution) was 8 per cent real, pre-tax. Average cost-reflective prices will be calculated for each oil product.

Development of Real Prices of Petroleum Products and Natural Gas:

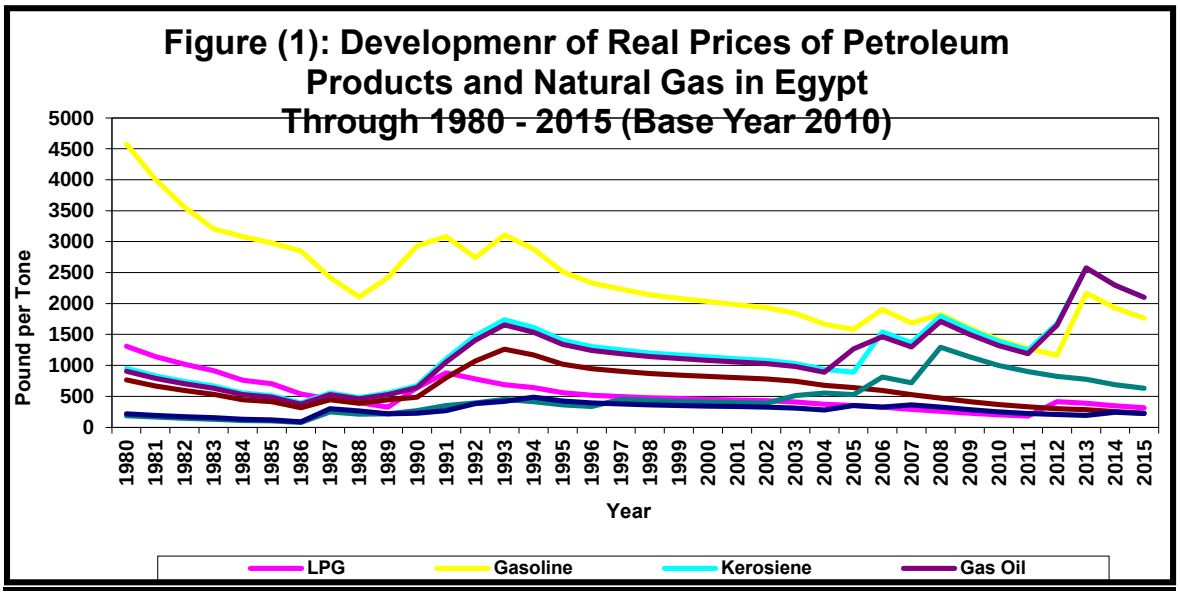

Figure 1 shows that the real prices of all products declined during the period from 1980 to 1987. The government started to move the prices of all products during that period following the severe economic crisis that hit the Egyptian economy at the end of the 1980s. The Egyptian economy entered a period of economic reform, which was implemented by the Egyptian government in coordination with the International Monetary Fund and the World Bank in the beginning of the nineties. The real prices witnessed a big leap at that time, and then the real prices continued to decline until mid-2006 in which the price of gasoline with excellent quality, diesel and kerosene was moved, as shown in figure (1).

The study concludes from this analysis that most of the products studied receive considerable subsides, which led to a decline in their real prices for 2019 compared with their levels in 1979, despite the high levels of nominal prices of all these products during the period under study.

Discussing Different Methods Available for Pricing Petroleum Products and Natural Gas:

The economic feasibility of the use of generally scarce resources is determined by identifying the opportunity cost of the current use of that depleted resource. Hence, the present value of possible exploitation of petroleum products and natural gas in the future must be identified. There are two ways to determine the fair price of crude oil or natural gas:

1 - Method Hoteling:

The well-known economist “Hotelling” formulated a condition known as the **Hotelling condition** to maximize the community's potential use of the depleted resource. This condition stipulates that the price of the depleted resource must be increased annually by the rate of the social interest rate until the product is balanced. If the price of the resource is expected to increase at a rate higher than the social interest rate, the depletion of the depleted resource must be delayed. If the expectation is that the price of the depleted resource will increase at a rate lower than the interest rate, it will be necessary to increase current production rates so as to maximize the potential use of the resource. Hotelling equation is on the form;

$$(1) \ldots\ldots\ldots\ldots P_t = P_0 e^{r a t}$$

Where:

1. r is the social interest rate.

2. a, which is the coefficient to be added to the social interest rate, where 1 => a => 0, which expresses the other factors involved in determining the discount rate on which to base the present value of the return of the crude oil and natural gas unit to be sold in the future.

3. P is the social price of the unit of crude oil and natural gas at present.

4. Pt is the social price of the unit of crude oil and natural gas in the future.

To apply this requirement to crude oil and natural gas, the following shall be specified:

First: Social Interest Rate r:

The social interest rate is the cost of using capital from a social point of view and is determined by the interaction of two factors: the marginal rate of return on investment and the consumer interest rate.

The consumer interest rate reflects the marginal cost that society will sustain by postponing some consumption from one year to the next. The price depends on two factors:

• The first is the net rate of time preference and review of the preference of individuals for present consumption on future consumption.

• Second: the rate of change in the marginal utility of consumption.

The interest rate can then be calculated using the following formula:

Consumer interest rate = Time preference rate + (average individual consumption growth rate X elasticity of marginal income assessment) ..... (2)

The average consumption rate is calculated from the Social Accounting Matrix (SNA). The rate of time preference and the elasticity of marginal income assessment can be estimated from the study of past government behaviour and the choices made by its stated policy. The social interest rate is then calculated using the equation:

$$ARI = s \cdot R + (1 - s) \cdot CRI \qquad \text{..... (3)}$$

Where:

ARI Social Interest Rate

R Internal Rate of Return

S Ratio of investment expenditure to total expenditure

(1 - s) Ratio of consumer spending to total expenditure

CRI Interest Rate

Equation (3) shows that the social interest rate is a weighted average for both the internal rate of return (on investment) and the consumer interest rate, so that the ratio of investment spending and consumer spending to total expenditure is used as a weighted sum.

This price is used as a discount rate to calculate the current social value of the future earnings of the community. The greater the government's assessment of the consumption of current generations and reduced the assessment of what the future generations will receive the social interest rate rose, and vice versa.

Second: Parameter a:

Factor A is determined by other factors that affect the decision to produce the depleted resource other than future price expectations and interest rates. These factors are due to uncertainty, political factors and various external damage. Thus, the discount rate in this case is r + a instead of r.

Third: Predicting the social price of the unit of crude oil and natural gas in the future Pt:

The study assumes that the social value of crude oil and natural gas is the price of its future export, ie, the world price in the future.

2. Method of the Tehran Convention 1971:

The OPEC agreement between OPEC and international oil companies in early 1971 approved an annual rate of increase of 5% at an appropriate rate to preserve the true value of those resources. This annual rate of increase was determined by three factors: the rate of inflation, the annual growth rate of oil demand and changes in the value of the dollar against major currencies. Abdullah (2005) proposes to take the price of a barrel of crude oil for 1987, which is $ 18 as the basis for

pricing, where there was a time of consensus that the price is acceptable and fair from different sides of the market.

Since the determination of free prices for petroleum products and natural gas is outside the scope of the study, to obtain these prices, the study will use the estimates of the study (2009 Khorshid) prices of petroleum products and natural gas. Using the previous theoretical method, the study reached a free price of crude oil of $ 100.6 per barrel.

The study also estimated the statistical relations between the prices of crude oil and the prices of refined petroleum products. The linear regression method was used to estimate the parameters of these ratios and using time series for the period from January 2003 to December 2007. The regression analysis showed high significance of the ratios by not less than 95%) and reached 98% (in the case of diesel). The following table shows the parameter values resulting from the regression analysis of various petroleum products:

Table 1: the Parameter Values of Various Petroleum Products

Price Equation	Product
PLPG = 9.229 Pc	LPG
PKerosene = 10.314 Pc	Kerosene
PGasoil = 9.446 Pc	Gas Oil
PFO = 4.878 Pc	Fuel Oil
PGasoline = 10.858 Pc	Gasoline

Source: Khorshid M. (2009) **"Revising Energy Pricing Strategy for Egypt – An Issue Oriented Economy-wide Analytical Approach"** 8th International Conference of the Middle East Association (MEEA), Monaco, France, March.

Where Pc is the price of crude oil per barrel in US dollars.

In order to arrive at the final price estimates reflecting the actual cost of these products, the costs of distribution, storage, delivery, transport and taxes have to be added.

According to table 1 and the global Oil prices that reached to US 70$ per barrel in May 2019, the study can estimate the economic pricing for these products to be as follows;

Table 2: the Parameter Values of Various Petroleum Products According to Tehran Treaty In US Dollar per Metric Ton	
Price Equation In $ US	Product
PLPG = 646	LPG
PKerosene = 722	Kerosene
PGasoil = 661	Gas Oil
PFO = 341.5	Fuel Oil
PGasoline = 760	Gasoline

These prices, represented in table 2 are in dollar per metric ton. Therefore, these prices have to be converted to Egyptian Pounds due to the transformation calculation. The new prices can be presented in the following table.

Table 3: the Parameter Values of Various Petroleum Products According to Tehran Treaty In Egyptian Pound per Metric Ton	
Price Equation In LE	Product
PLPG = 11111.2	LPG
PKerosene = 12418	Kerosene
PGasoil = 11369	Gas Oil
PFO = 5874	Fuel Oil
PGasoline = 13072	Gasoline

Conclusion:

This study tries to estimate the economic price for petroleum products and natural gas in Egypt. The study described the development of real prices for these products which showed that most of the products studied receive considerable subsides, which led to a decline in their real prices for 2019 compared with their levels in 1979, despite the high levels of nominal prices of all these products during the period under study.

Two methodologies of pricing to natural resources were discussed; Hotelling method and Tehran method. The study chooses to apply Tehran method since it is more simple and straightforward, and related to the international Oil prices.

Therefore, the resulting prices are as follows; LPG = 11111.2 per Metric Ton, Kerosene = 12418 per Metric Ton, Gas Oil = 11369 per Metric Ton, Fuel Oil = 5874 per Metric Ton, and Gasoline = 13072 per Metric Ton.

References

1. International Energy Agency, 2010, “Energy Policies of IEA Countries: Turkey 2009 Review” (Paris).

2. ———, 2011a, “Development in Energy Subsidies,” in the World Energy Outlook (Paris).

3. ———, 2011b, “Fossil- Fuel Subsidies— Methodology and Assumptions,” World Energy Outlook. Available via the Internet: http:// www .iea .org /publications /worldenergyoutlook/ resources /energysubsidies /methodologyforcalculatingsubsidies.

4. ———, 2011c, World Energy Outlook (Paris). International Finance Corporation, 2012, From Gap to Opportunity: Business Models for Scaling up Energy Access (Washington).

5. International Monetary Fund, 2008, “Food and Fuel Prices— Recent Developments, Macroeconomic Impact, and Policy Responses” (Washington). Available via the Internet: http:// www .imf .org /external/np /pp /eng /2008 /063008 .pdf

6. Kennedy, David. (2003) "**Power Sector Regulatory Reform in Transition Economies: Progress and Lessons Learned**" European Bank for Reconstruction and Development, WP No. 78.

7. Kerkelä, Leena. (2004) "**Distortion Costs and Effects of Price Liberalization in Russian Energy Markets**" Bank of Finland, Institute for Economies in Transition, BOFIT Discussion papers, N 2/2004, June.

8. Khorshid M. (2009) **"Revising Energy Pricing Strategy for Egypt – An Issue Oriented Economy-wide Analytical Approach"** 8th International Conference of the Middle East Association (MEEA), Monaco, France, March.

9. Khorshid M. (2009) "**An Energy Economy Interaction Model For Egypt**" International Conference on Policy Modeling, Ottawa, Canada, June.

10. Mabro, Robert. (2006) "**Egypt's Oil and Gas: Some Crucial Issues**" The Egyptian Center for Economic Studies, Lecture Series No. 25, September.

11. Maghyereh, Aktham. (2004) "**Oil Price Shocks and Emerging Stock Markets: A Generalized VAR Approach**" *International Journal of Applied Econometrics and Quantitative Studies*, Vol. 1-2.

12. Naka, A. and Tufte, D. (1997) "**Examining Impulse Response Functions in Cointegrated Systems**" *Applied Economics*, 29, 1593-1603.

13. Passey, R., Haghdadi, N., Bruce, A., MacGill, I., 2017. Designing more cost reflective electricity network tariffs with demand charges. Energy Policy 109, 642–649. https://www.researchgate.net/publication/318771310_Designing_more_cost_reflective_electricity_network_tariffs_with_demand_charges

14. Pindyck, R. S. (1999) "**The Long Run Evolution of Energy Prices**" *Energy Journal*, 20(2), p 1-27.

15. Salehi-Isfahani, D. (1996) "**Government Subsidies and Demand for Petroleum Products in Iran**", Oxford Institute for Energy Studies, WPM 22.

16. Stenner, K., Fredericks, E., Hobman, E.V. and Meikle, S., 2015, 'Australian Consumers' Likely Response to Cost-Reflective Electricity Pricing', CSIRO Energy Flagship, June, 2015.

17. Vagliasindi, Maria, 2013, "Implementing Energy Subsidy Reforms: Evidence from Developing Countries" (Washington: World Bank). Available via the Internet: https:// openknowledge.worldbank .org /handle /10986 /11965.

18. Velody, Mark, Michael J. G. Cain, and Michael Philips, 2003, "Energy Reform and Social Protection in Armenia," in a Regional Review of Social Safety Net Approaches: In Support of Energy Sector Reform (Washington: United States Agency for International Development).