



**EGYPT'S OIL AND GAS:
SOME CRUCIAL ISSUES**

ROBERT MABRO

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FOREWORD

Oil and gas constitute over one-tenth of Egypt's gross domestic product and around 40 percent of its commodity export proceeds. They are strategic inputs for future growth, however, Egypt's energy reserves are quickly depleting, oil production is aging and tends to decline, while natural gas reserves are rather new. Recent hikes in the price of oil, and to a lesser extent that of natural gas, have increased the gap between international and domestic prices of these products, which have traditionally been subsidized for domestic use, resulting in an untenable burden on the government budget.

In this edition of the *Distinguished Lecture Series*, Robert Mabro describes the main characteristics of Egypt's oil and gas industry. He addresses the issue of energy subsidies, highlights their fiscal, distributional and allocative impacts, and proposes policy recommendations to reduce their burden. He also examines Egypt's exposure to international oil and gas markets, stressing the important role foreign investors, domestic constituencies, and the various stakeholders play in shaping the energy market. In addition, Professor Mabro assesses the issue of natural gas exports and suggests refraining from further investments in the liquefaction of natural gas until the size of gas reserves and the true opportunity costs of domestic and export options are ascertained.

The discussion that followed the lecture was highly relevant and the answers provided by Professor Mabro were insightful and constructive. Both the lecture and summary of discussion are included in this publication.

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تقديم

يشكل النفط والغاز ما يزيد عن عُشر الناتج المحلي الإجمالي في مصر، وحوالي 40% من حصة الصادرات السلعية، فضلا عن أنهما من المدخلات الاستراتيجية للنمو في المستقبل. إلا أن احتياطات الطاقة آخذة في النضوب، كما أن الموارد الإنتاجية للنفط بدأت في التراجع، ويتجه إنتاجه إلى الانخفاض، في حين أن احتياطات الغاز الطبيعي جديدة نسبيا. وقد أدت الزيادات الأخيرة في أسعار النفط، وكذلك في أسعار الغاز الطبيعي ولكن بدرجة أقل، إلى توسيع الفجوة بين الأسعار الدولية والمحلية لمنتجات الطاقة التي تدعمها الدولة للاستهلاك المحلي، الأمر الذي شكل عبئا على الموازنة العامة يصعب على الحكومة الاستمرار في تحمله.

وفي هذا العدد من سلسلة المحاضرات المتميزة، يقدم روبرت مابرو توصيفا للخصائص الرئيسية لقطاع النفط والغاز في مصر. كما يتناول قضية دعم الطاقة، والآثار المالية والتوزيعية والتخصيصية المترتبة على الدعم، ثم يطرح توصيات للحد من العبء المترتب عليه. كما يتناول بالدراسة والتحليل مدى تعرض السوق المحلي في مصر لمخاطر التقلبات في الأسواق العالمية للنفط والغاز، مؤكدا على أهمية الدور الذي يقوم به المستثمرون الأجانب ومختلف أصحاب المصلحة في تشكيل خصائص سوق الطاقة في مصر. فضلا عن ذلك، يقوم مابرو بتقييم قضية صادرات الغاز الطبيعي ويقترح الإحجام عن ضخ مزيد من الاستثمارات في تسهيل الغاز إلى أن يتم التحقق من تكاليف الفرصة البديلة للاستخدام المحلي والتصدير.

وقد تطرقت المناقشة الثرية والمفيدة التي أعقبت هذه المحاضرة إلى العديد من الملاحظات والأسئلة المتعمقة، وجاءت إجابات مابرو عن استفسارات الحضور على نفس القدر من التعمق والوضوح. ويضم هذا الإصدار كل من المحاضرة وملخص المناقشات.

أ. د. هناء خير الدين

المدير التنفيذي ومدير البحوث

المركز المصري للدراسات الاقتصادية

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ABOUT THE SPEAKER

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Robert Mabro is currently a fellow of St. Antony's College, Oxford and former director of the Oxford Institute for Energy Studies. Prof. Mabro began his academic career at the School of Oriental and African Studies at London University then moved on to Oxford to take up a position at Oxford University as Senior Research Officer in the Economics of the Middle East. He founded the Oxford Energy Policy Club, the Oxford Energy Seminar as well as the Oxford Institute for Energy Studies.

Prof. Mabro is the author of numerous publications, including 13 books and monographs, as well as a large number of articles in journals and papers in collective books. His most recent book is entitled *Oil Markets and Prices: The Brent Market and the Formation of World Oil Prices* with Paul Horsnell.

Prof. Mabro has received several awards over the course of his career including the first OPEC award for contribution to oil studies in 2004 and a CBE* by HM the Queen of England in the New Year's Honors List in December 1995.

* Commander of the Most Excellent Order of the British Empire.

PART I
EGYPT'S OIL AND GAS:
SOME CRUCIAL ISSUES

I. INTRODUCTION

The ambitions of this paper are more modest than may be suggested by the broad title of the lecture I had the honor to give at ECES on May 11, 2006 on international market developments in oil and gas and implications for Egypt. Conference organizers kindly give invited speakers a broad brief that encompass several possible topics. The speaker is thus given the valuable freedom to choose among them the ones that appear most relevant to the interests of the audience, and one must add to his own interests.¹

I chose to focus on selected oil and gas issues that are currently of interest, and sometimes of concern, to the Egyptian government, the national petroleum corporation—Egyptian General Petroleum Corporation (EGPC)—and its subsidiaries, the oil and gas companies operating in the country, decision makers and economists, and in some cases the public at large.

These issues relate to burdensome energy subsidies, the distortions they cause in distribution and allocation, Egypt's exposure to international oil and gas markets, the difficult problem of defining and implementing a gas export strategy through appropriate contracts with foreign companies. Because oil and gas are tradable commodities any decisions about their possible uses involve assessing the opportunity costs in international markets. All the critical issues may seem to be domestic in nature but they also have a fundamental international trade dimension. The

¹ Acknowledgments are due to Dr. Hanaa Kheir-El-Din, ECES Executive Director and Director of Research, not only for the invitation that gave rise to this paper, but for the incisive comments on a first draft which resulted in major improvements. I would like to thank warmly Engineer Hany Soliman Aly, First Under-Secretary for Gas Affairs in the Ministry of Petroleum, and Engineer Sherif Ismail, Chairman of EGAS, who despite their disagreement with some of my views and conclusions, had the great courtesy to spend precious time putting me right on certain facts, discussing my ideas and clarifying my thoughts. Dr. Sherif Abdel Wadood was of immense help sharing generously his considerable knowledge of, and deep insights in, the Egyptian oil and gas situation. Engineer Ibrahim Saleh, Chairman of EGPC, found the time in his busy schedule for a long interview thanks to which my understanding of crucial issues was enhanced. I remain fully responsible for the contents, warts and all, of this paper.

objectives of the paper are to assess the nature, extent and implications of these issues of concern and propose, wherever possible, direct or indirect policy remedies.

It is evident that energy subsidies have become untenable in budgetary terms given the recent huge increases in the international prices of oil and gas as against the fixed prices of domestic supplies. In addition, subsidies cause economic distortions. They tend to benefit the rich at the expense of the poor and increase the profits of energy-intensive exporters. Energy subsidies also lead to serious allocation problems by raising domestic demand for energy products above the levels warranted by their true opportunity costs. For gas, they give rise to a bias in favor of investments in export plants against investments in the national grid. In short, the optimization of resource allocation becomes difficult, if not impossible to achieve.

The energy sector in Egypt, as in all countries, is subject to the international market and movements in international prices of oil and gas. A net exporter benefits from rises in international prices, while a net importer has to cope with the problem of financing a higher import bill. However, the net exporter's gains are reduced by the concomitant increase in subsidies, and the losses suffered by the net importer increase by the rise in the subsidy bill. As such, whether Egypt is a net exporter or a net importer of oil (crude and products taken as an aggregate) is a moot point. The relevant policy in both cases is to promote energy efficiency and give domestic prices more room to curb demand.

The third issue of concern is natural gas exports. Let me state from the outset that I am neither against exports on some principle, nor in favor of them irrespective of costs. Oil and gas subsidies distort the terms on which decisions about the allocation of gas between domestic demand and exports are made by the government. This is because gas, which has an opportunity cost in international markets, is a domestic consumption substitute for petroleum products that also have an opportunity cost as they are highly tradable. The cost of investing in export facilities (such as liquefaction plants) and in gas distribution networks needed to meet domestic incremental demand also enters the equation. A rational allocation decision needs to be based on a complex economic analysis that takes into account both opportunity costs and investments.

The remainder of this paper is organized as follows. Section II provides a description of the main features of Egypt's oil and gas industry and section III addresses the subsidy issue. Section IV explains the workings of the international oil market to which Egypt is exposed and discusses how the international gas market differs from that of oil. Egypt has recently entered this market in which bargaining power in the negotiation of contracts and prices is of the utmost importance. Section V examines gas export issues, while the final section offers some concluding remarks. Policies are proposed throughout the paper wherever they seem appropriate. It is important to note that their implementation often requires self confidence and political courage. Egypt's energy problems are sufficiently serious to warrant the government's full attention given that energy is of crucial importance for the economic development of the nation and the welfare of its citizens.

II. OIL AND GAS IN EGYPT

The oil and gas sector in Egypt is heavily regulated and most segments are under government control. Exploration, development and production are generally undertaken by foreign companies under production-sharing agreements (PSAs).² In the downstream—refining, distribution and the gas pipeline grid—the public sector has many assets owned by EGPC and its subsidiaries. Prices in the domestic market are administered and involve significant subsidies.

Oil

In the late 19th century, oil was discovered in Egypt making it the first oil country in the Middle East and North Africa region. It was followed a few years later by Iran, and much later by Iraq, then Kuwait and Saudi Arabia, and 60 years later by the UAE.

Despite being the first in the region to discover oil, Egypt was never a big oil producer compared to the aforementioned Middle East "giants." Proven oil reserves in Egypt, which include both crude oil and natural gas liquids (NGLs), were estimated at 3.7 billion barrels at end-2005 and

² For more information on PSAs, see Mabro 1998.

represent 0.3 percent of the world total. Egypt ranks 29th in the list of countries with oil resources (see BP 2006, 6).

In the mid-1990s, Egypt reached its peak oil production at around 925,000 barrels per day (bpd) (BP 2006, 8). Since then crude oil production has been falling, with the latest data putting it at 696,000 bpd in 2005 (BP 2006, 8). There are indications that output continued to decline in 2006 as some observers put the average output figure for 2005/2006 at 642,000 bpd. Egyptian oil fields are generally small and subject to a high rate of natural production decline which is not always fully compensated for by new discoveries.

While production went through a period of growth then decline over the past decades, domestic consumption continually increased. Egypt's generous subsidization of petroleum products means that the consumption levels, although small by developed world standards, are higher than they would have been if prices were closer to opportunity costs. But the drivers of domestic oil consumption growth (as opposed to levels) are both economic and population growth, as well as changes in the economic structure of the country which are partly due to industrial developments among other factors.

From 1995-2005, domestic consumption rose from 474,000 bpd to 616,000 bpd, or at a compound annual rate of 2.8 percent (BP 2006, 11). Though this is not a very high number, its cumulative impact over the years is obviously significant.

Egypt exports oil but the trade pattern involves imports of some petroleum products, mainly liquefied petroleum gas (LPG) used in Egypt for cooking and heating water and diesel, and the export of crude oil and other products mainly naphtha and heavy fuel oil. The apparent exportable surplus—defined as the difference between production and domestic consumption—which at one time was as high as 484,000 bpd fell to 80,000 bpd in 2005 (BP 2006; 8, 11), and will be probably even smaller in 2006. The volumes available for export were squeezed by production decline and consumption increases. On the basis of these data (BP 2006), Egypt appears to have become a marginal oil exporter. This means that Egypt's contribution to oil supplies to the world market was excessively small in 2005, and could have even become negative in 2006.

At this point it is important to distinguish between a ‘geographical’ and ‘national’ concept of international trade. The geographical concept relates to the volumes of a commodity or good that leave the country (exports) and those that enter it (imports). The national concept distinguishes between the exports and imports attributable to Egypt and those to foreign entities.

In the case of Egyptian oil this distinction is important because most foreign oil companies in Egypt operate under PSAs and a certain proportion of their production accrues to them. This may be either exported by the foreign entity or sold to EGPC which purchases oil from them, generally at international prices, to supply the domestic market. The volumes purchased by EGPC are not recorded in the trade statistics because they have not crossed an international border. Effectively, however, they are ‘national’ imports even though the transactions take place within the country. This line of reasoning also implies that exports by the foreign investor, although recorded in the trade statistics, are recorded in accordance with the national, not the geographical concept.

This conceptual distinction is relevant if one is concerned about foreign exchange cash flows. EGPC imports oil from foreign contractors and this adds to the outflows. The question is whether EGPC’s purchases from foreign investors are greater or smaller than the apparent exportable surplus which was estimated at 80,000 bpd for 2005 (BP 2006). This is an empirical question whose answer requires data for the EGPC purchases from the foreign investors. If EGPC purchased more than 80,000 bpd its net outflow is the difference between the value of total exports, assumed here to be 80,000 bpd, and its purchases from the cost recovery and the equity oil of foreign investors. In that case EGPC, meaning Egypt, is a net importer. One may reasonably guess that the purchases exceeded 80,000 bpd because a smaller volume would imply that the total share of the foreign oil production in Egypt was less than 11.5 percent in 2005. This would not concur with information on cost recovery and equity shares for foreign investors. As regards foreign exchange flows, the indirect evidence strongly suggests that Egypt is a net importer of oil.

Natural Gas

The decline in oil production has coincided with a natural gas boom induced by significant discoveries most interestingly in the Mediterranean Sea to the east of Alexandria. The proven natural gas reserves at end-June 2005 were estimated at 66.5 trillion cubic feet (Tcf) by official sources (see Arab Republic of Egypt 2006, 20; BP 2006, 22). Whether this estimate is reliable (to the same extent as reserves data published by other countries and energy companies round the world), or exaggerated (as some Egyptian commentators believe) are questions that cannot be answered without undertaking a thorough survey of the geological evidence.

Those who think that the 66.5 Tcf estimate overstates the size of the reserves base their opinion on the motives of the government and the companies engaged in exploring and developing Egypt's gas resources. Critics argue that both have an interest in promoting gas exports and that they need to counter the criticism of those who worry that the export drive will deplete gas resources too quickly and constrain the use of gas domestically. The claim that reserves are large is therefore meant to support the export policy.

Whether this is true or not, I cannot judge. What is certain, however, is that proven reserve estimates usually understate the volume of oil or gas that can be recovered in current economic and technological conditions. For this reason the 66.5 Tcf estimate, even if it was the result of some willful exaggeration, may well turn out to be closer to reality than a conservative, inherently understated number free from political manipulation. This is a paradox that arises from the way reserves are estimated.

Natural gas production has increased significantly in recent years thanks to the discoveries of new fields in the Mediterranean and elsewhere. In 1995, production was at 11 billion cubic meters (Bcm) and by 2005 had reached 34.7 Bcm (1225 billion cubic feet [Bcf]) (BP 2006, 24), increasing by a multiple of 3.15 in 10 years.

In 2004/2005, some 58.8 percent of gas production originated in the Mediterranean and 26.5 percent in the Western Desert (Arab Republic of Egypt 2006, 24). The remaining was obtained in the Delta (6.4 percent) and the Gulf of Suez (7.6 percent). The export drive is partly explained by

the sudden emergence of the Mediterranean as a new major source of gas whose production almost doubled in the first five years of this century. This issue will be discussed in detail in later sections.

According to British Petroleum (BP) statistics (2006, 27), domestic gas consumption increased from 11 Bcm in 1995 to 25.5 Bcm in 2005, or by a multiple of 2.32. Not surprisingly this coefficient is smaller than that for the production increase since gas was first exported in fiscal year 2003/2004.

It is worth noting that, according to BP (2006), gas consumption declined between 2004 and 2005 from 26.2 Bcm to 25.5 Bcm. This is the only annual fall of gas consumption in Egypt since the introduction of gas. If the data are accurate, the decline should be attributed to factors other than price increases—since domestic prices have remained fixed in Egyptian pounds—and economic recession since the Egyptian economy is continuing to grow. Once again, if the data are accurate the decline can only be the result of a policy designed to release some incremental gas for exports.

Egyptian official statistics differ from the statistics of BP. For example, the official figure is higher for consumption in 2004 (30.8 Bcm, which I computed as the average of the two fiscal years 2003/2004 and 2004/2005) than that of BP (26.2 Bcm) (Arab Republic of Egypt 2006, 46; BP 2006, 27). At the time of this writing the official 2005 data had yet to be published. It would be interesting to see whether they will show a consumption fall between 2004 and 2005.

The official numbers also provide a breakdown of distribution by sectors of use. As in many countries, power generation accounts for the lion's share of gas consumption (60 percent in 2004/2005) (Arab Republic of Egypt 2006). Conversely, private homes only account for 1.9 percent of total gas consumption. Industry, including fertilizers, petroleum, cement, petrochemicals and other manufacturing accounted for 30 percent of total consumption in 2004/2005 (Arab Republic of Egypt 2006, 46). Gas is predominantly a fuel for power generation and industrial plants in Egypt, hence its significance for the economic development of the country.

While gas production began in 1975 with the development of the Abu Madi field in the Delta region, gas exports only started in fiscal year 2003/2004. The first year, exports totaled 0.741 Bcm and by 2004/2005 had risen to 3.35 Bcm (Arab Republic of Egypt 2006, 46).

The natural gas export infrastructure consists of a pipeline and three LNG trains. Inaugurated in July 2003, the Arab Gas pipeline links Egypt to Jordan and there are plans to extend it to Syria and Lebanon and ultimately to Turkey. The first section of the pipeline between Al Arish, Egypt and Aqaba, Jordan is 36 inches in diameter and about 265 km long with a 15 km section running under the sea at a depth of 850 meters. The second section extends the pipeline by 396 kilometers from Aqaba to the north of Jordan close to the Syrian border. The effective capacity of the Arab Gas pipeline is 8.75 Bcm today. The supply agreement with Jordan is for a duration of 30 years. Currently, Jordanian gas demand is small (less than 2 Bcm) but the pipe was designed with a view to further demand developments, not only in Jordan itself where the possible exploitation of shale oil deposits will require the use of large gas volumes, but also in Syria and Lebanon, if not Turkey.

There are two LNG facilities in Egypt, one in Damietta with one train, and one in Edku to the west of Damietta with two trains. There are plans to add trains in each site.

The Damietta plant is owned by the Spanish-Egyptian Gas Company (SEGAS) whose shareholders are Union Fenosa/ENI (80 percent) and EGPC/Egyptian Natural Gas Holding Company (EGAS) (20 percent). The plant was inaugurated in May 2005 and its capacity is 4.8 million tons per year (mt/y). The investment costs of Egypt's 20 percent share was not paid *ab initio* but will be refunded out of future revenues. Egypt has a tolling agreement with SEGAS which enables it to use about 50 percent of the plant capacity in exchange for paying a 'toll' per unit moved through the facility.

The Edku site includes two trains—ELNG1 and ELNG2—each with a capacity of 3.6 mt/y. ELNG1 is owned by British Gas (BG) (35.5 percent), Petronas of Malaysia (35.5 percent), EGPC and EGAS (12 percent each), and Gas de France (5 percent).

ELNG2 has the same owners with the exception of Gas de France. EGPC and EGAS each own 12 percent, while BG and Petronas each own 38 percent.

These facilities have signed a number of gas export contracts. In 2003, Union Fenosa signed a 25-year contract to purchase 3 mt/y from the SEGAS facility in Damietta and exports began in 2004. ELNG1 supplies Gas de France with 3.6 mt/y under a 20-year contract signed in 2002, while ELNG2 supplies BG marketing 3.6 mt/y under a 20 year contract signed in 2003. The Union Fenosa contract is for a volume less than the capacity of the Damietta train, hence the surplus capacity for Egypt to use under a tolling agreement. By contrast, the Gas de France and the BG marketing contracts are for volumes equal to the full capacity of the trains. Another important difference between the contracts is that Union Fenosa is just a buyer of gas and is not a producer in Egypt, while BG has discovered, developed and produced fields under PSAs. Union Fenosa is thus supplied from the natural gas grid.

This description of some features of the oil and gas industry in Egypt provides a background but does not address the important questions that need to be raised. Domestically, there are questions about subsidies to oil products and gas for consumption, and the terms of contracts between Egypt and foreign investors operating upstream. Regarding international trade, there are questions about Egypt's position in the world market. Is Egypt a price taker or a price maker or a party to bilateral bargaining with, or without, power? Also, are the terms of the various gas export contracts fair to Egypt?

III. SUBSIDIES TO OIL AND GAS IN DOMESTIC CONSUMPTION

The subsidy problem, which may have been benign in its effects many years ago, has gained significance over time and may well have become intractable now. The problem has two important dimensions: fiscal burden and distributional distortions.

Fiscal Burden

Subsidies represent a growing fiscal burden to the government budget. It has been estimated to have reached, on a cash basis, LE 24 billion (a bit more than \$4 billion). However, the economic value of the subsidy is much higher because the oil and gas received by EGPC as Egypt's share under PSAs is treated as a free good. Their domestic sales at low subsidized prices appear as an

accounting profit. In reality, however, EGPC is incurring an opportunity loss equal to the difference between the domestic price and the prices which oil and gas are purchased from foreign investors. If this is taken into account the effective subsidy is said to be of the order of LE 40-45 billion. Whatever the accuracy of these estimates, the fact remains that the fiscal burden of energy subsidies is very heavy.

Distributional distortions

Subsidies also create numerous distributional distortions. Petroleum and natural gas subsidies to individuals and households benefit all consumers whether rich or poor. There is no reason based on equity or distribution to subsidize those who can afford to pay according to the economic opportunity costs of the fuel involved.

In many instances, however, discrimination on the basis of income may be impossible, or very difficult, to implement. Gasoline, for example, cannot be sold in service stations at different prices depending on the income of the car's owner or the driver who fills up the tank. The LPG cylinder which is heavily subsidized in Egypt, is necessarily sold at the same price to all customers. The only way to introduce some discrimination between rich and poor is through some rationing device (as was established in Egypt during WWII and remains in effect today for such necessities as sugar and cooking oil). Such a system is administratively cumbersome and open to abuse. It is always worth remembering that in the case of gasoline, diesel or LPG, the poorer tax payers are in effect subsidizing the rich.

However, discrimination on the basis of income is possible to some extent in the case of household gas or electricity. A graduated tariff system could be implemented where those in a higher consumption bracket would incur higher tariffs. The concept is simple, based on the very plausible assumption that consumption correlates to the size of the accommodation which in turn correlates to the income or wealth of the household. These correlations are not perfect but sufficiently close to reality to justify the graduated tariff policy.

Graduated tariffs are used in Egypt, but the system does not necessarily abolish all distributional distortions. Much depends on the structure of the scale (how many consumption

brackets are involved and the levels at which the tariffs are set). Consider, for example, a scale in which the highest bracket (which, by definition, has no upper bound) starts at a fairly low consumption level. In such a scale households with moderate fuel consumption will be paying for electricity or gas at the same tariff as rich households consuming very large amounts. An objective of equitable distribution will not be fulfilled in this case.

Subsidized fuels are not only supplied to households but to power stations, industry, the transport sector, and to the whole range of commercial, financial and other establishments. The aim is to make electricity, goods produced by industry and retailed by merchants, transport fares, services and so on, available to consumers at affordable prices.

Let us consider here the case of industry. Energy subsidies reduce production costs which in turn are expected to reduce *pari passu* final prices. The significance of the cost reductions depends on the energy intensity of the production of the manufactured good. Reductions would be fairly large in industries such as fertilizers, cement, metals or petrochemicals, but not very significant in light industries such as textiles, food processing and the like.

Cost reductions are not always *fully* passed on to the final consumer. Much depends on the degree of market concentration for the good concerned (monopoly or competition) and in the case of monopoly much also depends on the efficiency of regulation.

Some industries export part or all of their production. Subsidized fuels reduce production costs across the board, whether the good is sold in the domestic or international market. The fuel subsidy will therefore increase the profits of the exporter or reduce losses. In the case of the former, it will provide a boost for further exports; in the latter it will delay the moment when a company ceases to export which inevitably happens if losses continue to be incurred. Of course, the increase in profits (reduction of losses) depends on the size of the subsidy and the energy input coefficient in the production of the exported good. There again, the effect may be negligible for light-industry products, but would be more substantial for energy-intensive industries.

Allocation distortions

Fuel subsidies naturally cause allocation distortions. I shall not dwell here on the familiar issue that subsidies stimulate consumption patterns that do not correspond to the structure of relative scarcities. I would rather focus on a specific problem: the allocation of gas production between domestic and export markets.

In Egypt, both oil and gas are generally explored for, developed and produced by foreign investors (big or small oil companies) under PSAs. The investor has a claim on these shares of the output: the first (CR) is to recover exploration, development and production costs over a certain period of time, and the second (PR) to provide a profit in compensation for the risks incurred, and a return on the capital invested. EGPC has a claim on another share (G) so that:

$$CR+PR+G = 1$$

In the case of oil, EGPC may buy from the investors either all or part of $(CR+PR)* Q$, where Q is the production of the field.

For gas, the situation differs from that of oil in an important respect as gas exports require a specific infrastructure: pipelines and/or liquefaction plants for LNG. And the use of gas domestically requires a pipeline network that links fields to consumption points such as power stations, factories and households. For oil, refineries are needed, but if their domestic capacity is smaller than the size of the national market a balance can be achieved by exporting crude and importing petroleum products.

The development of gas resources by oil companies when new discoveries are made is only possible if the incremental output can be absorbed by the domestic or export market or both. But this depends on a domestic demand potential that is not constrained by the existing infrastructure, and/or on export markets that can be reached and supplied by the existing LNG and pipelines.

The development of gas production in a situation where the domestic pipeline network is constrained and the LNG or export pipeline capacity is either non-existent or insufficient (always assuming that a demand potential does exist) will require investment in these installations and

infrastructure, which could be done in joint ventures with foreign investors. In Egypt, EGPC has a domestic monopoly in both oil and gas either directly or through subsidiaries and thus invests in the natural gas grid and all relevant connections.

Sound investment decisions must take into account the opportunity costs of the fuels involved, *not* the cash costs which determine cash flows but do not lead in the direction of an optimum allocation of resources.

The oil/gas price structure in Egypt, presented in table 1 in an ordinal scale, distinguishes between transactions made at administered or subsidized prices and transactions at international prices. The latter are the true opportunity costs of such highly tradable commodities as crude oil and petroleum products, and now in Egypt, natural gas.

Table 1. Oil and Gas Price Structure

EGPC's Acquisition Prices	
(1) from its share from PSA agreements	free
(2) for its purchases from the share of foreign investors The price vector [p] is related to, but not necessarily equal to international prices. In gas contracts [p] is capped at \$2.5/2.65 per million Btu (MBtu), a level that now is below international prices.	[p]
(3) Imported petroleum products at cost, insurance and freight (cif) prices [c] as given in international markets	[c]
(4) Imported LPG at international prices	v
EGPC's Sales Prices	
(5) ary depending on the fuel. All petroleum products are sold domestically at fixed prices [y] lower than those in international trade. Gas is sold to households according to a tariff structure related to consumption levels. Prices can be represented by the vector [z]. Most of the elements of this vector are below the purchase prices [p], sometimes significantly.	[y] [z]
(6) LPG is sold at a heavily subsidized fixed price	b

Source: Author's definitions.

We generally have: $[z] < [p]$ and $[y] < [c]$

And always: $b < v$

The opportunity cost of (1) is not zero, however. It is the international price, or its proxy, the price $[p]$ paid by EGPC for its purchases (2) from foreign investors. That of LPG is clearly v ; and that of the range of fuels sold by EGPC domestically is clearly not $[y]$ or $[z]$, but their international price.

To illustrate with some numbers, for example, gas is now purchased at the capped price of \$2.50/2.65 per million Btu (MBtu) from the foreign investors and there is a general view that it is sold in export contracts at a bit less than \$1.0 MBtu, in one case and \$1.50 in another one. I do not have details on other contracts. Spot export deals by EGPC usually bring prices comparable to those in the relevant international market. Natural gas is sold domestically at prices ranging between \$0.48 and \$1.44 MBtu depending on consumption levels. A 12.5 kg LPG cylinder is sold at the official price of \$0.43 per equivalent to \$0.73 MBtu (Gerner, Franz and Sinclair 2006).

Considering opportunity costs instead of accounting prices has a significant bearing on the optimum allocation of natural gas between domestic consumption and exports. Gas used domestically displaces petroleum products: gasoline or diesel if compressed natural gas (CNG) used in taxis or buses; LPG if households are connected to the national gas grid; heavy fuel oil in power stations, and so on. The opportunity costs of the displaced petroleum products are to be compared with that of exported natural gas, more precisely with the netback obtained by EGPC at Egypt's border. The *actual* opportunity cost has to be computed as a weighted average.

The prices that a country or a company receives in gas sales may be lower than is warranted by international gas market conditions. Some will argue that the true opportunity costs are the warranted prices. In my judgment they are irrelevant if unobtainable under existing contracts. However, raising the point is important as a reminder that one should always seek to correct a flawed situation, and keep an eye on true opportunity costs in future deals or contracts.

Furthermore, the investment requirements in the domestic gas connection infrastructure and in the export installations (LNG trains and/or export pipelines) need to be compared. These are not

easy exercises but it is important to undertake them. Approximate results are better than no results at all.

The heavy subsidization of fuels in the domestic market and the peculiar institutional structure, which places a heavy burden on EGPC compelling it to sell fuels at lower than the purchase prices, inevitably distort the gas allocation decisions between exports and domestic use.

Other policy recommendations on subsidies

Resolving EGPC's cash flow problem (not that of the fiscal burden on the country) calls for institutional reform. In essence, the functions of EGPC and the Ministry of Finance should be clearly separated. EGPC's role is to buy and sell fuels, and the Ministry's roles are (a) to obtain the value of the equity oil and gas as these belong to the state and not to EGPC, and (b) to disburse fuel subsidies.

In practice this means that:

(1) EGPC would pay the Ministry of Finance a sum equal to $[q] \cdot [p]$ where $[q]$ is the volume of equity oil and gas obtained and $[p]$ the corresponding price vector of its acquisition from foreign investors. Then all oil and gas obtained both as equity or purchases from foreign investors is correctly accounted for in EGPC books.

(2) The Ministry of Finance would reimburse EGPC for the entire amount of implicit subsidies equal to $[q] \cdot [p]$ minus $[q] \cdot [z]$, and for LPG $[m] \cdot [v]$ minus $[m] \cdot [b]$ where m is the volume of LPG imported and sold domestically.³

This proposal would balance the books of EGPC, enabling it to work more efficiently and meet its payments obligations in a much easier and timely manner. It would also significantly increase transparency. The total amount of the subsidy will accurately appear in the state budget without the misleading subtraction of the proceeds from the sales of equity oil and gas assumed to be acquired

³ Subsequent to writing this proposal, I learned that Egypt recently adopted an approach which records the implicit energy subsidies as an explicit item of public expenditure in the government budget.

at zero cost. The value of the rent accruing to Egypt from the PSA would also appear in the Ministry of Finance books. Another important advantage of this proposal is that the cash flow pressures which influence EGPC/EGAS decisions on allocation between domestic gas consumption and exports will be removed. The decisions will become freer of an exogenous factor that may cause distortions.

The subsidy problem, though transferred more clearly to the budget, would remain a heavy burden on the government and needs to be urgently addressed. There are no radical solutions, however. Mitigation can only occur through gradual, and in some cases indirect, policies. To suddenly remove all fuel subsidies is not recommended although some economists advocate it on the grounds that a shock has immediate salutary effects, and that the pain initially felt tends to subside after a relatively short time. I do not belong to that school of thought.

The removal of all subsidies is politically dangerous and would cause hardship to low income groups. A solution of the Jordanian type—removing certain subsidies and making lump sum payments to those assumed to be affected—has theoretical merits, but its adoption in Egypt is likely to face difficult implementation problems.

The gradual approach is to increase domestic fuel prices over a period of five or six years by a small percentage, for example, 4 percent every year. The economic hardship would not be crushing and the risks of a political upheaval would be minimized. The tariff scales for gas and electricity should also be revised to ensure that those with high consumption (be it households or commercial, but not industrial establishments or power stations) are not lumped together with those with medium consumption.

Some indirect measures may remove the distributional distortions and generate some revenues to the government. Since automotive fuels (i.e., gasoline and diesel) cannot be sold at different prices to different customers (e.g., the wealthy and the less wealthy) an indirect approach is to impose a very high road tax on expensive cars according to cylinder capacity, price and age for example.

In addition, industrial plants which export all or part of their output could pay a fuel tax calculated as follows:

$$[s][f]x$$

Where [s] is the subsidy to the fuels [f] used, and x the ratio of exports to the total output of the company.

The LPG problem is more complex as it is heavily subsidized. The question is whether substitution with natural gas, which is itself subsidized, will reduce the fiscal burden. The answer to this question would have been straightforward if it only involved a comparison of the per Btu subsidy for the two fuels. The problem is that substitution requires investments for household connections to the gas supply network and changes in the domestic appliances that use LPG to enable them to burn natural gas instead.

A thorough study by Gerner and Sinclair (2006, 20) of the World Bank, estimates the average LPG subsidy at LE 57.8 MBtu, and the natural gas subsidy at between LE 14.3 and 18.5 MBtu depending on the household consumption level. The total subsidy for LPG for domestic use is estimated at \$1.5 billion in 2005 (Gerner and Sinclair 2006). It is likely to be higher in 2006 since crude oil prices which lead butane prices have risen compared to 2005 while domestic prices remain fixed. Assuming however that the international price of LPG will not change much compared to 2005, and that the natural gas subsidy will average LE 15.6 (27 percent of the LPG subsidy), I estimate that when completed, the substitution of LPG with gas will save EGPC/Egyptian government \$1.095 billion in subsidies.

The investment required to achieve these savings is large. It is estimated at LE 2500 (\$439) per LPG connection or a total of \$2.634 billion for six million households. The Egyptian government requires households to contribute LE 1500 toward the connection costs, which would reduce government investment to \$1.054 billion. No sophisticated economic analysis is required to justify an investment that, once completed, will be recouped in one year.

However, poor households cannot afford to pay LE 1500. Medium consumption households either cannot afford it or are not convinced of the benefits of LPG since they accrue

over the years while the contribution is paid upfront. The rich can afford it but some will be reluctant to pay. As a result, only a proportion of the households will be connected even though, according to Gerner and Sinclair (2006, 21), the National Bank of Egypt offers financing plans for the connection fees to some households.

In the case of partial connections, EGPC will recoup the investments made as the subsidy burden will be reduced (broadly speaking in the same proportion of the households connected) but the full savings on subsidies, which should be the objective, will not be achieved.

The bold proposal is that the government should undertake the entire investment without any contribution from connected households. Some revenues may then be obtained by raising gas tariffs by a modest amount to moderate consumers and bringing them close to the gas opportunity cost to high consumers. It is beyond the scope of this paper to embark on a sophisticated economic analysis to justify the proposal. This requires assumptions on the time it takes to complete the investment, a forecast of future LPG prices that is bound to be uncertain, a view about the financing method used and its costs among other parameters. My feeling, however, is that the proposal deserves to be considered.

IV. EXPOSURE TO THE INTERNATIONAL OIL AND GAS MARKETS

Egypt's revenues from oil and gas come from two sources: the equity share in hydrocarbon production and export proceeds. The former accrues to the country whether or not they are used to subsidize domestic energy consumption. The fact that they are used to finance energy subsidies and somehow seem to be lost in the wash conceals their true nature; income that can be potentially spent on this or alternative items. How they are spent is a policy decision that can be wise, economically sound, of debatable value, or plainly wasteful. Having addressed the subsidy issue at length let us now turn to exports and imports.

The International Oil Market

As regards imports and/or exports of crude oil and petroleum products, Egypt is for all intents and purposes a price taker due to its low level of international trade in petroleum. Small buyers/sellers

do not have market power except in very special circumstances (such as differentiated goods or very tight markets). The world petroleum market is vast, very active and flexible.

As a price taker, Egypt is exposed to the price volatility that has characterized the oil market for the past 20 years or more. In 1998 and early 1999 the Brent price⁴ fell to below \$10 per barrel (bbl); in 2006 it rose at some point above \$70/bbl. A net exporter benefits from price increases and suffers from price falls. The reverse applies to net importers. Because Egypt, from the point of view of foreign exchange flows, is a net importer low oil prices are beneficial on two counts: they reduce the size of the import bill and that of the total fuel subsidy. High oil prices are disastrous as they raise the size of the import bill and that of the total fuel subsidy. In both situations the two impacts have the same effect. There are of course certain qualifications. The price paid for purchases from the foreign investor are capped in some instances and the net importer suffers less from high prices in this case than it would otherwise. Also, subsidy rates may be slashed if huge increases in the import price make them unsustainable. In fact, some developing countries such as Indonesia or Jordan did just that in 2006, but Egypt has not yet followed suit.

Egypt may become a net exporter sometime in the future if recent exploration and development projects result in major discoveries. In that case, low oil prices would reduce export revenues, but they would also reduce the size of the total subsidy bill. High oil prices would increase both export revenues and the size of the total subsidy bill. In both situations there would be one negative and one positive factor.

One can see how the contractual structure of the upstream sector (PSAs) and the existence of subsidies complicate the picture and hence its interpretation.

The volatility of international oil prices is due, in part, to the nature of the price regime. There was a time, before 1973, when major oil companies administered the oil price and for a long period the administered price remained fixed in nominal terms. At the end of the 1960s this pricing regime experienced strong pressure from market forces until it collapsed in 1973. In order to bring demand

⁴ The relevant international reference for Egypt's trade.

and supply to some form of equilibrium, the administered price had to be raised significantly. The major oil companies could not do it for political reasons as they would be heavily criticized in their home countries of the United States, the United Kingdom and Europe. Therefore, OPEC took over and administered the oil price, which between 1974 and 1978 remained at a consistently higher level than in the 1960s. The Iranian Revolution caused a discontinuity and market forces took over, pushing oil prices to a peak (in real terms) and then bringing about their collapse in 1986. The administered price regime was not associated with short- or medium-term volatility but with shocks which separated two fairly long episodes of constant prices.

Since the second half of the 1980s, oil prices in international trade have been determined by the market. OPEC no longer administers the price but attempts to influence its movement by lowering production whenever downward pressures or significant falls occur. The success of these types of intervention depends on whether market agents believe that OPEC policy is credible and properly designed to meet its objective.

Oil exports are sold on the basis of a formula that references the price of a marker crude—WTI, Brent or Dubai/Oman—depending on the destination of the export—North America, Europe or the Far East, respectively. The reference prices in the case of the two most important (WTI and Brent) emerge in the futures market of New York and London. There is, of course, a relationship between the futures and the corresponding spot market but, in my judgment, the futures market dominates.

Those who believe, with good reason, that the price of commodity should be determined by a market are all in favor of the current price regime. They fail, however, to ask the fundamental question: Which market?

The futures market deals with a financial instrument—a contract to buy or sell 1000 barrels of oil at the date at which the contract expires. But the number of contracts that are exercised on expiry (that result in a purchase and delivery of physical oil) is extremely small as a proportion of the volume of contracts traded.

Those who trade in the futures market hope to make a profit by buying or selling a contract and then selling it at a higher price or buying it at a lower price on the same day or a few days later. There are very few reasons to hold on to a contract until expiry.

There are a number of factors that influence the price bidding including news about oil supply or demand or about factors that may influence those key parameters sometime in the next three or four months. Typically, geopolitical worries will cause fears that supplies may be interrupted; views about the state of the world economy, particularly the United States, China and, for some reason, India will impact views about the future course of oil demand and so on.

Non-oil factors can also move prices. The futures contract and the associated derivatives (e.g., options, contract for differences), being financial instruments, are held with other financial instruments in the traders' portfolios. The optimization of these portfolios involves shifts from one instrument to another when perceptions of relative profitability change. If I believe, for example, that oil prices may rise but bond prices will rise by a higher percentage I would sell some of my oil futures contracts in order to buy bonds. In this example, the oil price will fall even if the fundamentals point to a possible increase and simply because prices in other markets are expected to yield higher returns.

Movements of funds have become a main cause of high oil prices in futures markets in recent years. Large sums have been flowing in commodity markets, partly because big banks and hedge funds are flushed with money and partly because oil contracts appear to be more profitable than bonds, equities or foreign exchange. The view that oil supplies will be disrupted by geo-political disasters or constrained by a peak, according to the now famous Peak Oil Theory, makes it more attractive than other financial markets. Whenever *ex ante* demand exceeds *ex ante* supplies (the demand and supply here referring to oil financial derivatives) prices inevitably go up.

Futures markets are typically volatile because traders continually respond to a flow of news. And as the late Professor Dornbusch showed in an article published many years ago these markets tend to overshoot and undershoot (Dornbusch 1976).

This price regime, inappropriate as it may be, is here to last. None of the major groups in the oil market seek to change it and those who trade in it—the major banks, the hedge funds, some oil companies—have a vested interest in keeping it alive. OPEC finds it convenient as it shields it from blame if the oil price goes up. OECD countries that have argued for a long time that oil prices should be determined by a market cannot argue against a regime defined as a market-price related system.

Egypt as a price taker cannot influence the world petroleum market in a direction that favors its interests. Some advisers will say, however, that this is not a problem because hedging instruments exist and it is thus possible to manage risks. But this solution itself raises other problems.

In all situations Egypt will gain from promoting energy efficiency measures that reduce consumption of fuels without affecting economic development. Any such reduction means *ceteris paribus* a lower imports bill (when a net importer) or higher export revenues (when a net exporter) and in both cases a smaller subsidy budget. The introduction of energy efficiency measures often involves investment expenditures so their benefits must be carefully assessed in relation to costs. Some policies can be easily recommended, however. Small gradual increases in prices as mentioned earlier can be effective after a relatively short period of time. The expansion of public transport networks is always worth looking at. And much can be achieved in industry, power stations and refineries by imposing energy audits that will inevitably reveal sources of waste and encourage owners to take remedial action. Some substitutes for electricity generated by oil or gas, such as solar and wind energy, have a good potential in parts of Egypt in a number of applications. This list can be further increased by conducting focused research on opportunities for energy substitution and efficiency.

Egypt's exposure to the international oil market makes it even more important to consider the opportunity costs of crude oil and products in all relevant economic decisions.

The International Gas Market

The structure and characteristics of the gas and oil markets are different in many respects. The international price of gas does not involve clear references, as WTI or Brent for oil. Gas prices are

determined in two different ways. The first is through pricing formulae in long-term contracts, and the second is through spot prices. In the petroleum market the buyers are basically price takers. They may enjoy a bit of leeway when bargaining with the seller over the values to be attached to the parameters of the pricing formulae. In a slack market the seller may offer small discounts; in a very tight market the buyer may offer a premium. But the broad picture is one in which the price of every crude oil variety, considering location and destination, is more or less a given.

Pricing formulae in long-term contracts, which determine the price at which gas will be purchased/sold at different points in time, tend to differ from one contract to another. The variations are due to a host of factors such as when the contract was negotiated and signed, and more importantly the balance of bargaining power of the buyer and the seller.

The spot prices of LNG cargoes tend to vary significantly between transactions undertaken in the same period of time. There, again, relative bargaining powers seems to play a significant role.

For crude oil and petroleum products Egypt imports and exports at fairly transparent, given, market prices. For gas exports, Egypt is neither a price taker nor a price maker (in the conventional sense of an entity endowed with the power to influence the setting of the world market prices). The price at which it will export gas is determined by negotiations. Thus, Egypt is a price bargainer in the context of bilateral deals insofar as gas exports are concerned.

The outcome of bargaining may be reasonably fair to both parties or may favor one at the expense of the other. It may involve trade-offs between a number of objectives, trade-offs that are often difficult to evaluate. A party may make concessions on prices because it attempts to fulfill other objectives. The buyer, for example, sometimes offers more than a normal commercial transaction would warrant in order to create goodwill and improve the chances of accessing the country's gas reserves in the future. In a similar way, a seller may accept a lower price than warranted in order to enter the international gas market and overcome the problems that a newcomer may encounter, or to signal to potential investors that the country's objective is to increase gas production and that it requires their contribution. One can multiply these examples.

The empirical question, the answer to which is likely to vary from case to case, is whether the price concession is fully justified by the benefits expected to arise on other scores.

The fundamental issue remains that of bargaining power. Egypt is a developing country which means, among many things, that there is a desire for foreign exchange earnings, a strong motivation to attract foreign investors for the exploration, development and production of hydrocarbon resources. However, Egypt suffers from insufficient access to information and relevant knowledge about the geophysics of the country, a lack of foreign investors to build the trains and other facilities for LNG exports and other capital intensive installations, and some vulnerability because of pressure from outside interests. In addition, the subsidy burden weakens Egypt's bargaining power in gas export negotiations due to the strong desire to escape from the heavily-subsidized domestic market.

It would be wrong, however, to believe that the foreign investor has superior bargaining power in this context. Oil companies need access to hydrocarbon reserves and have difficulty trying to enter the market in many countries. They want to play a role in the expanding gas market. They need Egypt in the same way as Egypt needs them.

V. THE GAS EXPORT ISSUE

Let us now turn to the complex and contentious gas export issue, and the questions that need to be addressed. The first question relates to the factors that motivated the decision to promote exports. From the oil companies' perspective, the export option was attractive, particularly for companies such as BG, BP and ENI who discovered new reserves especially in the Mediterranean or close to it. Exporting would enable them to rapidly accrue sales revenues and to benefit from demand growth.

In Europe and the United States where spot prices were rising rapidly, the option to supply the domestic market was much less attractive. Expansion was constrained by the development of the domestic pipeline infrastructure, which EGPC was reluctant to undertake, and because payments

for gas sales agreements to EGPC/EGAS involved capped prices and delays due to the cash flow problems of these national oil companies.

Egypt, on the other hand, was keen to promote exports for a number of reasons. First, it saw an expanding gas market developing in the Mediterranean and elsewhere and wanted to enter it. Secondly, developing the infrastructure for domestic gas consumption required EGPC investments, while the LNG plants needed to export gas would be largely financed by foreign investors. Thirdly, the devaluation of the Egyptian pound relative to the dollar created an incentive to export. Fourthly, the subsidy burden on EGPC would be reduced if gas domestic consumption was restrained.⁵ And, petroleum products are also subsidized. Fifthly, as gas exports are an attractive option to foreign investors, Egypt hopes that this will encourage them to enter into upstream deals. Developing gas resources and thus increasing production is a major objective of the country's energy policy.

This raises the next questions. Are Egypt's gas reserves sufficient to meet future domestic demand if large volumes of gas are now committed, and then increasingly committed, to the export market? And was the decision to export based on a full economic appraisal taking into account the opportunity costs of natural gas and the petroleum products it would displace in domestic consumption?

It is difficult to answer the first question largely because reserve estimates are never accurate. They often underestimate the volumes available but they are also sometimes inflated to suit particular interests. Furthermore, the growth of domestic consumption can always be restrained by failing to invest in the required infrastructure. This would be disastrous should the net economic gains prove to be in favor of the domestic option.

We may form some idea as to whether Egypt's reserves can sustain growth in domestic consumption and export commitments on the basis of some calculations, however, they involve debatable assumptions.

⁵ This argument, however, is not convincing because the consumption of petroleum products will rise when incremental gas supplies are diverted to exports.

For example, let us assume that the 66.5 Tcf estimate is correct but includes allowances for reserve growth. Domestic consumption, unless restrained, would grow at 5 percent per year. Gas exports will utilize 70 percent of the capacity of the Arab pipeline with the three existing LNG trains and three additional trains. Based on these assumptions the call on reserves would be of the order of 65-68 Tcf over a 20-year period.

The conclusion is that the reliability of reserves estimates is critical to whether Egypt can sustain the assumed levels of demand growth and export expansion.

The final question is: Are the contracts relating to the production of gas in fields dedicated to exports, as well as in other fields, and to the sale of Egyptian gas to LNG plants fair to Egypt in today's circumstances? The situation today is significantly different from that at the time the agreements were signed.

On the production side, gas PSAs have the same structure as oil PSAs. The investor carries the exploration risks and is not compensated for exploration expenditures if no gas is found. If the field is declared commercial the investor is entitled to take gas for cost recovery at the rate of x percent per year including 25 percent of exploration costs and 25 percent of development costs plus operational costs. The proportion " x " sets an annual ceiling as to the volume the investor can take. The remaining gas, that is $1 - x$ percent is treated as profit oil of which EGPC is entitled to proportion " a " and the contractor to proportion " b ." Thus,

$$x + (a + b) (1 - x) = 1$$

" x " is usually set at 40 percent although this parameter is subject to bids and negotiations. The a/b shares of profit oil depend on the production volume, also on bids and negotiations. In oil contracts, a/b are usually set for " a " at 70-80 percent and " b " at 30-20 percent. The lowest EGPC share is for production of less than 25,000 bpd and the highest for production in excess of 50,000 bpd.

In some of the recent bids for gas fields (perhaps because of the higher costs of offshore productions) an a/b split of 60/40 percent has been agreed, though it is less favorable to EGPC.

Law no. 9/2002 set the cost recovery ceiling “x” at 40 percent if gas is used for the domestic market or at 30 percent if gas is to be exported. This implies that the investor is considered to be better off exporting the gas than supplying it domestically, and can therefore afford to wait a bit longer in recovering costs when exports instead of domestic supplies are involved.

Finally, the gas sales agreements between EGPC and the investor have a formula that determines the price at which EGPC would acquire gas from the investor. This formula has changed from time to time. The latest relates the price of gas to the Brent price, but involves an S curve as a floor and a ceiling. The ceiling is set at \$2.65 MBtu for Brent prices equal to or higher than \$20/bbl, and the floor at \$1.50 MBtu when the Brent price falls to \$10/bbl or less. This arrangement favors Egypt at a time when Brent prices are very high and unlikely to fall to \$10/bbl.

It is odd, however, to link the gas price to Brent although this is an old tradition. Logically, gas prices should relate to some gas reference in the international market. Reliable references do not yet exist because gas markets are still regionally segmented and the spot trade is still thin. Arbitrage between regions is still weak. Sometime in the future, when the gas market expands significantly, gas-to-gas pricing formulae should evolve. However, the gas pricing reference should not be based on futures markets to avoid the problems that characterize the oil market.

There are EGPC supply contracts to Union Fenosa and Jordan. The prices are not published. It is said that the price to Union Fenosa is low. The highest number mentioned by observers of the Egyptian gas scene is \$0.90 MBtu. Lower numbers, such as \$0.65 MBtu are sometimes quoted. This is the price at the point of entry to the LNG plant. If these numbers are gross underestimates EGPC/EGAS would be wise to publish the true figures in order to set the record straight.

It is true that in compensation for the low selling price EGPC/EGAS has provided some advantages such as delayed paying of their equity share in the LNG plant and the right to use up to 50 percent of the facility for their own exports under a tolling agreement. But what is the value of these advantages compared to the assumed loss on every Btu sold?

The sale price to Jordan is said to be set at \$1.50 MBtu which is a more reasonable number. Yet one needs to keep in mind that Egypt purchases gas at the margin from foreign investors at \$2.50/2.65 MBtu. To say that it gets 60-70 percent profit oil at zero price and that the average cost of acquisition is therefore much lower than \$2.65 is the wrong argument. As discussed previously, in the case of oil the equity oil is a rent for the state not necessarily a fund to subsidize domestic consumption or exports.

It is interesting to note a peculiarity in the agreement with BG for the development of gas fields dedicated to exports. There is a clause stating that if the netback revenue falls below the price at which the gas would be sold to EGPC for domestic use, EGPC would compensate the investor for the difference. Given that the investor was keen on the export option, the notion that he should be compensated whenever the domestic market becomes more attractive simply means that, as the English saying puts it, 'he wants to have his cake and eat it too.'

It is important to keep in mind some important facts. The first is that Egypt's export performance, in certain respects, is remarkable. Egypt entered the world gas market at a time of expansion, before other potential Mediterranean suppliers, and now has a share in it. The construction of the LNG trains was completed in record time. Furthermore, as mentioned earlier, the marketing of spot cargos has been competent.

We also have to allow for the factors that may have influenced the negotiations of the initial contracts—a multiplicity of objectives which were to be achieved all at the same time. Hence, perhaps, certain concessions on prices were made which may not have been the case given other circumstances.

Circumstances have changed. The information available suggests that all the contracts relating to the export of gas should be now re-opened and re-negotiated. This is possible whatever the precise re-opening clauses state. The fact that Egypt sells at a much lower price than that at which it purchases gas is sufficiently explosive to justify re-negotiation. The foreign companies involved in the contracts would be unwise to oppose a re-opening. Contracts are a formal framework for a

relationship. It is the relationship that matters, and it will only work to the benefit of both parties if it is continually perceived as fair by both of them.

Now that significant investments have been made in three LNG trains and in a pipeline to Jordan, and since these decisions cannot be reversed, it is crucial to postpone building new LNG trains until thorough studies are undertaken by independent consultants. Studies must be conducted on the size of the gas reserves (proven, probable and possible) and on the true opportunity costs of the domestic and export options. It is not enough to be reassured that the reserves are ample. This is a necessary, not a sufficient, condition. The second necessary condition is that the disposal of gas between the domestic and the international market must maximize the true economic benefits to the country. Whether this second necessary condition is satisfied cannot be ascertained today as the detailed research does not seem to have been undertaken.

VI. CONCLUSIONS

Egypt cannot afford to ignore the need to make some difficult decisions regarding its energy sector. Energy is of crucial importance for economic development for obvious reasons: It is a critical input of both agricultural and industrial production. Modern transport cannot function without oil in most instances and gas in some cases. Energy is fundamental to the welfare of populations even in its most humble applications such as cooking, washing and lighting.

Energy, of course, has to be affordable but not so cheap as to result in waste or because of subsidies indiscriminately given to rich and poor as to inflict on the government a crippling budgetary burden. Investments in energy—power stations, gas liquefaction plants, pipelines, refineries, storage, exploration and development for oil and gas—are very capital intensive and require huge amounts of scarce resources. Investment projects and all decisions relating to investments such as the terms of agreements with foreign entities require rigorous assessments of costs and benefits to the economy, that is, of true opportunity costs.

A number of policy recommendations are suggested in this paper. To restate them here will duplicate large parts of my arguments because a policy cannot be separated from the analysis that

justifies it. The main message is perhaps what matters most. Simply put, the onus is on the government to address Egypt's energy issues with the greatest intellectual rigor possible; to show courage in dealing with both foreign investors, domestic constituencies and the variety stakeholders in the energy field; and finally, to seek imaginative solutions to reconcile the important objectives of supporting the poor while ensuring a more efficient allocation of resources.

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PART II: DISCUSSION

EGYPT'S OIL AND GAS: SOME CRITICAL ISSUES

Participants in the discussion that followed Robert Mabro's presentation included Cyrus Sassanpour, Senior Resident Representative, International Monetary Fund; Galal El Zorba, ECES Chairman and Chairman, Nile Clothing Co.; Hany Soliman, First Undersecretary for Gas Affairs, Ministry of Petroleum, Egypt; Hesham Mekkawy, Managing Director, BP Egypt and member of ECES; Magda Shahin, Director, Trade Related Assistance Center, American Chamber of Commerce in Egypt; Sherif Ismail, Chairman, Egyptian Natural Gas Holding Co. (EGAS); and Tarek Selim, Assistant Professor of Economics, American University in Cairo. The following is a summary of the discussion.

Moderator: Thank you, Prof. Mabro. I'd like to begin by asking a question about reserves. You discussed figures for international reserves, but how accurate are these figures? Are true figures above or below these levels?

My second question is what could make oil prices reach \$100/bbl? And what is the relationship between increases in oil prices and increases in gas prices? Are they correlated in any way?

Speaker: Published data concerning figures on oil and gas reserves are what I would call metaphysical. One cannot consider them accurate according to any concept or definition. Why? Because there is no unified or worldwide definition of reserves. The US Geological Survey (USGS), the US Security and Exchange Commission (SEC), oil companies, and the Organization of the Petroleum Exporting Countries (OPEC) all have different definitions of reserves. This creates problems when comparing data between countries.

Another problem regarding accurate figures is that reserves are underground reserves. According to petroleum economists, we cannot know the full reserves of a certain petroleum field

until it has been completely drained. In addition, there is a concept known as reserve growth. For example, if a petroleum field is estimated at one point to contain 1000 barrels and we extract 300 barrels later reserve estimates could go up to 1200 barrels. This can be explained by the fact that in the process of drilling for oil, we were able to collect new information and reassess the amount of full reserves. Reserve growth usually occurs within the first few years of drilling.

There is also the issue of corporate policies. In the early 1970s, oil companies used to underreport the amount of oil they discovered in the North Sea in order to avoid paying high taxes. Now, oil companies are more concerned about their shareholders, who would not like it if a company says there is no oil. OPEC also negotiates production quotas and it is in their interest to report large reserves. Therefore, I never rely on published data.

Regarding the second question about oil prices reaching \$100/bbl, economists say that in a competitive market the selling price should equal the production cost (marginal cost), which means the price should be between \$10-20/bbl. As an economist, I would say that crude oil prices should range between \$12 and \$40/bbl, the first number representing the competitive cost floor and the second the cost of substitutes. The big gap between these two numbers leaves room for significant price fluctuations

In addition to economics, fiscal and political factors such as the security of supply and political lobbies also influence oil prices. For example, if prices are low, demand will increase, which means more reliance on Arab countries for oil which is not acceptable to the United States in particular. In 1998, when prices of crude oil dropped to \$8/bbl, many interested parties, not only OPEC, were disturbed. Nobody has an interest in very low oil prices. But what about a price of \$100 or 120/bbl?

Suppose for example, that a political bouleversement occurs in Saudi Arabia although this is unlikely. Oil prices then could reach as high as \$120/bbl, but I believe this would last for just a week or so. Likewise, if Iran decides to stop producing oil—which I don't think they will—prices could well reach \$100/bbl, but again a situation like this would not last for long.

Participant: In light of these price fluctuations, is there any possibility that international standards could be adopted for managing oil prices? I believe the WTO suggested that petrol could be among the commodities that the organization can negotiate. I would like to know your opinion regarding this matter.

Speaker: Oil prices, until 1973, were determined by companies in international markets. They called it the posted price, but this was not the selling price. Starting in 1973, OPEC determined prices, and from 1973-1985 it met every three or six months to determine the price for the Arabian Light. Starting in 1985, OPEC could not determine oil prices because there was tough competition from the North Sea, Alaska, and Mexico, this caused a problem and prices fell to \$8/bbl. So how are prices determined? The prevailing ideology at that time was to leave everything to the market, but this raises a question as to which market. There must be a market for petrol. As I said at the beginning of my presentation, the futures market in which oil prices are determined is a financial market rather than a commodity market. It is true that prices are influenced by the commodity but there are other factors that influence the final price too. As we've seen, dealers in such a market don't care about the commodity itself; rather they're interested in price differences from one month to the next. Most of the large oil companies, except Exxon, engage in the futures market, and make suitable profits from their trading. In short, no stakeholder has an interest in changing the current system, each for their own reasons.

Participant: Despite the fact that Egypt only recently entered the gas export market, exports have totaled approximately \$700-800 million. What is your vision regarding gas prices and Egypt's export potential in the future?

Speaker: World demand for gas is increasing at a higher rate than that for oil. At the same time, however, the number of countries producing gas is increasing. I believe we have been experiencing a period where the increase in demand has exceeded increases in production and exploration.

Currently, there are a lot of exploration projects all over the world which will boost gas production in the next two or three years. Therefore, price fluctuations are possible. I think one should not only rely on spot market prices, but should also guarantee the future through long-term contracts. It's a difficult balance.

Participant: I have a few comments and a question. Within the petroleum sector, we have a number of objectives that largely overlap with the government's general objectives including increasing reserves; increasing production in order to satisfy domestic market needs, and enhancing development; improving returns in order to be capable of covering the costs of exploration and production; and attracting international investments in the areas of exploration, as well as oil and gas production.

Today, Egypt has 67.5 Tcf of oil reserves because international companies have intensified their exploration activities. Moreover, Egypt's production is approximately 5900 mcf/d, part of which is exported, and the rest is allocated for domestic market consumption.

The amount of gas sold is 5600-5700 mcf, and according to your presentation the domestic market needs amounted to about 2500 mcf in 2004. This year, the need of the domestic market increased to 3600 mcf. I would like to make a point that this huge increase took place within just two years and was caused by the domestic market's need to cover electricity costs, the costs of running "fertilizer factories" and so on.

The issue of subsidies must be taken into consideration, as it reached LE 40 billion this year. How would the petroleum sector tolerate the burden of subsidies knowing that the current domestic prices do not cover the costs incurred? In light of this, there must be another resource that would generate returns to cover all the costs of production so that the cycle wouldn't stop.

My last comment is on domestic demand. We should differentiate between two types of demand in the local market. First, there is demand based on essential or basic needs (e.g., electricity generation, extending natural gas to reach all regions in Egypt). Second, there are other non-basic needs such as the manufacturing of fertilizers. Hence, it is important to rationalize

domestic demand, because it might be much more rewarding to export natural gas rather than to expand Egypt's fertilizer industry.

Participant: One might say that the primary driver of higher oil prices is the increasing cost of production due to the rising price of inputs, rigs and so on. What will happen if oil prices decrease while the cost of production remains high?

Speaker: I agree with you that the cost of production has definitely increased. However, the total production costs have not increased at the same rate as that of oil prices. This explains why the companies in business are still making huge profits.

Participant: I disagree to some extent with what Dr. Mabro just said about the rate of increase in the cost of production, because the price of some inputs has increased much faster than that of oil. For example, the price of rigs quadrupled in the last two years. Moreover, it takes two or three years to buy the rig, which further adversely affects project costs.

I would also like to comment on the issue of human resources, as it poses a challenge to the industry all over the world.

Speaker: Some input costs have indeed increased, sometimes significantly more than the price of oil, but this does not mean that total costs have risen faster than the price of oil. You are right however about the human resources problem, but this was partly due to companies downsizing too much in the 1980s and 1990s

Participant: I have three questions. Will potential reserves in Egypt be able to cover domestic consumption in the coming 20-30 years given the likely increase in domestic demand? Will there be excess reserves for exporting? And what can be done to enhance investments and exporting?

As an investor in Egypt, a foreign partner, and a representative of a company that has been in the Egyptian market for more than 40 years, I would like to share with you our experience with gas

exports. Our activities during all these years were mainly concentrated on oil, but we will work in the field of gas more extensively in the coming years. In the late 1990s a decision was made to export gas, before which our production of gas was very limited as the local market was quite small. Since the decision was made to export gas investments have boomed and explorations in turn, have increased.

Speaker: My view is that Egypt's gas reserves will initially support a moderate export volume and the required growth in domestic consumption. Whether that will be the case after 10 years or more requires very extensive research. As regards the incentives to investment, I think that what is provided today is sufficient and in some cases is more than necessary. Finally, it is important to note that every company makes different decisions about investing in Egypt and when in Egypt whether or not to favor exports of gas is based on a company's circumstances, its position and so on.

Participant: When discussing reasons why oil prices have tripled over the last five years, you mentioned a number of factors including supply uncertainties in Iran and Nigeria and corporate conspiracies, but the issue of demand was practically ignored. I agree that the rise in oil prices reflects all the issues you mentioned, but why are you downplaying the element of demand which seems more significant? For example, China is buying spare capacity in Africa and Asia, and so on.

Also, at what level do you consider oil prices to be high? If we look at today's prices in real value they're probably around the same level as they were back in the 1970s, which to some extent was responsible for the recession at that time. Is it possible that we're entering that danger zone? We talked about how oil prices might rise to \$100/bbl. Do you think this will lead to a weakened world economy? If there is an international recession, Egypt would be affected in many ways even though we're a price-taker in the oil market. Although there is no indication that oil prices have

affected the world economy, the counterview is what would have happened if oil prices had remained at \$30-40/bbl?

Speaker: The fact that I did not mention China does not mean that I underestimate the pressure it places on demand. However, considering China's huge population, its demand has not increased spectacularly. In fact, its per capita consumption of energy is minute compared to that of the United States.

Concerning oil prices, I agree with you that it will affect the world economy. Of course there are other extreme views that say that the transmission mechanism between oil prices and economies is broken. But as I said, this is an extreme view.

The fact is that small developing countries will suffer the most, and they are not heard, whereas the United States, which consumes 25 percent of oil production worldwide, refuses to make any reforms. The bottom-line is that, yes, I believe that these high prices will eventually affect the world economy, but there is no mechanism to bring the prices down.

Participant: I would like Prof. Mabro's opinion concerning two main subjects: Egypt's exporting policy and subsidy policy. When talking about increasing oil prices, I would like to note that proven reserves of natural gas around the world are much higher than proven reserves of oil. Therefore, economists predict that the price of oil will probably continue rising while that of natural gas may remain stable. Therefore, from an economic point of view, Egypt would be better off exporting oil and using natural gas for domestic consumption. What do you think of switching from subsidizing petroleum for domestic purposes to using natural gas?

This leads us to the subsidy policy. According to the latest statistics by the American Chamber of Commerce in Egypt, the government is apprehensive about taking steps towards reducing or eliminating subsidies due to a possible 7 or 8 percent increase in inflation, in addition to the extra

burden that will be placed on Egyptians. I would like to know your thoughts regarding the issue of subsidies.

Speaker: I never said subsidies should be eliminated. What I meant is that it is wrong to take them as a given. We could get around this problem in different ways. For example, high taxes could be levied on luxury cars, so that subsidies would be directed to those who really need them.

Moderator: I would like to thank Prof. Mabro for his presentation as well as the participants for their questions and comments.

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Distinguished Lecture Series

Energy is of crucial importance for economic development and, as Prof. Robert Mabro discusses in this *distinguished lecture*, Egypt's energy concerns are sufficiently serious to warrant the government's full attention. He argues that decisions need to be made regarding energy subsidies, gas export strategies, and Egypt's role in international oil and gas markets. As such, Prof. Mabro recommends reassessing energy subsidies so that they ease the fiscal burden on the government, reduce distribution and allocation distortions, and generate revenue. He also advocates renegotiating gas export contracts to close the gap between purchase and sale prices, and promoting energy efficiency measures that reduce fuel consumption without affecting economic development such as energy audits and alternative sources of energy.

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