Egypt

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SUBJECT: Energy Price Distortions

TO:

Introduction

Development analysts in Egypt are well aware that energy prices are badly distorted through an assortment of subsidies and price ceilings which together cause an inefficient allocation of resources and exacerbate balance of payments problems. USAID and other donor organizations have made gradual movement toward international price equivalents for energy a major focus of policy reform - but for reform to be meaningful an operational measure of gradual movement must be adopted. This memo briefly describes a measure of energy price distortions and provides empirical evidence of the degree of distortion, both by energy source, and for all energy sources combined.

Measuring Energy Price Distortions

A simple, but descriptive measure of the overall energy price distortion can be given by the Energy Price Criterion (EPC):[1/]

$$EPC_t = 1 - \frac{\sum_i (PE_{it} - PF_{it}) Vol_{it}}{\sum_i PE_{it} \; Vol_{it}}$$

1/The EPC was proposed by Jerry LaPittus in a memo dated June 7, 1982.

Where PE_{it} is the economic price of energy source i at time period t, PF_{it} is the financial (or domestic) price of the corresponding energy sources, and Vol_{it} is consumption of the energy sources. EPC is the share of the international value of the energy consumed in Egypt which is paid domestically. That is, EPC is expenditures for energy consumed in Egypt divided by the international value of the energy. EPC can assume values between 0 and 1 with higher values indicating that domestic prices are nearer to international prices and therefore that the distortions are lower.

EPC is useful because it allows all energy prices to be combined into one measure of price distortions. Targets for improvements in energy pricing can be stated in terms of EPC and performance in meeting the targets can be quantitatively measured. One caution is that it measures average relationship to efficiency prices for all energy sources rather than performance for each source. Thus, an EPC of one could be consistent with some energy prices above efficiency levels and some below efficiency with none at the international price; a situation that may lead to no better allocative efficiency than at present. Thus, analysis of individual source price performance is also necessary. Another caution is that improvements (or worsening) in the EPC can result from explicit policy decisions of the GOE or from movements in international prices or domestic energy consumption mixes with no shift in policy intended. The reason for movements in EPC can be more important for long term implications that the movements themselves, because the ratio may rise as international prices take a short term dip, but with no policy intention the ratio will fall again as international prices revert to increasing.

Energy Price Distortions

EPC was calculated for four years to demonstrate the level and recent trend in the ratio (table 1). Consumption (given in Appendix Tables 1 and 2) was measured by BTU equivalent energy values for each energy source. Energy sources included in the ratio are butane gas, gasoline and naptha, kerosene and jet fuel, diesel fuel, mazout, natural gas, and electricity.

TABLE 1
Energy Price Criterion Estimates

	YEAR[1]	EPC[2]
A	CY 1978	.185
B	CY 1979	.173
C	FY 1981	.172
D	FY 1982	.200

1/Calendar years are used for 1978 and 1979 and fiscal years for 1981 (July 1980 - June 1981) and 1982 because the reporting period was changed.

2/Energy consumption is included whether the energy is employed in its final use or as an input in production of another energy source, as mazout is used to produce electricity. In one sense this double counts energy sources but this procedure is used because the price distortions arise both in input use and final use.

International and domestic prices are reported in Appendix Table 3. Electricity and natural gas are more difficult than the petroleum products to include in the analysis because the international prices are not directly obtainable. The international shadow price for electricity is calculated by finding the expected average cost of producing electricity in the nearly completed Ismalia Thermal Power Plant Units 1 and 2. The international price of mazout is used in the calculation leading to an average cost of 58.8 millims per KWH for 1982[2/]. The World Bank approximated the international price of natural gas by using the international price for the exportable good for which it substitutes, mazout. That assumption is adopted here.

The EPC fails to rise above 0.20 for any of the four years meaning that domestic payment for energy consumed is about one-fifth of its international value (opportunity cost). Domestic energy payments during FY 1982, for example, were approximately L.E. 700 million. The international value of the the same energy was over LE 3,500 million meaning the implicit subsidy to energy was more than LE 2,800 million.

Year to year variations in the EPC must be interpreted with caution. Between 1978 and 1979, EPC declined as international prices rose while the only

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2/ Following the work from the Ismalia Power Plant Project Paper, an exchange rate of L.E. .7 = $1.00 is used.

domestic changes were small increases in gasoline and electricity. Gasoline, kerosene, diesel fuel, and electricity prices rose over th 1979 to FY 1981 time period, but EPC declined in the light of large international price increases. During the FY 1981 to fY 1982 time period, the EPC rose, but no domestic prices were increased and the rise is solely the result of lower international prices. Thus, the last year jump in the EPC is the result of a temporary drop in prices and fails to reflect policy decisions by the GOE.

Price Distortions by Energy Source

The variation in price distortions across energy sources must also be examined. Calculation of the EPC for each energy source reveals that the ratios vary from .065 for mazout to .765 for gasoline (Table 2). An important factor to observe is that consumption is growing most rapidly for natural gas where the distortion is worse than average. Continuation of rapid growth in consumption of natural gas, therefore, would mean the overall EPC would be expected to decline and overall distortions become worse.

TABLE 2
1982 Source Specific Energy Price Criteria

Source	Energy Price Criteria
Butane Gas	.199
Gasoline	.765
Kerosene	.151
Diesel Fuel	.147
Mazout	.065
Natural Gas	.095
Electricity	.180

Sensitivity Analysis

The question arises of how sensitive the all sources EPC is to increases in energy prices. Sensitivity is analyzed using FY 1982 as the base case (Table 3). Some lessons include the following:

Table 3
Sensitivity Analysis1/

Case	Energy Performance Criteria
A. Base Case	.200
B. 10 percent increase in all prices	.220
C. Double electric prices	.254
D. Electric prices to international	.449
E. Mazout prices to international	.372
F. Gasoline to international	.223
G. Butane to international	.226
H. Two Piastre increase in gasoline enacted 7/6/82	.214

1/ Consumption is assumed to remain constant as prices increase. Because consumption patterns would be altered if prices were increased, the sensitivities shown here represent upper bounds on the actual response.

A ten percent increase in domestic prices, with international prices held constant, only increases the ratio from .200 to .220.. Increases to international price levels for major energy sources such as mazout or expensive energy sources such as electricity cause large increases in the EPC. Increases for fuel sources such as butane have little impact on the EPC because consumption is a small share of the total energy consumption. Movement to international price for gasoline has relatively little impact on the EPC because, although it's a large source, the price is relatively

close to the international price. This is exhibited again in the case where gasoline price is increased two piastres. Finally, the price increase for a single energy source must be very large to significantly increase the EPC. This is evidenced by the small change in EPC resulting from a doubling of electricity prices.

Sensitivity of the Electric EPC

Small changes in electricity prices have little impact on the all sources EPC but will, of course, have greater effects on the electric price EPC. If policy dialogue between USAID and the GOE focuses on each individual source rather than all sources simultaneously, the EPC for each source is more important.

Electricity prices were recently increased for residential, commercial, other non-industrial medium and low voltage users, and irrigation and drainage high voltage consumption (Appendix Table 5). The increases tended to be greatest for the highest blocks of consumption, which has the effect of marginally discouraging consumption.

The Egyptian Electricity Authority (EEA) has estimated that the rate increase will yield EEA LE 8 million during FY 1983. A rate increase of a comparable magnitude during FY 1982 would yield EEA approximately LE 6.84 million. EEA provides power to seven distribution companies that receive approximately 27 percent more revenue than EEA. Thus, the rate increases would have cost

consumers nearly LE 8.7 million if enacted for FY 1982. This would have little impact on the all sources EPC for FY 1982. Even the EPC for electricity is only increased from .18 to .19 with these rate increases.

Rate increases for public sector and private sector high voltage industrial users are currently under study by the GOE. These users consume about 60 percent of electricity, with the Kima Company and Nag Hammady Aluminum Complex alone accounting for 27 percent of total consumption. These sectors have very low tariffs. For example, Kima payed an average 3.4 millim per kwh and Nag Hammady 2.6 millims per kwh (during 1978) compared with consumer rates that vary between 16 and 21.6 millions. No rate increases for these high voltage users have occurred since 1975.

The low rates and large consumption in these sectors make rate increases here a necessity for achieving gradual movement towards international prices. Adoption of one set of recommendations for rate increases made by EEA would have a total cost to industrial firms of around LE 9 million. This would raise prices to where electricity would be priced at about one fifth of its production value, if no international price increases occur.

APPENDIX TABLE 1

ENERGY CONSUMPTION[1]
(Consumption in 000 MT)

SOURCE	CY 1978	CY 1979	FY 1981	FY 1982
Butane Gas	296	338	368	435
Gasoline[2]	981	1,078	1,285	1,460
Kerosene[3]	1,571	1,695	1,760	1,910
Diesel Fuel	1,861	2,123	2,830	2,899
Mazout[4]	4,436	4,971	5,424	5,572
Natural Gas	583	863	1,870	2,500
Electricity (10^8KWH)	130.68	138.25	156.42	183.01[5]

1/Consumption of petroleum fuels is measured by production plus imports minus exports. Actual consumption will differ from the values reported here to the extent that year end inventories varied across the years.

2/Naptha accounts for 1-1.5 percent.

3/Jet fuel accounts for about 15 percent.

4/Solar is approximately 28 percent.

5/Estimated assuming 17 percent growth; the approximate average for 1975-1980.

Sources: Consumption and prices for energy sources other than electricity were taken from the IMF series "Arab Republic of Egypt - Recent Economic Developments," 1979, 1980, 1981 and 1982. Electricity consumption and revenues and natural gas price was provided by the Ministry of Planning.

APPENDIX TABLE 2

(Energy Consumption in BTU Equivalents)1/

(Consumption (x 10^{13}

SOURCE	CY 1978	CY 1979	FY 1981	FY 1982
Butane Gas	1,321	1,510	1,643	1,943
Gasoline	4,296	4,721	5,628	6,395
Kerosene	6,586	7,107	7,380	8,008
Diesel Fuel	7,879	8,988	11,982	12,274
Mazout	17,600	19,720	21,522	22,510
Natural Gas	2,571	3,854	8,249	11,028
Electricity	4,439	4,718	5,339	6,246

1/Energy consumption was converted from volumes to BTU's using the following conversion factors.

Butane gas	1 MT	=	4.466	x	10^7	BTU
Gasoline	1 MT	=	4.380	x	10^7	BTU
Kerosene	1 MT	=	4.193	x	10^7	BTU
Diesel Fuel	1 MT	=	4.234	x	10^7	BTU
Mazout	1 MT	=	3.968	x	10^7	BTU
Natural Gas	1 MT	=	4.411	x	10^7	BTU
Electricity	1 KWH	=	3413 BTU			

APPENDIX TABLE 3

ENERGY PRICES IN L.E.1/

SOURCE	CY 1978	CY 1979	FY 1981	FY 1982
Butane Gas (12 1/2 Kg) Cylinder	.65	.65	.65	.65
Gasoline, Premium (liter)	.08	.11	.13	.127
Kerosene (liter)	.025	.025	.03	.029
Diesel Fuel (liter)	.021	.021	.026	.0245
Mazout (MT)	7.5	7.5	7.5	7.5
Natural Gas (MT)	7.5	8.7	10.35	11.00 3/
Electricity (KWH)	.0093	.0097	.0106	.0106 4/

INTERNATIONAL PRICES

Butane Gas	3.809	3.95	2.85	3.27
Gasoline	.207	.207	.18	.166
Kerosene	.131	.223	.187	.191
Diesel Fuel	.159	.204	.180	.167
Mazout	86.69	105.0	152.25	115.24
Natural Gas	86.69	105.0	152.25	115.24
Electricity 5/	.0487	.0500	.0761	.0588

1/ Exchange rate L.E. .7 = U.S.$1.00

2/ Average electricity prices increase because residents and commercial users face upward block pricing structures so that rising consumption increases the average effective price.

3/ Only 1979 and 1981 data were available. Other values are estimated.

4/ Assumed to be the same as the previous year.

5/ Estimated as the cost of production at the Ismalia Thermal Power Plant when mazout is priced at the international level.

APPENDIX 4

INDUSTRIAL ELECTRICITY PRICES

A. High Tension consumers

Very high tension fed from 132 K.V. and higher (220 K.V.) at 5.072 millimes/K.W.H.

High tension fed from 33 and 66 K.V. at 6.464 millimes/K.W.H.

B. Medium voltage consumers contracting for more than 500 K.W.

1. Fixed annual demand charge based on K.W. contracting for or more if measured demand exceeds contract amount:

   L.E. 5.620 K.W.

2. Energy charge annual basis.

   Step 1 : first 1,000 hours use of contract k.w. at 10.103 millimes/K.W.H.

   Step 2 : Next 500 hours use of contract k.w. at 9.503 millimes/K.W.H.

   Step 3 : Next 1,000 hourse use of contract k.w. at 8.303 millimes/K.W.H.

   Step 4 : Next 1,000 hours use of contract K.W. at 7.103 millimes/K.W.H.

   Step 5 : Next 1,500 hours use of contract K.W. at 5.403 millimes/K.W.H.

   Step 6 : Excess over 4.603 millimes/K.W.H.

C. Medium & Low voltage consumers contracting for 500 K.W. or Lower.

Annual energy charge:

Step 1 : First 70,000 K.W.H. at 20.347 m/K.W.H.
Step 2 : Next 100,000 K.W.H. at 16.647 m/K.W.H.
Step 3 : Excess over _____ at 15.847 m/K.W.H.

ELECTRIC TARIFF RATES

APPLIED TO INVESTMENT PROJECTS IN FREE ZONES

TENSION	ANNUAL DEMAND CHARGE	RATE
	L.E./K.W.	Millime/K.W.H.
Very High	15.290	8.150 + A
High	16.000	9.465 + A
Medium:		
Power more than 500 K.W.	24.230	12.470 + A
Power of 500 K.W. or More	6.000	15.940 + A
Lower	-	23.150 + A

A = The effect of the difference between the international price and the local price of Mazout (7.5 L.E.) on every K.W.H. as follows:

Every L.E. of the difference between the two prices adds:

0.38 Millime/K.W.H. on very high and high tensions

0.40 Millime/K.W.H. on medium tensions

0.42 Millime/K.W.H. on low tensions.

APPENDIX TABLE 5

RATE INCREASES APRIL 1982

Block	Increase percent
First: Residential Consumption	
a- Up to 100 K.W.h	no change
b- From 101 to 250 K.W.h	10%
c- More than 250 K.W.h	20%
Second: Commercial Consumption (shops, offices, clinics, ...etc.)	
a- Up to 75 K.W.h	no change
b- From 76 to 100 K.W.h	5%
c- From 101 to 250 K.W.h	10%
d- More than 250 K.W.h	20%

Third: Medium & low voltage Consumption for non-residential, shops, moving power, general lighting, water supply & sewage, government institutions, housing companies ...etc an increase of 10%

Fourth: Irrigation and drainage high voltage Consumption:

An increase of 5%