FEMISE RESEARCH PROGRAMME

Estimates of Total Factor Productivity and Capital Stock for 3-digit ISIC Manufacturing Sectors in Iran and Egypt

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Estimates of Capital Stock for 3-digit ISIC Manufacturing Sector in Egypt: 1964-1995*.

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1. Background

This paper, which is the first part of a two-stage project, deals with developing a databank for capital stock at 3-digit ISIC levels for the manufacturing industries in select countries of the Middle East and North Africa (MENA), notably Egypt and Iran covering the period 1964-95 for Egypt and 1983-97 for Iran. Calculations are based both upon the UNIDO country data as well as local (in-country) data. The second stage involves utilizing this databank to construct systematic estimates of Total Factor Productivity (TFP) in these countries and industries.

Creation of such a databank will enable both countries to address key policy issues that cannot be adequately answered now and is therefore beyond the scope of this paper. For example, capital stock data are needed for estimation purposes in EU-MENA trade policy (e.g., role of trade in factor intensity and identifying sectors with comparative advantage), or the impact of EU expansion on the MENA's industrial and labor policies (e.g., skill and capital substitutability) and its macro policies (e.g., economic growth and convergence hypothesis). Similarly, TFP is key to understanding sources of economic growth and is especially relevant to technology and knowledge-based policies, such as the impact of technology on economic growth, education and training of the workforce, role of trade with EU on technology diffusion to the MENA region, export promotion policies and their sectoral productivity impact, and the productivity effects of Intellectual Property in different sectors, to mention a few.

Growth in the MENA region has been sensitive to trends in TFP. A sharp decline in the rate of growth of total factor productivity (TFP) and lower rates of physical capital accumulation are the most important factors explaining a marked slow-down of GDP growth rate in the MENA region after mid-1980s (Senhadji,1999). Both capital accumulation and increased employment have contributed significantly to economic growth in MENA. For the 1960-94 period as a whole, capital accumulation is estimated to be the most significant source of growth, followed by increased employment and human capital formation, respectively. Even though MENA's rate of TFP growth declined precipitously after 1974, and its growth rate during 1987-1994 was estimated to be negative, TFP has contributed *comparatively* more to economic growth in MENA than in Africa and Latin America, but less than that in South and East Asia. Compared to Latin America, Sub-Saharan Africa, and to a lesser extent South Asia, human capital has been a relatively more important source of growth in MENA. Growth policies should search for the type of economic and institutional reforms capable of inducing a higher rate of increase in TFP.

This paper begins with a detailed description of the methodology section 2), followed by a description of capital stock estimation (section 3), additional observations (section 4), and concuding remarks (section 5). The actual results are presented in the data tables in the end.

2. Methodology

UNIDO and in-country are used to convert capital stock data from gross investment data. The method used is the PIM (Perpetual Inventory Method), outlined in OECD (1992) with distribution function for life of machinary from Ball and Witzke (1993). Because more information from in-country sources are needed to supplant the UNIDO data, the present project deals with an initial set of two countries, Iran and Egypt for which the UNIDO data exists *and* contacts with regional ERF fellows have been made. In Iran, Dr. Ahmad Jalali-Naini and in Egypt, Drs. Lobna Abdel-Latif and Elia El-Mahdi are contributing to the calculation of capital stock.

The PIM Method: PIM is known as the Perpetual Inventory Method (PIM) and is thoroughly described by OECD (1992) as well as detailed in Statistics Canada (1979). The first step involves adding up *weighted* sums of investments (Gross Capital Formation) over time, as follows:

$$K_t = \sum_{i=0}^{L} w_{t-i} I_{t-i} \qquad (L \leq t)$$

where K_t is the real Gross stock of capital, L is service life of capital (discussed below), I_t is the real Gross Capital Formation in time t, and w_i is the weight associated with the contribution of investments during the period t-L to t.

Measuring w_i: This weight is estimated differently by different OECD countries, based on varying assumptions regarding the survival of machinery after initial installation. One common assumption made by some OECD members is that the machinery of the same kind are withdrawn from service *simultaneously* when their service life L is reaches. This approach, known as “Simultaneous Exit”, assumes a mortality function that is in the form of step function:

$w_i = 1$ for $i < L$, and $w_i = 0$ for $i \geq L$.

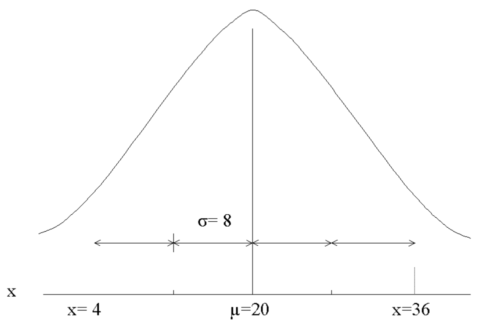
Yet, the assumption of simultaneously discarding machines seems unrealistic. Thus, some OECD members assume a “Delayed Linear” function where discarding begins sometime *after* initial installation but occurs at a constant rate. Then w_i will be uniformly distributed around L. Still, other OECD countries assume a normal distribution of w_i over time. Comparing the resulting figures for Gross Capital Stock from these varying assumptions, Statistics Canada (Koumanakos, 1980) and the Norwegian Bureau of Statistics (Biorn, et. al., 1985) find the results to be sensitive to the choice of mortality functions. Still, OECD analysts conclude, “…the bell-shaped function is really the only plausible candidate,” (OECD, 1992) and most OECD members use this function. Given the prevalence of the bell shaped distribution, we adopt this approach as well. However, since capital’s life is finite, we modify this by estimating a truncated normal distribution, following Ball and Witzke (1993) around some mean value of L, as discussed below.

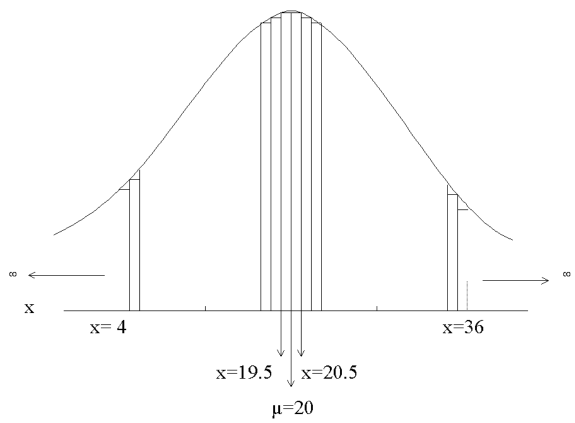
Measuring L: This measure has two aspects, the mean value of L and the distribution around this mean value. Methods to estimate the mean value of L has ranged from estimates based on capital assets' lives from tax authorities, with many inconsistencies (see OECD, 1992) to estimates based on company accounts (e.g., estimates used for France by Atkinson and Mairesse (1978) and Cette and Szpiro (1978), for Italy by Barca & Magnani (1989) and for Canada by Tarasofsky et. al. (1982)), to estimates based on survey methods (e.g, Japan). However, many OECD countries use other countries estimates for this purpose. For this reason, OECD (1992) provides a rather detailed table providing for estimates of mean value of L across a large number of detailed sectors. There are in general three broad sectors of capital stock; machinery and equipment, buildings and construction, and transportation equipment. Although there appears to be some variance in the estimates for the mean life of capital stock in each of these three categories,[1] a common practice is to use single value for this estimate and then to assume a distribution around that mean. In section 3-C we discuss the specific mean values used for the case of Egypt.

For the distribution of L around a given mean value (discussed in 3-C) we use a truncated normal density function, truncated at 2 SD of the mean. For example for a mean value of say μ=20 years, representing $\overline{L}$ and standard deviation of σ=8 years representing one SD around $\overline{L}$, the distribution is truncated at points of two standard deviations before and

[1] For example the OECD (1992) estimates for machinery and equipment is 12-20 years in the manufacturing sector and somewhat longer in the non-manufacturing sector, for transport and vehicles is about 8-35 years, and for building and construction is about 15-60 years.

after the mean. The area under the truncated normal curve is then adjusted upward within the allowed range of asset lives as shown below.





This density function then assigns weights π_i to each value of L_i where π_i is the probability of occurrence of a machine with life of L_i obtained from the truncated normal distribution. The index i runs from 1 to 199, indicating the number of segments that are used to calculate the truncated normal distribution. A SAS program was written to generate this distribution.

We then calculate the *efficiency function* for that service life by assuming a value for the decay rate of capital stock (see Ball 1993 for details). For this purpose β=.5, the decay rate of capital, repeating the process for all possible service lives. This decay rate of capital was chosen by comparing these rates for several different countries, and also by local expert interviews. This efficiency function is given by:

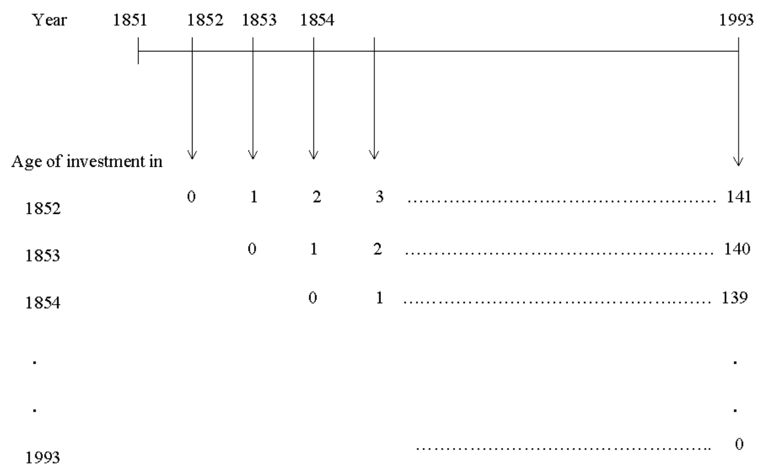
$$w_{it} = \frac{L_i - t}{L_i - \beta t}, \qquad 0 \le t \le L, \qquad d_t = 0 \qquad if \qquad t > L$$

An aggregate efficiency index was then constructed as a weighted sum of the individual efficiency functions using the frequency of occurrence as weights.

$$w_t = \sum_{i=1}^{199} \pi_i . w_{i,\tau}$$

Measuring Initial Capital Stock: There are several approaches to the measure of initial capital stock, including the ICOR (incremental capital-output ratio). However, for the purposes of parsimony and consistency we extend the PIM method backwards following Ball and Witzke (1993) and Behrens (1981) until the investments flow levels of to zero. (For Ball this point is reached in the year 1850 in the case of France. For our analysis this level is reached in the year 1914, implying that investments grew from zero in 1914 to the initial year of observation in our sample, 1982. This approach has a distinct advantage in that it makes any assumptions regarding the initial choice of capital stock unnecessary.

The diagram below illustrates this point. Although the diagram starts from 1850 we have actually chosen 1914 as our initial year of I=0, as mentioned. (Note that since the service lives of assets are deviated two standard errors from their mean, if age t exceeds the maximum expected service lives L, then the efficiency index would be w_{it}=0.



The procedure involves the following steps: The first step involves forecasting backward, as discussed above, to expand the real investment data. This involves first running the following regressions

$$\log(y) = a+b(\text{year})$$

$$\log(I/y)=c+d(year)$$

where y=real sectoral output, I=real sectoral investment and year=1914-1995. We then calculate the real investment series, for 1914-1982, predicted from above equations, by:

$$\hat{I} = \exp[\log \hat{y} + c + d(year)]$$

Capital Stock Calculation: Finally, the capital stock of period t was constructed as the weighted sum of all past real investment, with the weights (w) obtained from above:

$$K_t = \sum_{i=0}^{L} w_{t-i} I_{t-i} \quad (L \leq t)$$

3. Data Collection Issues on Egyptian Data

Due to the paucity of data at 4-digit, an initial goal of this project, only 3-digit data is reported here. For Egypt, that data are reported for the 1964 to 1995. Data were extracted primarily from the local Egyptian (CAPMAS) sources and well as from UNIDO. Since a relatively large discrepancy was observed between the two data sets, a decision had to be made on which data set to use for the construction of capital stock and total factor productivity. Due to their greater consistency over the UNIDO data, the CAPMAS data set was chosen for further calculations. Below, we describe the procedure involved in each of the two cases.

A. The CAPAMS data:

Calculation of the data based on CAPMAS sources involved several steps:

1. Figures on "Additions to Capital" (which is investments, net of inventories) were extracted from the Egyptian *Industrial Survey*. Since this includes investments in both construction and buildings as well as machinery and transport equipment, the total figure had to be distributed between the two categories. For this purpose the ratio of these two components of overall investments were determined from the Egyptian *Economic Indicators Report* at the 2-digit ISIC and then applied to the 3-digit ISIC data.

2. Each category is deflated, using separate price indices, one for building and construction, and the other for machinery and transport equipment. Deflated components of Fixed Capital formation are compiled from CAPMAS publication (Whole Price Prices Indices) on monthly basis, from which annual price deflators are constructed for equipment and machinery, transportation, construction. Inventory is deflated by the general investment price deflators. A weighted price deflators is then formed from these annual series. Relative weights are the share of each component in the fixed capital formation. They are taken from 2-digit ISIC CAPMAS publication (Statistical Industrial Survey – Annual issues). No information is available of the 3-digit ISIC, therefore the prices of 2-digit were applied to the 3-digit ISIC series. These weighted prices are adjusted to year 1981=100 as a base year. Additional details are given in Appendix 1.

B. UNIDO Data:

To compare the data from the Egyptian local sources with the UNIDO data the two data sets had to be compatible first. The following steps were followed to achieve this compatibility.

1. Since UNIDO's provides investment data only on the basis of "fixed capital formation" (which is inclusive of inventories) while CAPMAS provides data both on fixed capital formation as well as "additions to capital stock," we used the CAPMAS to construct the ratio of "addition to capital" to "capital formation" and applied the results to UNIDO data. We thus obtained the UNIDO's equivalent of the CAPMAS-based data on "addition to capital."

2. We then calculated the ratio of two categories of (a) buildings and construction and (b) machinery and transport equipments, obtained in the previous section from the CAPMAS sources, applying it to the "modified" UNIDO data, constructed in step 1.

3. The data were then deflated using the compound price indices as discussed in the last section. Additional notes on this measurement issues in this section are given in appendix 2.

As mentioned earlier, because of greater consistency in the CAPMAS data, this data was used for the calculation of capital stock and TFP in the subsequent analysis.

C. The life of machinery:

According to some interviews made with engineers in the GOFI (General Organization of Industries), the life service of machinery and transport equipment seems to range from 15-17 years for new capital and about 7-10 years for the imported old. The ratio of this latter component to investments in machinery and transport equipment in Egypt is about 50% (CAPMAS, Economic Indicators). Therefore, for one set of calculations, we applied a 13-year mean life service ($\bar{L}$) for machinery and equipment on average. However, according to OECD tables (e.g. , OECD, 1992, p. 13), a large number of advanced countries report mean life of machinery (excluding vehicles) far exceeding the value of 13 (e.g, 13-30 years in Canada and 12-25 year in the US, depending on specific manufacturing sub-sectors.) Since developing countries often face slower rates of technological change and also import constraints, plant obsolescence in such countries is likely to be delayed. Thus, it is rather more likely therefore that the figure of $\bar{L}$ =13 years may be an underestimate for a developing economy such as Egypt. For this reason we also report our calculations for a value $\bar{L}$ = 20-years. Finally, for buildings and construction, we used a mean life figure ($\bar{L}$) of 40 years, consistent with the estimates of the OECD (1992). The standard deviation around these values (to be used in the truncated normal distribution discussed in section 2) are assumed to be as follows: In the case of machinery and transport equipment, for mean life value of $\bar{L}$ =13 we use a standard deviation of σ=6 and for mean life of $\bar{L}$ =20, we use a standard deviation of σ=8. In the case of buildings and construction ($\bar{L}$ =40), we use a standard deviation of σ=10.

D. Capital stock calculations:

Capital stock figure are reported in three forms. The first two forms reflect capital stock in the form of machinery and transport equipment with $\overline{L}$=13 and $\overline{L}$=20 years, respectively. In the third form, we add capital stock figures for buildings and construction ($\overline{L}$=40) to values of machinery and equipment with the lower $\overline{L}$ values ($\overline{L}$=13). This reporting of capital stock under various forms has the advantage that it offers future researchers a choice of different measures under different assumptions. In calculating the capital stock, the procedure outlined earlier is followed. Following the procedure outlined earlier, table 2 gives the sector definitions while tables 3a, 3b and 3c provide three measure of capital stock from a SAS output based on the above forms.[2]

4. Additional Observations

To assess the relative capital deepening of sectors, and their respective adjustments in capital use over time, we examine the sectoral distribution of capital accumulation over time. We choose the data from Figure 3c for this purpose. We do because we think that despite their productive value, exclusion of buildings and construction and a more focused approach on the machinery and transport equipment represents the growth of the capital stock in manufacturing more accurately. Moreover we choose the average machine life of 20 years, rather than 13, for the same reasons as discussed in Section 3C. Figure 1 graphically presents this result in histogram form. The

[2] It should be noted that with each of the three measures the calculations vary slightly. This leads to the result that some sectors are dropped because under the given procedure they yield no data or unreliable estimates. A more detailed discussion of these points is available from the authors.

interesting point here is the existence of an outlier in the 1980-84 period, pointing to a much faster than average growth rate. This sector which also shows up as an outlier, in the 1970-74 and 1975-79 period (not shown here), is sector 372, or "non-ferrous metals." The sector is *not* an outlier in the early period (1965-69), and the late period (1994-95) of the study. One possibility is a much protection that the sectors enjoyed during periods with above-average rate of capital accumulation, but not during the period of openness that Egypt has experienced in 1994-95 period. Another interesting sector, sector 390 which represents "other manufactured products," shows a generally below average and often negative rate of capital accumulation, showing up as a relative outlier in the negative range.

5. Conclusion

Detailed sectoral data at 3-digit level are constructed for the Egyptian manufacturing sector for 32 years (1964-1995) for the first time to the knowledge of the authors. The data is represented by the different measures based on different assumptions that may be used in their calculation.

The data has been calculated based on modern methods and should provide future researchers with a valuable tool for analysis.

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Table 1: Sector Definitions

Series Cod	Series Name
311	FOOD PRODUCTS
313	BEVERAGES
314	TOBACCO
321	TEXTILES
322	WEARING APPAREL,EXCEPT FOOTWEAR
323	LEATHER PRODUCTS
324	FOOTWEAR,EXCEPT RUBBER OR PLASTIC
331	WOOD PRODUCTS,EXCEPT FURNITURE
332	FURNITURE,EXCEPT METAL
341	PAPER AND PRODUCTS
342	PRINTING AND PUBLISHING
351	INDUSTRIAL CHEMICALS
352	OTHER CHEMICALS
353	PETROLEUM REFINERIES
354	MISC. PETROLEUM AND COAL PRODUCTS
355	RUBBER PRODUCTS
356	PLASTIC PRODUCTS
361	POTTERY,CHINA,EARTHENWARE
362	GLASS AND PRODUCTS
369	OTHER NON-METALLIC MINERAL PROD.
371	IRON AND STEEL
372	NON-FERROUS METALS
381	FABRICATED METAL PRODUCTS
382	MACHINERY,EXCEPT ELECTRICAL
383	MACHINERY ELECTRIC
384	TRANSPORT EQUIPMENT
385	PROFESSIONAL & SCIENTIFIC EQUIPM.
390	OTHER MANUFACTURED PRODUCTS

Table 2a: Egypt: 3-Digit Capital Stock, 1964-95 Calculations (Machinery and Transport Equipment, mean life=13 years, standard deviation =6 years)

	311	313	314	321	322	323	324	331	332	341	342	351	352	353	354	355	356	361	362	369	371	372	381	382	383	384	390
1964	0,14	0,02	0,01	0,24	0,00	0,00	0,00	0,01	0,00	0,04	0,01	0,38	0,12	0,03	1,37	0,01	0,00	0,00	0,01	0,06	0,28	0,00	0,02	0,01	0,03	0,55	2,12
1965	0,15	0,02	0,01	0,23	0,00	0,00	0,00	0,01	0,00	0,04	0,01	0,32	0,13	0,03	1,15	0,01	0,00	0,00	0,01	0,08	0,24	0,00	0,02	0,01	0,03	0,51	1,91
1966	0,17	0,02	0,01	0,22	0,00	0,00	0,00	0,01	0,00	0,04	0,01	0,26	0,15	0,03	0,98	0,01	0,00	0,00	0,00	0,09	0,20	0,00	0,03	0,01	0,03	0,53	1,72
1967	0,21	0,02	0,01	0,23	0,00	0,00	0,00	0,01	0,00	0,05	0,01	0,21	0,17	0,02	0,84	0,01	0,00	0,00	0,00	0,11	0,16	0,00	0,04	0,01	0,03	0,60	1,53
1968	0,21	0,02	0,01	0,22	0,00	0,00	0,00	0,01	0,00	0,05	0,01	0,17	0,18	0,02	0,71	0,01	0,00	0,00	0,00	0,12	0,13	0,00	0,04	0,01	0,04	0,60	1,37
1969	0,22	0,02	0,01	0,27	0,00	0,01	0,00	0,01	0,00	0,05	0,02	0,13	0,22	0,02	0,61	0,01	0,00	0,00	0,00	0,11	0,10	0,00	0,04	0,02	0,05	0,74	1,21
1970	0,23	0,02	0,02	0,29	0,00	0,01	0,00	0,01	0,00	0,04	0,02	0,13	0,21	0,05	0,50	0,01	0,00	0,00	0,01	0,11	0,20	0,00	0,05	0,02	0,05	0,85	1,05
1971	0,24	0,02	0,02	0,33	0,00	0,01	0,00	0,01	0,00	0,04	0,02	0,17	0,20	0,06	0,41	0,02	0,00	0,00	0,01	0,13	0,20	0,00	0,05	0,02	0,05	0,89	3,35
1972	0,24	0,02	0,02	0,38	0,00	0,02	0,00	0,01	0,00	0,04	0,01	0,22	0,19	0,08	0,33	0,02	0,00	0,00	0,01	0,14	0,21	0,00	0,06	0,03	0,06	0,93	4,30
1973	0,24	0,02	0,02	0,44	0,00	0,02	0,00	0,01	0,00	0,04	0,01	0,29	0,18	0,11	0,28	0,02	0,00	0,00	0,02	0,15	0,21	0,00	0,06	0,03	0,06	0,97	3,95
1974	0,24	0,03	0,03	0,48	0,00	0,03	0,00	0,01	0,00	0,05	0,01	0,38	0,17	0,14	0,24	0,02	0,00	0,00	0,02	0,17	0,34	0,01	0,07	0,03	0,06	0,94	3,59
1975	0,23	0,04	0,03	0,51	0,00	0,03	0,00	0,01	0,00	0,05	0,01	0,47	0,16	0,16	0,20	0,02	0,01	0,01	0,02	0,19	0,32	0,01	0,08	0,04	0,06	0,98	3,24
1976	0,24	0,04	0,03	0,55	0,00	0,03	0,00	0,01	0,00	0,06	0,02	0,52	0,16	0,15	0,18	0,03	0,01	0,00	0,02	0,21	0,34	0,05	0,08	0,05	0,07	0,92	2,90
1977	0,27	0,04	0,03	0,61	0,00	0,03	0,00	0,01	0,00	0,06	0,03	0,62	0,17	0,17	0,15	0,03	0,01	0,00	0,02	0,26	0,34	0,08	0,09	0,08	0,07	1,00	8,59
1978	0,30	0,04	0,04	0,72	0,00	0,03	0,00	0,02	0,00	0,08	0,04	0,76	0,17	0,18	0,14	0,04	0,02	0,01	0,03	0,29	0,34	0,11	0,11	0,11	0,08	1,36	7,95
1979	0,34	0,06	0,03	0,76	0,00	0,02	0,00	0,02	0,00	0,09	0,04	0,81	0,18	0,26	0,13	0,06	0,03	0,01	0,03	0,41	0,32	0,13	0,11	0,11	0,10	1,67	7,24
1980	0,36	0,07	0,06	0,90	0,00	0,03	0,01	0,03	0,00	0,11	0,04	0,73	0,16	0,34	0,12	0,06	0,03	0,01	0,03	0,52	0,39	0,16	0,12	0,11	0,11	1,79	6,55
1981	0,40	0,08	0,08	0,97	0,00	0,03	0,01	0,03	0,00	0,18	0,06	0,74	0,20	0,48	0,11	0,06	0,03	0,01	0,03	0,62	0,40	0,21	0,15	0,18	0,13	2,11	5,86
1982	0,43	0,13	0,08	1,13	0,01	0,03	0,01	0,04	0,01	0,18	0,07	0,78	0,25	0,56	0,11	0,07	0,04	0,01	0,04	0,77	0,38	0,33	0,17	0,18	0,13	2,33	5,18
1983	0,55	0,16	0,13	1,16	0,01	0,03	0,01	0,04	0,01	0,19	0,07	0,79	0,30	0,63	0,12	0,09	0,05	0,02	0,05	0,94	0,44	0,40	0,17	0,18	0,14	2,37	4,54
1984	0,76	0,25	0,19	1,35	0,01	0,03	0,01	0,07	0,02	0,20	0,08	0,80	0,34	0,70	0,12	0,09	0,06	0,02	0,06	1,18	0,42	0,42	0,21	0,22	0,17	2,78	3,98
1985	0,85	0,30	0,22	1,63	0,01	0,04	0,01	0,07	0,02	0,20	0,08	0,76	0,34	0,71	0,12	0,09	0,06	0,03	0,08	1,58	0,39	0,41	0,22	0,23	0,17	2,90	3,40
1986	0,96	0,34	0,25	1,74	0,02	0,04	0,01	0,07	0,02	0,21	0,09	0,73	0,35	0,73	0,11	0,09	0,06	0,03	0,08	1,69	0,37	0,42	0,22	0,24	0,17	2,93	2,87
1987	1,02	0,33	0,25	1,71	0,01	0,03	0,01	0,06	0,02	0,24	0,09	0,74	0,42	0,68	0,12	0,10	0,07	0,03	0,08	2,08	0,41	0,56	0,25	0,23	0,18	3,16	2,41
1988	1,08	0,30	0,23	1,68	0,01	0,03	0,01	0,06	0,02	0,25	0,08	0,93	0,46	0,66	0,12	0,10	0,07	0,03	0,08	2,41	0,53	0,73	0,31	0,23	0,18	3,18	1,98
1989	1,02	0,29	0,22	1,63	0,01	0,05	0,04	0,06	0,01	0,22	0,07	0,98	0,46	0,84	0,12	0,15	0,06	0,03	0,07	2,47	0,50	0,73	0,29	0,21	0,18	3,17	1,59
1990	1,01	0,26	0,20	1,53	0,01	0,04	0,04	0,05	0,01	0,22	0,07	1,12	0,46	1,01	0,11	0,13	0,06	0,02	0,08	2,55	0,49	0,73	0,28	0,22	0,18	2,99	1,25
1991	1,04	0,23	0,18	1,37	0,02	0,04	0,04	0,04	0,01	0,20	0,06	1,01	0,44	0,91	0,09	0,12	0,05	0,02	0,07	2,31	0,43	0,65	0,26	0,20	0,16	2,65	0,98
1992	0,99	0,20	0,16	1,37	0,02	0,03	0,03	0,04	0,01	0,18	0,06	0,98	0,44	1,00	0,08	0,12	0,05	0,02	0,08	2,08	0,45	0,60	0,25	0,18	0,16	2,42	0,75
1993	0,96	0,19	0,19	1,29	0,02	0,03	0,03	0,03	0,01	0,16	0,05	0,89	0,44	1,10	0,07	0,11	0,05	0,02	0,08	1,89	0,43	0,55	0,23	0,17	0,15	2,23	0,55
1994	0,84	0,16	0,17	1,12	0,02	0,03	0,03	0,03	0,01	0,14	0,05	0,78	0,39	0,98	0,06	0,09	0,04	0,02	0,07	1,66	0,38	0,48	0,20	0,15	0,13	1,92	0,40
1995	0,73	0,13	0,15	0,96	0,02	0,02	0,03	0,02	0,01	0,12	0,04	0,68	0,34	0,87	0,05	0,08	0,03	0,02	0,06	1,43	0,33	0,42	0,17	0,13	0,12	1,64	0,28

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Table 2b: Egypt: 3-Digit Capital Stock, 1964-95 Calculations (Machinery and Transport Equipment, mean life=20 years, standard deviation =8 years)

	311	313	314	321	324	331	332	341	342	352	361	371	372	381	382	383	384	390
1964	1,84	0,24	0,17	3,25	0,03	0,25	0,02	0,56	0,16	1,56	0,05	5,94	0,01	0,35	0,17	0,43	0,84	3,39
1965	1,96	0,24	0,17	3,17	0,03	0,25	0,02	0,58	0,17	1,72	0,04	5,31	0,01	0,36	0,18	0,44	0,81	3,08
1966	2,23	0,24	0,17	3,17	0,03	0,24	0,02	0,61	0,18	1,91	0,04	4,72	0,01	0,41	0,18	0,45	0,82	2,80
1967	2,69	0,24	0,17	3,28	0,03	0,23	0,02	0,64	0,18	2,13	0,04	4,17	0,01	0,53	0,18	0,46	0,89	2,55
1968	2,67	0,24	0,17	3,25	0,03	0,24	0,02	0,69	0,19	2,29	0,03	3,67	0,01	0,53	0,20	0,51	0,89	2,32
1969	2,85	0,24	0,20	3,75	0,03	0,23	0,02	0,67	0,23	2,76	0,03	3,20	0,01	0,58	0,25	0,66	1,04	2,11
1970	2,99	0,26	0,21	4,00	0,03	0,23	0,02	0,65	0,22	2,68	0,04	4,03	0,02	0,63	0,29	0,67	1,15	1,90
1971	3,08	0,26	0,26	4,40	0,04	0,22	0,02	0,64	0,21	2,62	0,04	3,87	0,02	0,68	0,31	0,70	1,19	4,15
1972	3,15	0,28	0,29	4,95	0,05	0,22	0,02	0,64	0,20	2,55	0,05	3,76	0,03	0,74	0,32	0,74	1,24	5,12
1973	3,20	0,29	0,31	5,67	0,04	0,21	0,02	0,66	0,20	2,48	0,06	3,69	0,04	0,81	0,35	0,78	1,29	4,84
1974	3,24	0,35	0,35	6,15	0,04	0,22	0,02	0,70	0,19	2,42	0,06	4,80	0,09	0,91	0,40	0,79	1,28	4,56
1975	3,24	0,48	0,33	6,53	0,05	0,21	0,02	0,73	0,21	2,38	0,07	4,54	0,11	0,97	0,49	0,82	1,33	4,28
1976	3,33	0,53	0,39	6,98	0,04	0,20	0,02	0,83	0,25	2,41	0,06	4,75	0,47	1,06	0,58	0,87	1,29	4,01
1977	3,68	0,51	0,41	7,78	0,05	0,21	0,02	0,83	0,35	2,48	0,06	4,62	0,86	1,14	0,87	0,98	1,38	9,75
1978	4,03	0,51	0,45	8,93	0,06	0,23	0,03	1,05	0,44	2,59	0,07	4,65	1,16	1,32	1,25	1,09	1,75	9,30
1979	4,51	0,70	0,43	9,49	0,06	0,27	0,03	1,12	0,50	2,70	0,12	4,45	1,39	1,38	1,29	1,22	2,09	8,83
1980	4,74	0,85	0,68	11,09	0,08	0,32	0,03	1,40	0,48	2,51	0,11	5,15	1,76	1,52	1,30	1,39	2,25	8,36
1981	5,21	0,95	0,95	12,07	0,08	0,41	0,03	2,10	0,66	2,90	0,14	5,36	2,23	1,85	2,00	1,56	2,61	7,86
1982	5,58	1,46	0,90	13,91	0,09	0,45	0,06	2,13	0,80	3,41	0,17	5,19	3,51	2,06	2,08	1,64	2,88	7,34
1983	6,91	1,82	1,50	14,49	0,08	0,49	0,09	2,23	0,81	3,92	0,19	5,84	4,40	2,16	2,18	1,79	2,97	6,83
1984	9,05	2,76	2,11	16,67	0,08	0,77	0,18	2,45	0,93	4,34	0,24	5,71	4,65	2,56	2,61	2,06	3,44	6,37
1985	10,17	3,28	2,45	19,82	0,09	0,77	0,18	2,46	0,95	4,45	0,32	5,50	4,74	2,72	2,80	2,16	3,62	5,87
1986	11,44	3,86	2,83	21,34	0,09	0,78	0,19	2,66	1,06	4,59	0,35	5,42	5,03	2,83	2,92	2,22	3,74	5,37
1987	12,36	3,84	2,90	21,56	0,10	0,79	0,18	2,95	1,11	5,34	0,35	5,86	6,56	3,14	2,91	2,29	4,04	4,91
1988	13,24	3,68	2,80	21,71	0,11	0,79	0,18	3,11	1,08	5,82	0,36	7,10	8,40	3,83	2,96	2,37	4,14	4,45
1989	12,95	3,62	2,73	21,71	0,47	0,75	0,18	2,93	1,02	5,88	0,35	6,83	8,68	3,71	2,86	2,41	4,21	3,99
1990	13,12	3,45	2,63	21,11	0,45	0,70	0,17	2,98	0,96	6,01	0,33	6,84	8,86	3,70	2,97	2,42	4,10	3,55
1991	13,70	3,24	2,46	19,85	0,43	0,65	0,16	2,80	0,92	5,88	0,32	6,38	8,38	3,50	2,83	2,30	3,84	3,14
1992	13,42	3,05	2,37	20,12	0,41	0,61	0,15	2,67	0,88	5,96	0,32	6,63	8,04	3,47	2,74	2,29	3,66	2,75
1993	13,37	2,92	2,73	19,56	0,40	0,57	0,15	2,56	0,86	6,14	0,32	6,46	7,76	3,33	2,67	2,28	3,51	2,39
1994	13,05	2,75	2,68	18,54	0,38	0,52	0,14	2,48	0,82	6,28	0,32	6,68	8,95	3,41	2,62	2,32	3,36	2,07
1995	13,75	2,54	2,87	17,44	0,36	0,48	0,13	2,45	0,81	6,45	0,30	6,48	8,66	3,50	2,68	2,39	3,16	1,76

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Table 2c: Egypt: 3-Digit Total Capital Stock Calculations, 1964-95
(Machinery &Transport Equipment, mean life=13 standard deviation =6;
Plus Construction & Buildings, mean life=40, standard deviation =10)

	311	313	314	321	322	323	324	331	332	341	342	351	352	353	354	355	356	361	362	369	371	372	381	382	383	384	390
1964	0,25	0,03	0,02	0,53	0,00	0,01	0,01	0,09	0,00	0,66	0,18	1,36	0,18	0,05	126,09	0,02	0,01	0,00	0,01	0,10	0,83	0,00	0,04	0,02	0,04	0,09	48,58
1965	0,26	0,03	0,02	0,50	0,00	0,01	0,01	0,08	0,00	0,61	0,17	1,22	0,19	0,04	106,87	0,02	0,01	0,00	0,01	0,11	0,75	0,00	0,04	0,02	0,04	0,08	41,55
1966	0,29	0,03	0,02	0,49	0,00	0,01	0,01	0,08	0,00	0,56	0,16	1,09	0,21	0,04	89,95	0,02	0,00	0,00	0,01	0,14	0,67	0,00	0,04	0,02	0,05	0,09	35,32
1967	0,34	0,03	0,02	0,49	0,00	0,01	0,01	0,07	0,00	0,52	0,14	0,97	0,22	0,03	75,15	0,02	0,00	0,00	0,01	0,16	0,60	0,00	0,05	0,02	0,05	0,09	29,84
1968	0,34	0,03	0,02	0,48	0,00	0,01	0,01	0,07	0,00	0,49	0,13	0,86	0,24	0,03	62,31	0,02	0,00	0,00	0,01	0,17	0,53	0,00	0,05	0,02	0,05	0,09	25,05
1969	0,36	0,03	0,02	0,52	0,00	0,01	0,00	0,07	0,00	0,45	0,13	0,77	0,29	0,03	51,29	0,02	0,00	0,00	0,01	0,17	0,48	0,00	0,06	0,03	0,07	0,11	20,90
1970	0,37	0,03	0,02	0,54	0,00	0,01	0,01	0,07	0,00	0,41	0,12	0,71	0,27	0,06	41,88	0,02	0,00	0,00	0,01	0,17	0,56	0,00	0,06	0,03	0,07	0,12	17,34
1971	0,37	0,03	0,03	0,57	0,00	0,02	0,01	0,06	0,00	0,38	0,11	0,70	0,26	0,08	33,95	0,02	0,00	0,00	0,01	0,18	0,54	0,00	0,07	0,03	0,07	0,12	14,65
1972	0,37	0,03	0,03	0,62	0,00	0,02	0,01	0,06	0,00	0,35	0,10	0,71	0,25	0,10	27,37	0,02	0,01	0,00	0,02	0,19	0,52	0,00	0,07	0,03	0,07	0,12	12,25
1973	0,37	0,03	0,03	0,69	0,00	0,03	0,01	0,06	0,00	0,33	0,09	0,73	0,23	0,13	21,99	0,02	0,01	0,01	0,03	0,21	0,50	0,00	0,08	0,03	0,08	0,13	10,11
1974	0,37	0,04	0,04	0,73	0,00	0,03	0,01	0,05	0,00	0,31	0,08	0,80	0,22	0,15	17,67	0,02	0,01	0,01	0,03	0,22	0,62	0,01	0,09	0,04	0,08	0,12	8,36
1975	0,36	0,05	0,04	0,76	0,00	0,04	0,01	0,05	0,00	0,30	0,08	0,85	0,21	0,17	14,20	0,03	0,01	0,01	0,03	0,25	0,58	0,01	0,09	0,05	0,08	0,13	6,92
1976	0,36	0,06	0,04	0,80	0,00	0,04	0,01	0,05	0,00	0,29	0,08	0,88	0,21	0,17	11,41	0,03	0,01	0,01	0,03	0,26	0,59	0,05	0,10	0,06	0,08	0,12	5,73
1977	0,40	0,06	0,04	0,87	0,00	0,04	0,01	0,05	0,00	0,27	0,09	0,95	0,22	0,19	9,17	0,04	0,02	0,01	0,03	0,33	0,57	0,10	0,11	0,08	0,09	0,13	5,49
1978	0,43	0,05	0,05	0,98	0,00	0,03	0,01	0,05	0,00	0,28	0,09	1,07	0,22	0,20	7,37	0,05	0,02	0,01	0,03	0,35	0,56	0,14	0,12	0,12	0,10	0,16	4,65
1979	0,48	0,07	0,04	1,01	0,00	0,03	0,01	0,05	0,00	0,27	0,10	1,10	0,23	0,28	5,94	0,07	0,03	0,01	0,03	0,48	0,53	0,16	0,13	0,12	0,11	0,19	3,95
1980	0,50	0,09	0,07	1,16	0,00	0,03	0,01	0,06	0,00	0,28	0,09	1,00	0,21	0,37	4,78	0,07	0,03	0,01	0,03	0,60	0,59	0,19	0,14	0,12	0,13	0,21	3,36
1981	0,55	0,10	0,10	1,24	0,00	0,03	0,01	0,07	0,00	0,34	0,10	0,98	0,25	0,52	3,85	0,07	0,04	0,01	0,04	0,72	0,59	0,24	0,17	0,19	0,14	0,24	2,87
1982	0,58	0,15	0,10	1,40	0,01	0,03	0,01	0,07	0,01	0,33	0,11	1,01	0,30	0,60	3,10	0,08	0,05	0,02	0,04	0,88	0,56	0,38	0,19	0,19	0,15	0,26	2,45
1983	0,71	0,19	0,16	1,43	0,01	0,04	0,01	0,07	0,01	0,33	0,11	1,00	0,35	0,66	2,52	0,09	0,05	0,02	0,05	1,06	0,62	0,47	0,19	0,20	0,16	0,27	2,10
1984	0,92	0,28	0,22	1,62	0,01	0,04	0,01	0,10	0,02	0,33	0,12	0,99	0,38	0,74	2,05	0,10	0,06	0,02	0,07	1,32	0,59	0,49	0,23	0,24	0,18	0,31	1,80
1985	1,02	0,33	0,25	1,89	0,02	0,04	0,01	0,10	0,02	0,32	0,12	0,94	0,39	0,76	1,66	0,10	0,06	0,03	0,09	1,74	0,55	0,48	0,24	0,25	0,19	0,32	1,55
1986	1,13	0,38	0,28	2,00	0,02	0,04	0,01	0,09	0,02	0,33	0,12	0,90	0,40	0,77	1,35	0,10	0,06	0,03	0,09	1,86	0,52	0,50	0,25	0,25	0,19	0,32	1,33
1987	1,20	0,37	0,28	1,97	0,02	0,04	0,01	0,09	0,02	0,34	0,12	0,90	0,47	0,73	1,10	0,11	0,07	0,03	0,09	2,27	0,56	0,64	0,27	0,25	0,19	0,35	1,15
1988	1,27	0,34	0,26	1,93	0,01	0,04	0,01	0,09	0,02	0,34	0,11	1,08	0,51	0,70	0,91	0,11	0,07	0,03	0,09	2,62	0,67	0,82	0,34	0,24	0,20	0,35	0,99
1989	1,21	0,33	0,25	1,90	0,01	0,06	0,05	0,08	0,02	0,31	0,10	1,12	0,50	0,89	0,75	0,16	0,06	0,03	0,08	2,69	0,63	0,82	0,32	0,23	0,20	0,35	0,86
1990	1,20	0,30	0,23	1,79	0,01	0,05	0,05	0,07	0,02	0,30	0,09	1,26	0,50	1,06	0,61	0,14	0,06	0,03	0,09	2,79	0,62	0,82	0,31	0,23	0,20	0,33	0,74
1991	1,23	0,27	0,21	1,62	0,02	0,05	0,05	0,07	0,01	0,28	0,09	1,14	0,48	0,96	0,50	0,13	0,06	0,03	0,08	2,54	0,56	0,75	0,28	0,21	0,18	0,30	0,65
1992	1,18	0,24	0,19	1,61	0,02	0,04	0,04	0,06	0,01	0,25	0,08	1,10	0,48	1,06	0,41	0,12	0,05	0,03	0,09	2,31	0,57	0,69	0,27	0,20	0,17	0,27	0,57
1993	1,14	0,22	0,22	1,53	0,02	0,04	0,04	0,05	0,01	0,23	0,08	1,00	0,49	1,16	0,33	0,12	0,05	0,03	0,09	2,12	0,55	0,65	0,25	0,19	0,17	0,25	0,50
1994	1,02	0,19	0,20	1,35	0,02	0,04	0,04	0,05	0,01	0,20	0,07	0,89	0,43	1,04	0,27	0,10	0,04	0,02	0,08	1,87	0,49	0,58	0,22	0,17	0,15	0,22	0,44
1995	0,91	0,17	0,18	1,18	0,02	0,03	0,03	0,04	0,01	0,18	0,06	0,78	0,38	0,93	0,22	0,09	0,04	0,02	0,07	1,64	0,43	0,51	0,19	0,14	0,13	0,19	0,38

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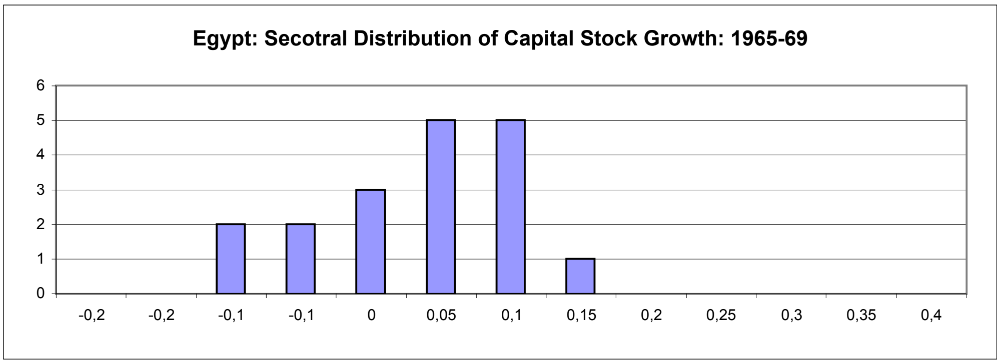
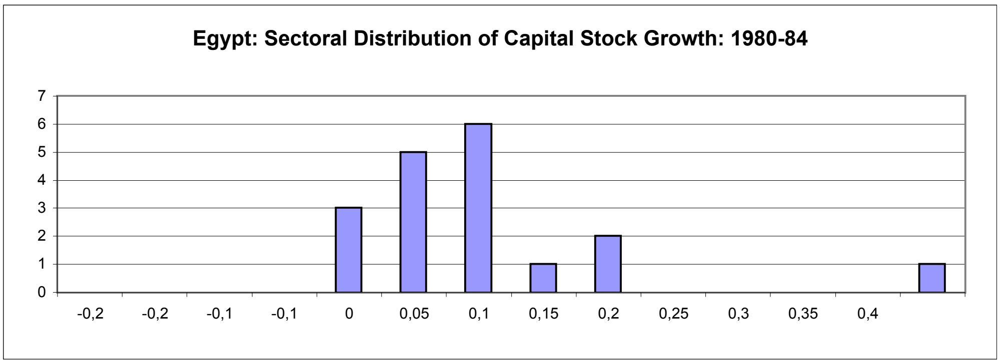
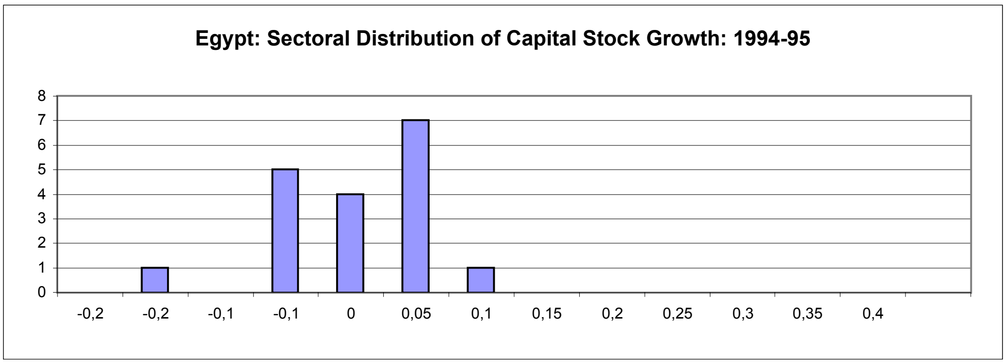
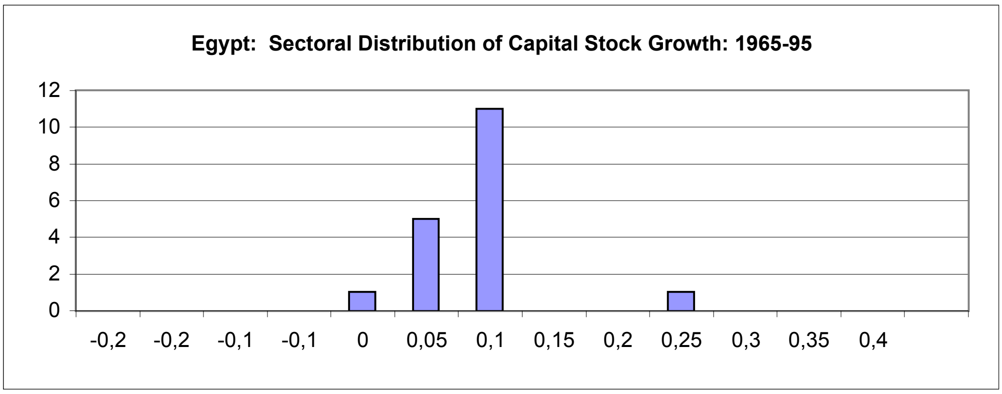
Figure 1: Sectoral Distribution of Capital Stock for Egypt









Appendix 1: Notes on the calculation of CAPMAS (local) data

1- Owing to some difficulties in collecting the data of 1960-1969 from Industrial Survey (addition to capital) and due differences in sector codes definitions we used sector to match sector data on different variables.

2- In collecting the data, a number of sectors had missing observations. These sectors have been removed from analysis (351, 353, 355, 362, 371 and 385.)

3- There was some missing data on year 1966 and 1972. For these years, we averaged the data from the two neighboring years.

4- The years 1984, 1985, and 1986 were totally missing from the publications of the Industrial Survey. For these year, we used the data on "addition of capital" in the economic indicators report (2-digit ISIC). To distribute the addition of each 2-digit ISIC sector on the 3-digit ISIC sectors we used this ratio from the prior 3 years (1981,1982 and 1983), and then applied the results to the values of economic indicators Report (2-digit ISIC).

5- In the years from 1960-1969 both the sectors 322 and 324 were combined into one sector according to the old classification that was in use at the time. We addressed this problem by finding the breakdown of the two sectors from data on the subsequent years in the 70s from the total 2 ISIC sector and then applied the result to these sectors (322 and 324).

6- In calculating the ratios of the components to construct the price index for machinery equipment from Economic Indicators Survey, the years 1960-1964, 1967, 1970-1975, 1976, 1978-1979, 1983, and 1992 were missing. The solution was to take the average of these ratios for the missing years. It was found that the differences in the ratios through the time were very slight.

7- Base year for price indices used in calculating the components of “additions to capital,” were adjusted to a unified base year for entire period.

Estimates of Capital Stock for 3-digit ISIC Manufacturing Sector in Iran: 1982-1997*

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Estimates of Capital Stock for 3-digit ISIC Manufacturing Sector in Iran: 1982-1997

1. Background

This paper, which is the first part of a two-stage project, deals with developing a databank for capital stock at 3-digit ISIC levels for the manufacturing industries in select countries of the Middle East and North Africa (MENA), notably Egypt and Iran covering the period 1964-95 for Egypt and 1983-97 for Iran. Calculations are based both upon the UNIDO country data as well as local (in-country) data. The second stage involves utilizing this databank to construct systematic estimates of Total Factor Productivity (TFP) in these countries and industries.

Creation of such a databank will enable both countries to address key policy issues that cannot be adequately answered now and is therefore beyond the scope of this paper. For example, capital stock data are needed for estimation purposes in EU-MENA trade policy (e.g., role of trade in factor intensity and identifying sectors with comparative advantage), or the impact of EU expansion on the MENA's industrial and labor policies (e.g., skill and capital substitutability) and its macro policies (e.g., economic growth and convergence hypothesis). Similarly, TFP is key to understanding sources of economic growth and is especially relevant to technology and knowledge-based policies, such as the impact of technology on economic growth, education and training of the workforce, role of trade with EU on technology diffusion to the MENA region, export promotion policies and their sectoral productivity impact, and the productivity effects of Intellectual Property in different sectors, to mention a few.

Growth in the MENA region has been sensitive to trends in TFP. A sharp decline in the rate of growth of total factor productivity (TFP) and lower rates of physical capital accumulation are the most important factors explaining a marked slow-down of GDP growth rate in the MENA region after mid-1980s (Senhadji,1999). Both capital accumulation and increased employment have contributed significantly to economic growth in MENA. For the 1960-94 period as a whole, capital accumulation is estimated to be the most significant source of growth, followed by increased employment and human capital formation, respectively. Even though MENA's rate of TFP growth declined precipitously after 1974, and its growth rate during 1987-1994 was estimated to be negative, TFP has contributed *comparatively* more to economic growth in MENA than in Africa and Latin America, but less than that in South and East Asia. Compared to Latin America, Sub-Saharan Africa, and to a lesser extent South Asia, human capital has been a relatively more important source of growth in MENA. Growth policies should search for the type of economic and institutional reforms capable of inducing a higher rate of increase in TFP.

This paper begins with a detailed description of the methodology, followed by a description of capital stock estimation. The actual results are presented in the end.

2. Methodology

UNIDO and in-country are used to convert capital stock data from gross investment data. The method used is the PIM (Perpetual Inventory Method), outlined in OECD (1992) with distribution function for life of machinary from Ball and Witzke (1993). Because more information from in-country sources are needed to supplant the UNIDO data, the present project deals with an initial set of two countries, Iran and Egypt for which the UNIDO data exists *and* contacts with regional ERF fellows have been made. In Iran, Dr. Ahmad Jalali-Naini and in Egypt, Drs. Lobna Abdel-Latif and Elia El-Mahdi are contributing to the calculation of capital stock.

The PIM Method: PIM is known as the Perpetual Inventory Method (PIM) and is thoroughly described by OECD (1992) as well as detailed in Statistics Canada (1979). The first step involves adding up *weighted* sums of investments (Gross Capital Formation) over time, as follows:

$$K_t = \sum_{i=0}^{L} w_{t-i} I_{t-i} \qquad (L \leq t)$$

where K_t is the real Gross stock of capital, L is service life of capital (discussed below), I_t is the real Gross Capital Formation in time t, and w_i is the weight associated with the contribution of investments during the period t-L to t.

Measuring w_i: This weight is estimated differently by different OECD countries, based on varying assumptions regarding the survival of machinery after initial installation. One common assumption made by some OECD members is that the machinery of the same kind are withdrawn from service *simultaneously* when their service life L is reaches. This approach, known as "Simultaneous Exit", assumes a mortality function that is in the form of step function:

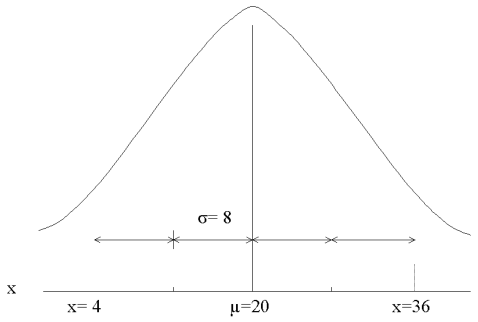
$$w_i = 1 \text{ for } i < L, \text{ and } w_i = 0 \text{ for } i \geq L.$$

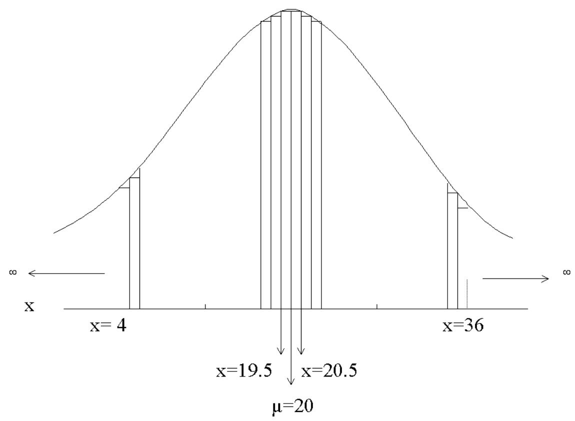
Yet, the assumption of simultaneously discarding machines seems unrealistic. Thus, some OECD members assume a "Delayed Linear" function where discarding begins sometime *after* initial installation but occurs at a constant rate. Then w_i will be uniformly distributed around L. Still, other OECD countries assume a normal distribution of w_i over time. Comparing the resulting figures for Gross Capital Stock from these varying assumptions, Statistics Canada (Koumanakos, 1980) and the Norwegian Bureau of Statistics (Biorn, et. al., 1985) find the results to be sensitive to the choice of mortality functions. Still, OECD analysts conclude, "…the bell-shaped function is really the only plausible candidate," (OECD, 1992) and most OECD members use this function.

Given the prevalence of the bell shaped distribution, we adopt this approach as well. However, since capital's life is finite, we modify this by estimating a truncated normal distribution, following Ball and Witzke (1993) around some mean value of L, as discussed below.

Measuring L: This measure has two aspects, the mean value of L and the distribution around this mean value. Methods to estimate the mean value of L has ranged from estimates based on capital assets' lives from tax authorities, with many inconsistencies (see OECD, 1992) to estimates based on company accounts (e.g., estimates used for France by Atkinson and Mairesse (1978) and Cette and Szpiro (1978), for Italy by Barca & Magnani (1989) and for Canada by Tarasofsky et. al. (1982)), to estimates based on survey methods (e.g, Japan). However, many OECD countries use other countries estimates for this purpose. For this reason, OECD (1992) provides a rather detailed table providing for estimates of mean value of L across a large number of detailed sectors. Yet it is not uncommon to see researchers use a single value for this number, ranging from 15 to 20 years, since most values do fall in this range. For the purpose of this work, we have assumed an average service life of 20 years.

For the distribution of L around this mean value we use a truncated normal density function, truncated at 2 SD of the mean with mean of μ=20 years, representing $\overline{L}$ for mean life of machinery and standard deviation of σ=8 years representing one SD around $\overline{L}$. The distribution was truncated at points of two standard deviations before and after the mean. The area under the truncated normal curve was then adjusted upward within the allowed range of asset lives as shown below.





This density function then assigns weights π_i to each value of L_i where π_i is the probability of occurrence of a machine with life of L_i obtained from the truncated normal distribution. The index i runs from 1 to 199, indicating the number of segments used to calculate the truncated normal distribution. A SAS program was written to generate this distribution.

We then calculate the *efficiency function* for that service life by using assuming a value for the decay rate of capital stock (see Ball 1993 for details). For this purpose β=.5, the decay rate of capital, repeating the process for all possible service lives. This decay rate of capital was chosen by comparing these rates for several different countries, and also by local expert interviews. This efficiency function is given by:

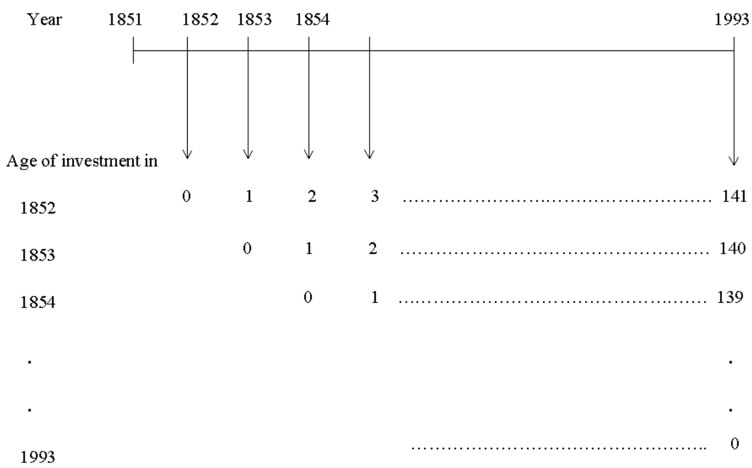
$$w_{it} = \frac{L_i - t}{L_i - \beta t}, \qquad 0 \le t \le L, \qquad d_t = 0 \qquad if \qquad t > L$$

An aggregate efficiency index was then constructed as a weighted sum of the individual efficiency functions using the frequency of occurrence as weights.

$$w_t = \sum_{i=1}^{199} \pi_i . w_{i,\tau}$$

Measuring Initial Capital Stock: There are several approaches to the measure of initial capital stock, including the ICOR (incremental capital-output ratio). However, for the purposes of parsimony and consistency we extend the PIM method backwards following Ball and Witzke (1993) and Behrens (1981) until the investments flow levels of to zero. (For Ball this point is reached in the year 1850 in the case of France. For our analysis this level is reached in the year 1914, implying that investments grew from zero in 1914 to the initial year of observation in our sample, 1982. This approach has a distinct advantage in that it makes any assumptions regarding the initial choice of capital stock unnecessary.

The diagram below illustrates this point. Although the diagram starts from 1850 we have actually chosen 1914 as our initial year of I=0, as mentioned. Further, note that since the service lives of assets are deviated two standard errors from their mean (20 years), if age t exceeds the maximum expected service lives L, then the efficiency index would be w_{it}=0.



The procedure involves the following steps: The first step involves forecasting backward, as discussed above, to expand the real investment data. This involves first running the following regressions

$$log(y) = a+b(year)$$

$$log(I/y)=c+d(year)$$

where y=real sectoral output, I=real sectoral investment and year=1914-1997. We then calculate the real investment series, for 1914-1982, predicted from above equations, by:

$$\hat{I} = \exp[\log \hat{y} + c + d(year)]$$

Capital Stock Calculations: Finally, the capital stock of period t was constructed as the weighted sum of all past real investment, with the weights (w) obtained from above:

$$K_t = \sum_{i=0}^{L} w_{t-i} I_{t-i} \qquad (L \leq t)$$

Table 1 gives the sector desafinitions while table 2 provides the SAS output of the 3-digit capital stock for Iran based on the above procedure.

3. Data Collection Issues

Due to the paucity of data at 4-digit, an initial goal of this project, only 3-digit data is reported here. Data are reported for the 1983 to 1997 period. Data on manufacturing value-added, output, intermediate purchases, investment, wages, employment, gender composition of the work force, … are obtained through annual surveys for "large establishments”—defined as manufacturing units with ten or more employees. Manufacturing units receive a detailed questioner for the survey year and they are all obligated to fill them. The relevant data is extracted from questioners and is aggregated according to ISIC codes. Firms surveyed are identified by information available from operation permits, and through local search by the staff of the Statistical Center of Iran--the official body responsible for collection and publication of 2, 3, and 4 digit ISIC data for manufacturing industry. Since the raw data on fixed investment are in nominal terms we had to choose an appropriate deflator. We began with several deflators and a weighted-average of several indices, to reflect the weighted- average cost of the bundle of investment goods. For each industry (e.g. food, textiles, glass) annual fixed investment is the sum of expenditures on machinery, tools, transportation vehicles, construction, electrical generators, etc. Therefore, a wholesale price deflator for each of the above items had to be obtained and weighted with their share in total investment expenditures to calculate a deflator for each ISIC number. For a number of years and a number of industries the breakdown of total investment expenditures were not available, and therefore we had to find an alternative deflator. Since fixed investments (capital goods, electric generators, and construction) are considerably less heterogeneous than industrial output, the manufacturing sector’s fixed investment deflator was found to be a good representative index for deflating nominal investment when data on the components of investment expenditures were not available. The deflated investment series, or real investment flows, was used to estimate real capital stock series.

Real investment flows were initially estimated for 3 and 4-digit ISIC code. For comparative purposes, and due to the fact that time series 4-digit data are much more limited, three digit data were finally chosen. Capital stock data according to “machinery” and “construction” classification were available, hence we used these two components as the raw data for further calculations. Different rates of depreciation were calculated for construction and machinery. For depreciation, or more technically, decay rate of machinery both international data and a small survey of local expert opinion was considered. The decay rate for construction is usually lower than that for machinery. A use-life of between 16 to 20 is usually considered for machinery. After applying the decay rate specific for “machinery” and “construction,” a series for each component was calculated. The aggregate capital stock for industry reported in this study is the sum of depreciation adjusted “machinery” and “construction” series for each year.

Factors such as the availability of exchange rate and the black market exchange rate premium influence the decision to buy and install new machinery in those countries that import capital goods. Usually when foreign currency becomes significantly more expensive and/or its availability is limited new capital equipment purchases are delayed and older machinery stay in use for a longer period of time. In the case of Iran, official exchange rate depreciated very massively in the early 1990s, and black market premia was very high during the 1985-1991 period. Considering all these factors, an average use-life of about twenty years was assumed.

4. Additional Observations

Estimated capital stock series for a number of ISIC codes exhibit a bump during the mid-1980s (mostly 1986-1987). This is due to a sharp decline in fixed investment during this period. Gross fixed domestic investment in constant prices in Iran fell by –15.9, -23.56, and –17.33 per cent during 1985 to 1987, respectively. The price of crude oil fell sharply from a high of about 34 dollars in 1984 to a low of about six dollars per barrel causing a significant decline in foreign exchange receipts from the oil sector, a sever foreign exchange shortage, and a large cut in government's development expenditures. Private fixed investments also fell significantly. The impact of the balance of payment crisis was carried through 1987. The adverse impact of lower oil prices on investment and output was exacerbated by the Iran-Iraq war. Aside from negatively affecting economic activity, the war damaged oil-export facilities, hampered sea-transportation, thus exacerbating the impact of a sharp fall in the price of oil.

To assess the relative capital deepening of sectors, and their respective adjustments in capital use over time, it is insightful to examine the sectoral distribution of capital accumulation over time.

In Figure 1 which graphically presents this result with respect to Iran, we observe the existence of one sector that remains an outlier at the low end of the distribution spectrum in both 1983-90 and 1981-97 period, reflecting a significant decapitalization (negative growth rate of capital stock). This sector turns out to be sector 354, which is “miscellaneous petroleum and coal products”. The Iran-Iraq War (1981-87) can explain much of this negative growth rate in the *first* of the two periods under study. The war was responsible for much destruction of capital stock, especially in the oil sector and related petrochemical industries. The factor that can explain the negative growth rate of capital stock during the *second* part of this period is the US-led embargo on foreign investments in the Iranian Oil industry. Though this embargo has not been entirely successful, due to the lack of support from the European Union, it has nonetheless led to a substantial slow down in investments in this sector. It is also interesting to note that between the first and the second period of observation, the entire histogram experiences a shift to the right of the spectrum, suggesting an improvement in the growth environment in the second period, probably thanks to the end of the war and an environment of construction as the revolution entered its more pragmatic pro-reform phase.

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Table 1: Sector Definitions

Series Cod	Series Name
311	FOOD PRODUCTS
313	BEVERAGES
314	TOBACCO
321	TEXTILES
322	WEARING APPAREL,EXCEPT FOOTWEAR
323	LEATHER PRODUCTS
324	FOOTWEAR,EXCEPT RUBBER OR PLASTIC
331	WOOD PRODUCTS,EXCEPT FURNITURE
332	FURNITURE,EXCEPT METAL
341	PAPER AND PRODUCTS
342	PRINTING AND PUBLISHING
351	INDUSTRIAL CHEMICALS
352	OTHER CHEMICALS
353	PETROLEUM REFINERIES
354	MISC. PETROLEUM AND COAL PRODUCTS
355	RUBBER PRODUCTS
356	PLASTIC PRODUCTS
361	POTTERY,CHINA,EARTHENWARE
362	GLASS AND PRODUCTS
369	OTHER NON-METALLIC MINERAL PROD.
371	IRON AND STEEL
372	NON-FERROUS METALS
381	FABRICATED METAL PRODUCTS
382	MACHINERY,EXCEPT ELECTRICAL
383	MACHINERY ELECTRIC
384	TRANSPORT EQUIPMENT
385	PROFESSIONAL & SCIENTIFIC EQUIPM.
390	OTHER MANUFACTURED PRODUCTS

Table 2: 3-digit ISIC Sector-Wide Capital Stock Estimates for Iran: 1982-97

year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
311	1,03	1,03	1,09	1,12	1,15	1,17	1,27	1,27	1,25	1,23	1,24	1,27	1,28	1,34	1,40	1,45
314	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,09	0,08	0,08	0,07	0,09	0,12	0,11	0,11	0,11
321	1,25	1,30	1,38	1,41	1,46	1,50	1,54	1,53	1,53	1,56	1,62	1,71	1,77	1,93	1,95	1,96
322	0,03	0,03	0,03	0,03	0,03	0,03	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10	0,10
323	0,12	0,11	0,11	0,11	0,10	0,10	0,10	0,10	0,09	0,09	0,09	0,09	0,08	0,08	0,08	0,07
324	0,11	0,10	0,10	0,10	0,10	0,09	0,10	0,09	0,09	0,08	0,08	0,08	0,08	0,07	0,06	0,06
331	0,17	0,17	0,17	0,17	0,16	0,16	0,17	0,17	0,17	0,17	0,17	0,17	0,17	0,17	0,17	0,17
332	0,05	0,05	0,05	0,05	0,05	0,06	0,07	0,08	0,08	0,07	0,08	0,08	0,08	0,07	0,07	0,06
341	0,09	0,10	0,11	0,13	0,14	0,14	0,15	0,15	0,17	0,17	0,18	0,18	0,20	0,24	0,26	0,27
342	0,03	0,03	0,04	0,04	0,05	0,05	0,06	0,07	0,08	0,09	0,10	0,11	0,12	0,14	0,15	0,15
351	0,04	0,06	0,07	0,08	0,09	0,10	0,13	0,16	0,18	0,22	0,24	0,25	0,26	1,15	1,25	1,35
352	0,31	0,32	0,33	0,35	0,38	0,39	0,43	0,46	0,47	0,49	0,51	0,53	0,54	0,59	0,62	0,64
353	0,02	0,03	0,03	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,10	0,14	0,26
354	1,65	1,34	1,09	0,89	0,72	0,59	0,48	0,39	0,32	0,27	0,22	0,18	0,15	0,13	0,10	0,09
355	0,08	0,08	0,09	0,11	0,13	0,14	0,15	0,15	0,17	0,16	0,16	0,18	0,19	0,20	0,31	0,66
356	0,47	0,45	0,45	0,45	0,45	0,44	0,44	0,44	0,44	0,42	0,41	0,42	0,41	0,41	0,40	0,40
361	0,02	0,02	0,02	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,05	0,05	0,07	0,07	0,08
362	0,24	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,23	0,25	0,24	0,23	0,23	0,24
369	2,42	2,32	2,30	2,29	2,26	2,24	2,27	2,24	2,19	2,12	2,06	2,06	2,00	1,96	1,94	2,05
371	0,07	0,25	0,25	0,26	0,28	0,30	0,31	0,32	0,32	0,33	0,37	0,52	0,71	1,36	1,55	1,91
372	0,07	0,07	0,09	0,10	0,11	0,12	0,21	0,30	0,30	0,31	0,47	0,56	0,58	0,59	0,58	0,58
381	0,36	0,37	0,39	0,43	0,45	0,47	0,53	0,53	0,60	0,61	0,63	0,65	0,77	0,81	0,82	0,85
382	0,48	0,48	0,51	0,55	0,60	0,60	0,70	0,75	0,77	0,79	0,87	0,94	0,97	1,00	1,00	1,00
383	0,54	0,53	0,54	0,53	0,53	0,54	0,55	0,56	0,54	0,52	0,50	0,51	0,50	0,50	0,52	0,53
384	0,42	0,42	0,43	0,49	0,60	0,59	0,60	0,61	0,59	0,58	0,62	0,66	0,68	0,71	0,74	0,81
385	0,04	0,04	0,05	0,05	0,05	0,05	0,06	0,06	0,05	0,05	0,06	0,06	0,07	0,08	0,08	0,09
390	0,01	0,01	0,01	0,01	0,02	0,02	0,03	0,03	0,03	0,03	0,03	0,04	0,04	0,04	0,05	0,05

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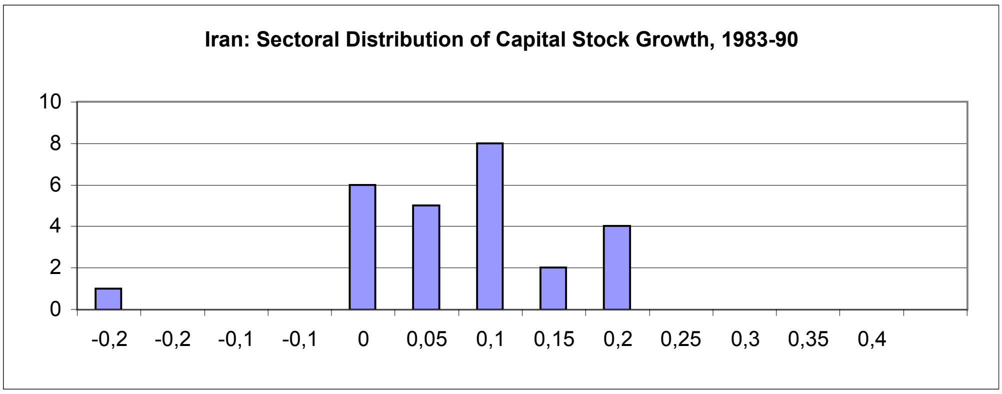
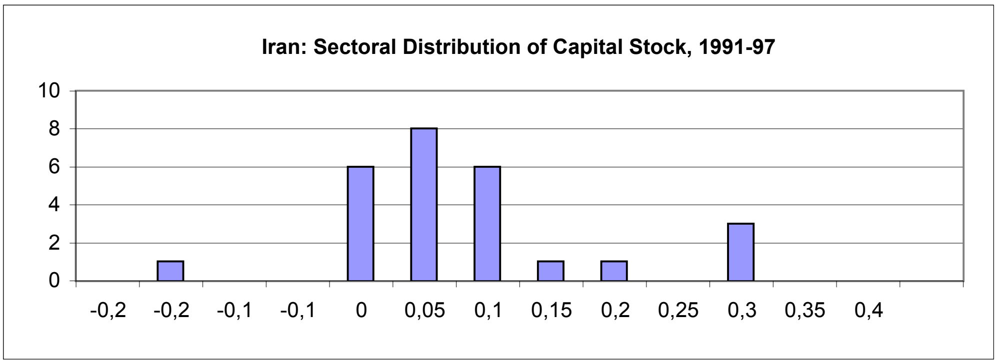
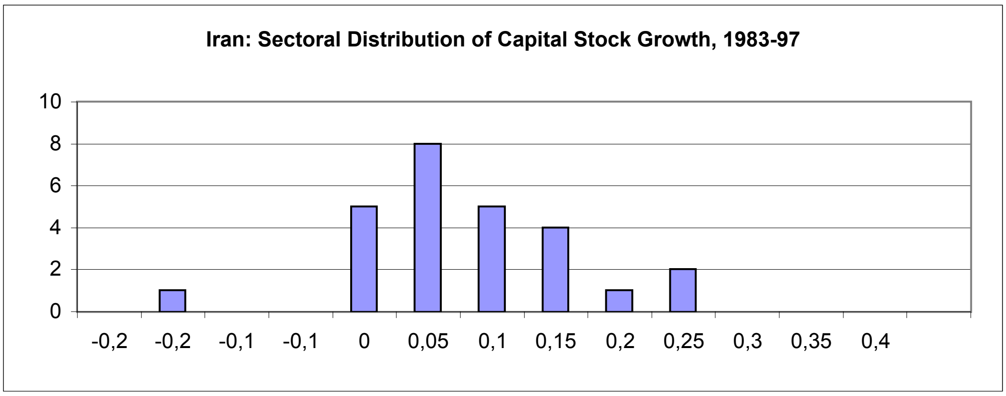
Figure 1: Sectoral Distribution of Capital Stock Growth for Ir







Estimates of Total Factor Productivity for 3-digit ISIC Manufacturing Sectors in Iran (1983-97) and Egypt (1964-1993)*

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Estimates of Total Factor Productivity for 3-digit ISIC Manufacturing Sectors in Iran (1983-97) and Egypt (1965-1993)

1. Executive Summary

Among the most important and fundamental components of economic development is the role of *capital accumulation, employment growth* and *technological change*. These processes are highly sensitive to market forces and incentives, to industrial policy, to macro economic policy, and to international trade policy. To the extent that these forces provide an environment for technological change, capital deepening and employment growth typical follow, all else unchanged. However, all else is seldom unchanged. The economic shocks experienced in the 1970s and 1980s, and other economic contingencies often give rise to "boom and bust" cycles, making difficult the tracing of the fundamental sources of economic growth, or the lack thereof. Given the dynamic and leading role that the *industrial sector* plays in this process, this project is about understanding these processes for the industrial sector. It has been the principal goal of this project to construct a databank that focuses on these processes at a sufficiently *disaggregate* sector-wide level to make the results useful to policy makers and available to future researchers, emphasizing sub-sector specific and economy-wide forces that induce growth.

The project has focused on Iran and Egypt, two of the most populated and arguably most strategically key countries in the Middle East and North Africa region. In view of both countries' geo-political and strategic importance, the question of the ability of the countries to prosper and to integrate into the world trade is fundamentally important both for the region, and for their trading and strategic partners.

The economy of each of the two countries has been subject to a number of adverse effects. In Egypt, many years of state control of the economy led to an extremely large public sector, relatively low output to capital and output to labor ratios, and a sluggish response to changes in the external environment. In Iran, decades of turmoil has affected economic performance in profound ways. The continuing political tensions on the direction of the economy and the polity affected the private sector and the incentive structure of the economy in many adverse ways. Historically, both countries have been relatively closed with emphasis on import-substitution policies, although, in the case of Egypt, starting in the early to mid 1990s, there has been a more serious effort under way to reduce the size of the public sector and to open up the economy. In the case of Iran, the most recent atmosphere of political openness is a hopeful sign that may contain the seeds of economic openness in the coming years.

The sectoral analysis of both counties confirm the aggregate trends. This analysis is based on our year and half long effort to develop a databank on capital stock and total factor productivity on 3-digit ISIC sectors. Although we first began our project with a more detailed search for 4-digit ISIC data, we soon learned of enormous and frequent limitations on this data. We therefore used 3-digit data instead. The final data includes 18 3-digit sectors for Egypt for the 1964-1993 period (1995 for capital stock data) and 26 3-digit sectors for Iran for 1983-1993 period (1997 for capital stock and value added).

The detailed methodology of measurement of the data follow this executive summary. Detailed sectoral data on TFP growth as well as selected charts from our results are presented at the end. However, some results from the aggregation across the industries are reported and discussed presently.

Chart 1 compares the two country's industrial performance, in terms of output growth for 1983-97 period for Iran and 1965-93 period for Egypt. The smoothed (filtered) line removes idiosyncratic shocks, a mean preserving procedure common in business cycle analysis, based on what is known as the Hodrick-Prescott filter. The chart for Egypt reveals the boom and bust periods of the 1970s, the contraction and readjustment of the early 1980s, and then an adjustment to what appears a more stable path in the early 1990s. The case for Iran begins in the 1980s, and reveals a similar pattern to Egypt.   Over comparable years, both charts suggest that industrial growth in both countries stagnated over the long-run. However, in Iran there is some evidence of growth beginning 1995; in the case of Egypt, value added data stops at 1993, but other evidence (e.g. World Bank Report) suggest some increase in this sector's activity, since 1993.

Chart 1a:

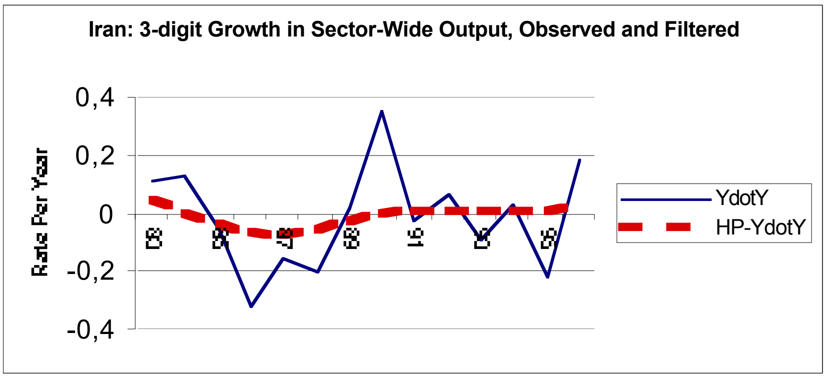
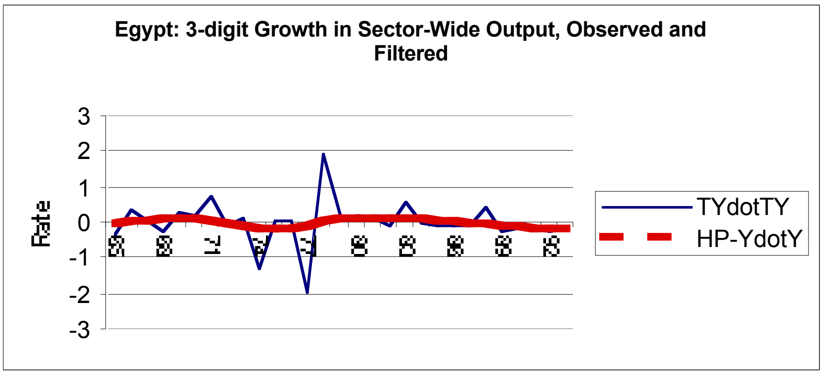


Chart 1b:



The growth of capital stock (Chart 2) in both countries has seen wide fluctuations, with Egypt showing a period of decline in growth during the period of 1980s until early 1990s. This evidence is consistent with Egypt's industrial and structural adjustments associated with its struggle to liberalize the economy. Moreover, the turn-around that can be seen at the end of chart 2b is also consistent with Egypt's relative success with open door policies, beginning 1993. In Iran, despite some fluctuations, there has been a steady increase in the growth of capital stock. But this may have been due to large public sector spending including large state enterprises, rather than increased openness.

Chart 2a:

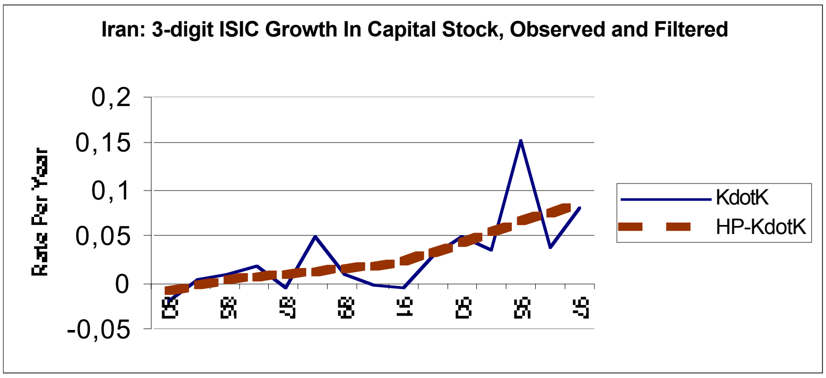
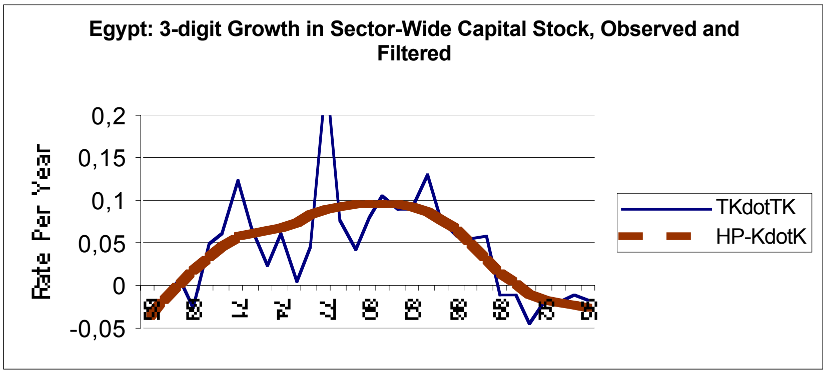


Chart 2b:



Finally, contrasting the growth of the factors labor and capital as well as total factor productivity (Chart 3), one is struck in the Egyptian case by the large fluctuations in output that are not associated with similar fluctuations in labor input. This confirms the widely known fact that employment policy in Egypt's public and quasi-public enterprises discourages unemployment across business cycles. Since the public sector plays an unusually large role in Egypt's industrial production, output fluctuations result in fluctuations in capital utilization rates, rather than in employment. Our detailed sectoral analysis revealed unusually large share of labor costs in value added (sometimes exceeding 100%), suggesting the possibility that some state sector industries may have been producing at a substantial loss, a loss that is then absorbed by, for example, the banking sector or directly from the central government's budget. To the extent that our residual estimate of the growth in total factor productivity embodies these and other considerations, it should not be interpreted as a pure measure of technological progress. Rather, one may seek to assess its determinants, such as in sphere of public versus private sector ownership.

The forgoing analysis has been done for each of the 3-digit industrial sectors for both countries. However, the main objective of this project has been the development of an extensive databank on capital stock and total factor productivity in order to answer these and many other policy questions by future researchers in the area one may choose to investigate.

Chart 3a:

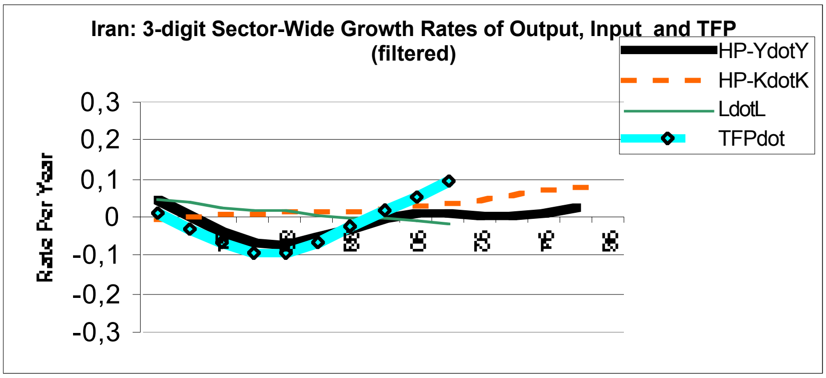
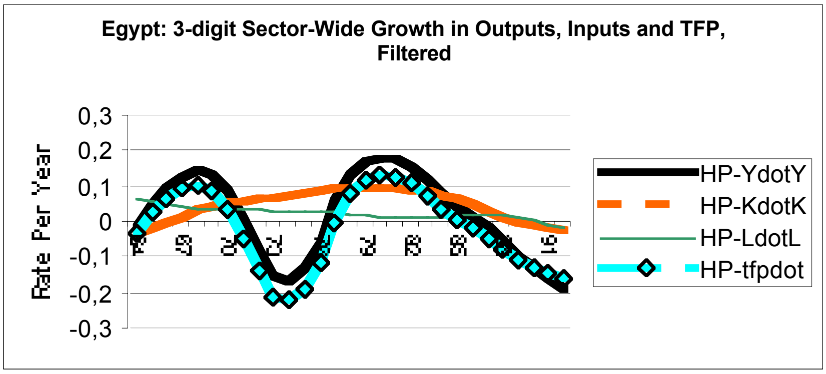


Chart 3b:



2. Introduction

This paper deals with the second part of a two-stage project. The first stage involved developing measures of capital stock for 3-digit ISIC manufacturing industries for select countries of Middle East and North Africa, notably Egypt and Iran, covering the period 1964-95 for Egypt and 1983-97 for Iran. The second stage, which is the subject of this paper, involves utilizing this databank to construct systematic estimates of Total Factor Productivity (TFP) in these countries and industries for the same period, though lack of availability for a few other indicators reduces the time span of the TFP project to a slightly smaller range than that for the capital stock project.

Creation of such a databank will enable both countries to address key policy issues that cannot be adequately answered now and is therefore beyond the scope of this project. For example, capital stock data are needed for estimation purposes in EU-MENA trade policy (e.g., role of trade in factor intensity and identifying sectors with comparative advantage), or the impact of EU expansion on the MENA's industrial and labor policies (e.g., skill and capital substitutability) and its macro policies (e.g., economic growth and convergence hypothesis). Similarly, TFP is key to understanding sources of economic growth and is especially relevant to technology and knowledge-based policies, such as the impact of technology on economic growth, education and training of the workforce, role of trade with EU on technology diffusion to the MENA region, export promotion policies and their sectoral productivity impact, and the productivity effects of Intellectual Property in different sectors, to mention a few.

Following a detailed description of the methodology, TFP growth results and some selected charts are presented at the end of the report.

3. Methodology

Due to the relatively short time series of data at this time, a regression approach to the calculation of TFP yields unsatisfactory results. Thus, a non-parametric approach is employed following Alyuwn Young (1995). In aggregate studies of TFP only capital and labor appear as inputs. However, at the industry level, the issue is more complex because intermediate inputs must also be considered (such inputs do not appear in macro studies as aggregation across all industries causes them to "cancel out" at the aggregate level). For this reason, value added data, rather than gross output data, are of key significance. Estimates of industry-level TFP will be enormously useful to numerous analyses and questions.

The specific steps involve, first, the estimation of a translog *value –added* production function as follows:

$$\ln Y = \alpha_0 + \alpha_L \ln L + \alpha_K \ln K + \alpha_t t + \beta_{LL} (\ln L)^2 + \beta_{KK} (\ln K)^2$$
$$+ \beta_{KL} \ln K \ln L + \beta_{Kt} \ln K * t + \beta_{Lt} \ln L * t + \frac{1}{2} \beta_{tt} t^2$$

where Y, K, L and t denote output, capital input, labor input and time. Under the assumption of constant return to scale, α 's and β 's satisfy the restrictions:

$$\alpha_K + \alpha_L = 1 \qquad \beta_{KK} + \beta_{KL} = \beta_{LL} + \beta_{KL} = \beta_{Kt} + \beta_{Lt} = 0$$

Then the growth of output can be decompose as

$$\ln(\frac{Y(t)}{Y(t-1)}) = \bar{\theta}_K \ln[\frac{K(t)}{K(t-1)}] + \bar{\theta}_L \ln[\frac{L(t)}{L(t-1)}] + TFP_{t,t-1}$$

where

$$\bar{\theta}_i = [\theta_i(t) + \theta_i(t-1)] / 2$$

and where the θ 's denote the elasticity of output with respect to each input, equivalently, under perfect competition assumption, the share of each input in total factor payments. The share of labor income in each sector is the ratio of corresponding sectoral compensation to value added. Data on wage compensation and employment were used both from UNIDO and local sources for both countries. These data are described at some length in two separate papers on the measurement of the capital stock for both countries. Given the CRS assumption the share of capital is therefore also found. Both wages rates and value added are measured in nominal terms, since they enter in ratio form. This assumes the same price index for both indicators. Appendix 1 provide sector definitions, Appendices 2-4 reports the results for both countries with each appendix being divided into two subsets (A and B) for Iran and Egypt respectively.

Several important issues arise in the calculation of total factor productivity using the Solow-Residual approach. First, given the statistical noise in the various series that are used in the calculation of the TFP as a residual, the residual itself embodies such noise. Thus, while we have presented the actual calculated TFP series for detailed sectors, in the presentation of the *aggregate* results (Charts 1-3 main text), we have chosen the approach developed by Hodrick-Prescott (1997) in their study of the Business Cycles. This approach amounts to filtering the noise in order to produce a smooth mean preserving series.

This method has a long history of use, particularly in the actuarial sciences. Following Hodrick and Prescott, the observed time series, y_t, are viewed as the sum of cyclical components, c_t, and growth components, g_t, i.e.,

$$y_t = g_t + c_t, \text{ for } t = 1, ..., T.$$

Our prior knowledge, based upon growth theory, is that growth components vary "smoothly" over time following their secular evolution. The measure of the smoothness of the $\{g_t\}$ path is the sum of the squares of its second difference. By taking differences, the somewhat ill behaved random walk nature of the data series become ultimately well behaved series of zero mean white noise and makes the series stationary. The variable c_t is the deviation from $g_{t.}$ The notion is that, over long time periods, the cycles, $c_{t\,,}$ where c_t $=y_t-g_t$, average near zero. This presumption leads to the following programming problem for determining the underlying growth components in the observed time series y_t:

$$Min_{<g_t>_{t=-1}^{T}} \sum_{t=1}^{T}(y_t - g_t)^2 + \lambda\sum_{t=1}^{T}\left[(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})\right]^2$$

The parameter λ is a positive number that penalizes variability in the growth component of the series. The larger the value of λ, the "smoother" is the underlying growth trend g_t. For a sufficiently large λ, at the optimum all the $g_{t+1} - g_t$ must be arbitrarily near some constant β and therefore the g_t arbitrarily near $g_0 + \beta_t$. This implies that in the limit of solution to the above equation as λ approaches infinitely is the least squares fit of a linear time trend model, and for $\lambda = 0$, the smoothed data are exactly the same as the sample data.

The selection of the smoothing parameter λ is based on a probability model. If the cyclical components and the second differences of the growth components are identically and independently distributed normal variables with mean zero and variances σ_1^2 and σ_2^2 (which they are not), then the conditional expectation of the g_t, given the observations, would be the solution of the above equation when $\sqrt{\lambda} = \sigma_1/\sigma_2$.

Different values of λ provide different information, e.g., a large value of λ approximates the annual average rate of growth given by an ordinary least squares fit to the log of the data. The problem is to choose the value of λ that best depicts the underlying growth components in the data, and then to employ that value for all the cases. The serial correlation of the cyclical components for different values of λ indicates that the selected smoothing parameter ($\lambda = 20$) seems to capture the underlying growth components of the data without undue smoothing which appears to result when x reaches its upper bound. [1]

The results of this smoothing exercise are reported in Charts 1-3 in the body of this paper (Executive Summary).

A second measurement problem we faced was that in the case of Egypt, the share of labor costs in value added (that enters into the calculation of TFP) exceeded unity for some specific years and sectors! Further exploration revealed that for these cases, periods of decline in value added for that sector (s) was *not* accompanied with corresponding declines in that sector's (sectors') employment level. This finding is consistent with the stability of employment and employment guarantees that has been historically observed to be associated with the state sector in Egypt (C.f. Holt and Roe, 1993) *combined* with the relative large share of the state sector in many industries, averaging for example to 69 percent of total sectoral production in the

[1] See Also Diao, Roe and Agapi (1999) for an application of this method to the agriculture sector.

1980s (ibid, p. 201). When the Egyptian economy began to open and foreign firms entered in the 1980s and 1990s, such heavily protected sectors faced increased competition resulting in output declines. Under these circumstances the employment guarantees lead to excess capacity and labor shares exceeding unity, as we have found.

Since the labor share enters the TFP calculations, this phenomenon has to be corrected. In order, to correct for this, we ran a regression equation for the 1964-1993 (time period of the data) that "filtered out" the cases where the labor share exceeded unity. This was done a follows (the sector subscript is suppressed for convenience):

$$\ln(Y/K)_t = a + b\ln(L/K)_t + cD_t + \varepsilon_t$$

where D_t is a dummy variable, such that $D_t=1$, wherever $SL_t \geq 1$ where SL_t is the labor share, and $D_t=0$ wherever $SL_t < 1$.

The slope $\hat{b}$ is then an estimate of the "corrected" labor share, once the "excessively large" values of labor share are controlled for by the dummy variable. Thus, it is an estimate of the equivalent (competitive) labor share when excess capacity together with employment rigidity causes the value of labor share to exceed unity.

The resulting estimates of TFP, based on the production function method are reported in Appendices 2A for Iran and 2B for Egypt. In the case of Appendix 2B, Table 1a reports the calculated TFP growth shares based on observed shares and table 1b which presents these results based on the estimated labor shares using the above method. For the purposes of TFP estimates in Egypt, of the three alternative estimates of capital stock provided Mohtadi, Mohtadi, Abdel-Latif and Lin (2001) the more exclusive measure (machinery and transport equipment) has been used. Although the more inclusive measure that includes construction and buildings is also available, the authors felt that for the purposes of measuring the TFP, this more specific measure of capital stock is more appropriate.

4. Additional Observations

Of interest is also a "Growth Accounting" exercise. This amounts to measuring the contribution of each factor to the overall growth of net output for each sector. This task is illustrated both numerically and graphically in Appendices 3A and 3B for a few select sectors. For example, in the case of food processing (sector 311) the result of this growth accounting exercise suggests that except for the spike in 1985-87 period, where a rise in the contribution of labor is associated with a decline in the contribution of TFP, for other years the sector has experienced a relatively stable contribution of labor and capital (and thus TFP). For the same sector in Egypt greater variation is observed on the contribution of the three factors. This is especially so in the period that is comparable with the Iranian data (1983-93). With respect to another common sector, that of transport and equipment (384), both countries experienced periods of relative stability in the contribution of each factor, though again greater stability is observed with the Iranian data. In the comparable period of the 1980s, this stability is interrupted for Egypt by sharp rise in employment form 85 to 89 (and some increased capital expenditures in 87-89 period), while in Iran, the 91-92 period shows a similar rise in this sector's employment (with an accompanying *decline* in capital expenditures).

Whether efforts towards a greater openness of the Egyptian economy during the 1980s period, as compared with the increasing isolation of the Iranian economy following the Iranian revolution in this period, have produced these different results remain to be determined by future research.

To assess the relative capital deepening of sectors, and their respective adjustments in capital use over time, it is insightful to examine the sectoral distribution of capital accumulation over time.

In Appendix 4A which graphically presents this result with respect to Iran, we observe the existence of one sector that remains an outlier at the low end of the distribution spectrum in both 1983-90 and 1981-97 period, reflecting a significant decapitalization (negative growth rate of capital stock). This sector turns out to be sector 354, which is "miscellaneous petroleum and coal products". The Iran-Iraq War (1981-87) can explain much of this negative growth rate in the *first* of the two periods under study. The war was responsible for much destruction of capital stock, especially in the oil sector and related petrochemical industries. The factor that can explain the negative growth rate of capital stock during the *second* part of this period is the US-led embargo on foreign investments in the Iranian Oil industry.

Though this embargo has not been entirely successful, due to the lack of support from the European Union, it has nonetheless led to a substantial slow down in investments in this sector. It is also interesting to note that between the first and the second period of observation, the entire histogram experiences a shift to the right of the spectrum, suggesting an improvement in the growth environment in the second period, probably thanks to the end of the war and an environment of construction as the revolution entered its more pragmatic pro-reform phase.

The corresponding Appendix for Egypt is Appendix 4B. The interesting point here is the existence of a positive outlier in the 1980-84 period, pointing to a much faster than average growth rate. This sector which also shows up as a positive outlier, in the 1970-74 and 1975-79 period (not shown here), is sector 372, or “non-ferrous metals.” The sector’s was not an outlier in the very early period of the study (1965-69), and also is no longer an outlier in the very late period of the study (1994-95). One possible explanation is that this sector enjoyed much protection during those periods with above-average rate of capital accumulation, but has now lost this protective advantage as Egypt has begun to experience its relative openness since the mid-1990s. Another interesting sector, sector 390 which represents “other manufactured products,” shows a generally below average and often negative rate of capital accumulation, showing up as a relative outlier in the negative range.

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Table 1: Sector Definitions

Series Cod	Series Name
311	FOOD PRODUCTS
313	BEVERAGES
314	TOBACCO
321	TEXTILES
322	WEARING APPAREL,EXCEPT FOOTWEAR
323	LEATHER PRODUCTS
324	FOOTWEAR,EXCEPT RUBBER OR PLASTIC
331	WOOD PRODUCTS,EXCEPT FURNITURE
332	FURNITURE,EXCEPT METAL
341	PAPER AND PRODUCTS
342	PRINTING AND PUBLISHING
351	INDUSTRIAL CHEMICALS
352	OTHER CHEMICALS
353	PETROLEUM REFINERIES
354	MISC. PETROLEUM AND COAL PRODUCTS
355	RUBBER PRODUCTS
356	PLASTIC PRODUCTS
361	POTTERY,CHINA,EARTHENWARE
362	GLASS AND PRODUCTS
369	OTHER NON-METALLIC MINERAL PROD.
371	IRON AND STEEL
372	NON-FERROUS METALS
381	FABRICATED METAL PRODUCTS
382	MACHINERY,EXCEPT ELECTRICAL
383	MACHINERY ELECTRIC
384	TRANSPORT EQUIPMENT
385	PROFESSIONAL & SCIENTIFIC EQUIPM.
390	OTHER MANUFACTURED PRODUCTS

Appendix 2A: TFP Growth at 3-digit ISIC in Iran

	311	314	321	322	323	331	332	341	342	351	352	353	354	355	356	361	362	369	371	372	381	382	383	384	385	390
1983	-0,08	0,17	0,03	0,11	0,02	-0,06	0,10	0,11	-0,05	0,37	0,16	0,02	0,16	0,15	0,24	0,07	0,03	0,13	-0,26	0,36	0,10	0,30	0,13	0,20	0,04	0,39
1984	-0,08	-1,39	0,00	0,25	0,25	0,21	-0,12	0,02	0,09	0,03	0,16	0,10	0,37	-0,05	0,01	-0,25	0,22	0,08	0,34	0,22	0,06	0,18	0,03	0,11	0,23	0,07
1985	0,03	-0,28	-0,04	-0,25	-0,17	-0,07	-0,24	-0,08	-0,06	-0,11	-0,09	-0,07	0,47	-0,15	-0,14	0,27	-0,16	0,01	0,08	-0,15	-0,05	-0,19	-0,04	-0,24	-0,24	-0,12
1986	-0,19	-0,19	-0,38	-0,34	0,12	-0,17	-0,31	-0,42	-0,36	0,03	0,05	-1,14	-0,20	0,01	-0,14	-0,36	-0,41	-0,29	-0,33	-0,40	-0,26	-0,46	-0,27	-0,55	-0,35	-0,49
1987	-0,07	-0,01	-0,42	0,07	-0,16	-0,11	0,11	-0,76	0,05	-0,12	-0,19	0,82	0,90	0,01	-0,13	-0,46	-0,36	-0,05	-0,45	-0,39	-0,31	0,04	-0,59	-0,19	-0,40	-0,08
1988	0,24	1,00	-0,18	-0,97	-0,22	-0,09	-0,45	-0,10	-0,57	-0,58	-0,42	-0,09	-0,16	-0,27	0,38	-0,39	-0,23	-0,67	0,01	-0,48	-0,19	-0,16	0,00	-0,25	-0,28	-0,72
1989	-0,13	-0,59	-0,08	-0,26	-0,25	-0,07	-0,02	-0,09	0,38	0,43	0,31	-0,22	0,56	0,22	0,04	-0,10	-0,14	-0,03	-0,23	-0,33	0,30	0,10	-0,10	0,30	0,25	-0,12
1990	0,26	0,19	0,32	0,32	0,39	0,03	-0,05	0,41	-0,18	0,11	0,06	-0,11	0,36	0,16	0,27	0,40	0,03	0,20	0,82	1,25	-0,07	0,33	0,81	0,61	0,06	0,55
1991	0,26	0,80	-0,22	-0,53	-0,42	-0,44	0,08	-0,04	-0,28	-0,01	-0,22	0,30	-0,21	-0,03	-0,15	-0,54	0,48	-0,12	-0,30	-0,41	0,03	-0,58	0,54	0,76	0,33	-1,07
1992	-0,04	-0,54	-0,02	-0,01	-0,11	0,24	0,08	0,01	0,07	-0,50	0,06	-0,57	0,18	0,40	-0,29	0,29	0,18	0,50	0,65	0,40	-0,16	-0,16	-0,18	-0,79	0,15	0,63
1993	0,31	0,05	-0,19	-0,50	-0,14	-0,13	-0,26	-0,03	-0,31	0,42	-0,37	0,50	-0,18	-0,42	-0,12	-0,07	-0,41	-0,22	-0,33	-0,82	0,00	-0,05	-0,12	0,01	-0,08	0,81

Appendix 2B: TFP Growth at 3-digit ISIC in Egypt

Table 1: Growth in TFP, Based on Actual Labor shares, Egypt

	311	313	314	321	324	331	332	341	342	352	361	371	372	381	382	383	384	390
1964																		
1965	-0,28	-0,17	-0,79	-0,30	-0,47	-0,78	-0,22	-0,45	-0,34	-1,16	0,00	-0,40	-0,28	-0,18	-0,26	-0,22	-0,28	-0,02
1966	0,42	0,29	0,91	0,36	0,32	0,47	0,15	-0,05	0,14	0,32	0,67	0,65	-0,36	0,41	0,48	0,16	-0,16	0,36
1967	0,02	-0,02	0,37	0,02	0,09	-0,04	-0,20	0,05	0,24	0,21	0,21	0,40	-1,06	-0,17	0,31	0,18	0,11	-0,09
1968	-0,21	-0,14	-0,19	-0,19	-0,31	0,31	0,11	-0,11	0,01	-0,08	-0,31	-2,68	-0,03	-0,08	-0,41	-0,06	0,50	0,15
1969	-0,11	0,05	-0,13	0,02	3,01	0,13	-0,18	0,09	0,07	0,08	0,32	1,66	0,04	0,10	-0,09	-0,05	-0,38	-0,57
1970	-0,07	-0,03	-0,04	0,05	0,53	0,19	-0,38	0,08	0,17	0,16	-0,03	0,40	-0,36	0,02	0,07	0,17	0,01	-1,26
1971	0,48	-0,53	-0,01	1,72	-3,41	0,45	0,23	0,33	-0,10	0,06	0,02	-0,18	-0,16	0,03	-0,06	-0,11	-0,05	0,15
1972	-0,07	-0,10	-0,16	-0,17	-0,07	-0,09	-0,09	-0,08	0,00	-0,01	-0,23	-0,02	-0,17	0,00	-0,16	-0,03	-0,04	-0,50
1973	0,13	0,11	0,04	-0,01	0,15	0,19	0,16	0,07	0,11	0,13	-0,06	0,11	0,63	0,09	0,15	0,20	0,16	0,44
1974	-0,45	0,18	-0,10	-2,35	-0,20	-0,19	0,07	0,17	-0,25	-0,29	-0,50	-0,92	-0,62	-0,26	-0,08	-0,24	-0,03	-0,44
1975	-0,07	-1,98	-0,16	0,48	-0,01	-0,40	-0,14	-0,01	0,30	-0,07	-0,05	-1,16	-0,36	-0,13	-0,15	0,01	-0,25	0,08
1976*	0,10	2,38	-0,91	0,00	-0,21	0,01	0,01	-0,27	-0,03	0,22	0,31	0,42	-0,10	-0,05	0,28	0,03	0,09	0,48
1977*	-1,33	-3,12	-2,15	-2,92	-1,71	-1,59	-0,47	-2,58	-0,38	-1,35	-3,11	-2,57	-5,22	-1,66	-2,91	-3,80	-4,32	-1,87
1978	-0,78	3,34	2,04	3,00	1,57	2,01	0,58	1,99	0,21	1,44	3,01	3,44	4,93	1,63	2,41	3,73	4,45	0,39
1979	2,25	-0,44	0,71	-0,29	-0,19	0,07	0,07	0,01	-0,33	-0,32	-0,06	0,46	-0,21	-0,04	-0,10	-0,05	0,32	0,73
1980	0,28	-0,16	-0,65	0,25	0,81	-0,57	0,02	0,49	0,29	0,17	-0,10	0,19	0,13	-0,01	0,07	0,00	-0,45	-0,29
1981	-0,10	0,62	0,50	-0,05	-0,65	0,22	0,14	-0,57	0,50	0,27	0,35	0,13	-0,34	0,46	0,01	0,49	0,33	0,51
1982	-0,10	-0,08	-0,40	-0,07	-0,08	-0,06	-0,11	-0,06	-0,23	-0,16	-0,21	-0,10	-0,09	-0,09	-0,07	-0,18	-0,09	0,02
1983	0,27	0,46	1,64	0,25	0,52	0,09	0,17	0,83	0,05	0,43	-0,06	1,95	0,72	0,27	0,56	0,40	0,38	0,51
1984	-0,09	-0,10	-0,27	-0,04	-0,03	-0,07	-0,15	-0,04	-0,04	-0,10	0,12	0,07	-0,21	-0,05	-0,16	-0,07	-0,07	-0,12
1985	-0,15	-0,19	-0,21	-0,20	-0,19	-0,07	-0,10	0,30	-0,05	-0,01	-0,30	-0,02	0,05	-0,13	-0,21	-0,15	-0,10	0,12
1986	-0,11	-0,21	-0,16	-0,03	-0,03	-0,04	-0,12	-0,47	-0,09	-0,11	-0,06	-0,04	-0,02	-0,09	-0,07	-0,11	-0,04	-0,05
1987	-0,11	-0,05	-0,15	-0,12	-0,11	-0,29	-0,13	-0,14	-0,13	-0,16	-0,19	-0,21	-0,15	-0,13	-0,07	-0,06	-0,12	-0,20
1988	-0,24	0,35	1,98	0,40	0,47	1,48	0,08	0,29	-1,54	0,19	0,01	-1,99	1,17	0,73	0,34	0,44	0,73	-0,53
1989	-0,28	-0,31	-0,19	-0,27	-1,23	-0,25	-0,32	-0,20	0,32	-0,26	-0,28	-0,50	-0,45	-0,13	-0,26	-0,19	-0,33	-0,30
1990	-0,21	-0,20	-0,16	-0,13	-0,19	-0,11	-0,21	0,06	0,47	-0,14	-0,18	-0,27	-0,20	-0,16	-0,20	-0,25	-0,23	-0,13
1991	-0,19	-0,13	-0,13	-0,11	-0,08	-0,23	-0,16	0,04	-0,52	-0,08	-0,46	-0,06	-0,07	-0,07	-0,05	-0,03	-0,10	-0,23
1992	-0,14	-0,01	-0,18	-0,24	-0,24	-0,14	-0,17	-0,35	-1,95	-0,25	0,14	-0,14	-0,20	-0,17	-0,22	-0,20	-0,17	-0,26
1993	-0,10	-0,15	-0,25	-0,08	-0,12	-0,10	-0,14	0,01	0,40	-0,08	0,07	-0,27	-0,12	-0,08	-0,04	-0,06	-0,07	-0,37

Table 2: Growth in TFP, Based on Estimated Labor shares, Egypt

	311	313	314	321	324	331	332	341	342	352	361	371	372	381	382	383	384	390
1964																		
1965	-0,28	-0,26	-0,63	-0,29	-0,52	-0,68	-0,24	-0,48	-0,44	-1,17	-0,02	-0,41	-0,35	-0,18	-0,43	-0,14	-0,28	-0,46
1966	0,43	0,31	0,91	0,36	0,21	0,44	0,15	-0,05	0,16	0,32	0,64	0,66	-0,44	0,41	0,31	0,28	-0,08	0,43
1967	0,03	-0,01	0,38	0,02	0,06	-0,05	-0,20	0,05	0,27	0,23	0,15	0,39	-1,07	-0,15	0,28	0,16	0,05	-0,53
1968	-0,22	-0,16	-0,19	-0,19	-0,32	0,31	0,10	-0,09	-0,02	-0,07	-0,32	-2,12	-0,04	-0,08	-0,32	-0,06	0,51	0,26
1969	-0,11	0,04	-0,13	0,02	2,99	0,12	-0,07	0,08	0,05	0,11	0,27	1,67	0,02	0,11	-0,12	-0,05	-0,38	-0,85
1970	-0,07	-0,04	-0,04	0,06	0,70	0,18	-0,39	0,07	0,17	0,14	0,04	0,41	-0,27	0,02	0,16	0,17	0,01	-1,27
1971	0,49	-0,53	0,00	1,71	-3,14	0,45	0,23	0,32	-0,10	0,05	0,05	-0,19	-0,07	0,05	-0,14	-0,11	-0,06	0,69
1972	-0,08	-0,11	-0,16	-0,11	-0,06	-0,10	-0,10	-0,07	0,04	-0,04	-0,15	-0,01	-0,14	-0,01	-0,12	-0,03	-0,03	-0,16
1973	0,13	0,10	0,04	0,05	0,07	0,18	0,16	0,07	0,14	0,12	0,02	0,10	0,51	0,09	0,13	0,20	0,16	0,18
1974	-0,44	0,22	-0,10	-2,36	-0,19	-0,18	0,11	0,17	-0,31	-0,30	-0,49	-0,92	-0,52	-0,26	-0,10	-0,23	-0,01	-0,11
1975	-0,07	-2,52	-0,16	0,48	0,12	-0,40	-0,15	-0,01	0,28	-0,07	-0,05	-0,87	-0,36	-0,13	-0,08	0,01	-0,24	0,02
1976	0,10	2,37	-0,95	0,00	-0,31	0,00	0,00	-0,23	-0,03	0,22	0,28	0,30	0,01	-0,05	0,30	0,03	0,09	0,39
1977	-1,33	-3,14	-2,16	-2,92	-1,68	-1,56	-0,48	-2,55	-0,43	-1,34	-3,15	-2,66	-5,13	-1,66	-2,83	-3,81	-4,32	-1,51
1978	-0,78	3,33	2,00	3,01	1,70	2,02	0,63	2,03	0,17	1,43	3,04	3,51	4,93	1,63	2,70	3,73	4,46	0,47
1979	2,26	-0,42	0,71	-0,29	-0,17	0,08	0,08	0,03	-0,39	-0,32	0,09	0,44	-0,20	-0,04	-0,18	-0,06	0,37	0,66
1980	0,28	-0,38	-0,98	0,25	0,97	-0,59	0,04	0,50	0,31	0,18	-0,11	0,20	0,15	-0,02	0,13	0,03	-0,46	-0,28
1981	-0,10	0,62	0,41	-0,06	-0,63	0,16	0,14	-0,55	0,50	0,27	0,33	0,11	-0,48	0,46	0,06	0,49	0,31	0,50
1982	-0,11	-0,08	-0,61	-0,08	-0,05	-0,09	-0,12	-0,06	-0,28	-0,17	-0,15	-0,20	-0,11	-0,09	-0,07	-0,20	-0,14	-0,04
1983	0,27	0,48	1,61	0,22	0,43	0,08	0,19	0,84	0,08	0,44	-0,05	1,87	0,75	0,27	0,50	0,40	0,39	0,41
1984	-0,12	-0,09	-0,26	-0,06	-0,01	-0,10	-0,26	-0,03	-0,17	-0,11	0,09	0,02	-0,24	-0,07	-0,09	-0,09	-0,14	-0,03
1985	-0,17	-0,17	-0,21	-0,30	-0,16	-0,13	-0,16	0,20	0,04	-0,01	-0,33	-0,06	0,09	-0,14	-0,19	-0,15	-0,07	0,01
1986	-0,14	-0,22	-0,16	-0,05	-0,04	-0,18	-0,11	-0,41	-0,21	-0,12	0,11	-0,06	-0,01	-0,09	-0,07	-0,12	0,02	-0,09
1987	-0,09	-0,05	-0,15	-0,13	-0,15	0,01	0,04	-0,14	-0,19	-0,15	-0,22	-0,16	-0,29	-0,10	-0,05	-0,03	-0,10	-0,19
1988	-0,27	0,34	1,96	0,40	0,52	1,54	0,08	0,30	-1,15	0,19	0,10	-2,31	1,26	0,78	0,32	0,44	0,65	-0,38
1989	-0,21	-0,30	-0,21	-0,26	0,06	-0,27	-0,38	-0,23	-0,44	-0,27	-0,26	-0,18	-0,34	-0,16	-0,26	-0,18	-0,32	-0,38
1990	-0,17	-0,20	-0,17	-0,12	-0,09	-0,16	-0,20	0,01	-0,19	-0,13	-0,16	-0,18	-0,20	-0,17	-0,20	-0,26	-0,23	-0,10
1991	-0,08	-0,29	-0,13	-0,12	-0,12	-0,16	0,02	-0,01	-0,10	-0,06	-0,11	-0,08	-0,07	-0,07	-0,06	0,00	-0,11	-0,11
1992	-0,32	0,03	-0,19	-0,21	-0,23	-0,17	-0,26	-0,35	0,06	-0,24	-0,37	-0,27	-0,23	-0,17	-0,22	-0,21	-0,14	-0,15
1993	-0,10	-0,22	-0,21	-0,05	-0,01	-0,09	-0,03	0,01	-0,03	-0,10	-0,05	-0,08	-0,11	-0,08	-0,03	-0,06	-0,12	0,05

Appendix 3A: Select Sector Specific Growth Accounting for Iran

Table 1: Growth Accounting for Food Processing (311), Iran

Contribution of L, K and TFP to the Growth of Output

	CL	CK	CTFP	total
83	0,04687	-0,326042	1,279171	1
84	-0,554288	-0,309891	1,86418	1
84	0,618422	-1,051453	1,433031	1
86	-0,091351	-0,210851	1,302202	1
87	0,613859	6,158051	-5,77191	1
88	0,205918	-0,40763	1,201712	1
89	-0,018179	-0,391514	1,409692	1
90	-0,037916	-0,265975	1,303891	1
91	-0,041364	0,059562	0,981802	1
92	-0,043135	-0,236263	1,279397	1
93	0,055566	-0,012039	0,956473	1

Table 2: Growth Accounting for Petroleum Refineries (353), Iran

Contribution of L, K and TFP to the Growth of Output

	CL	CK	CTFP	total
83	0,766946	0,124315	0,108739	1
84	0,575596	0,009856	0,414548	1
85	-2,080119	1,443717	1,636402	1
86	-0,03335	0,032194	1,001156	1
87	0,007741	0,279533	0,712726	1
88	0,091809	0,194014	0,714177	1
89	0,066765	-0,252162	1,185398	1
90	-0,008532	0,481128	0,527404	1
91	-0,045803	0,149833	0,89597	1
92	0,038799	0,186983	0,774219	1
93	-0,015781	-0,004817	1,020598	1

Table 3: Growth Accounting for Transport Equipment (384), Iran

Contribution of L, K and TFP to the Growth of Output

	CL	CK	CTFP	total
83	-0,000305	0,279014	0,721292	1
84	0,101439	0,295797	0,602765	1
85	-0,242772	-0,066278	1,30905	1
86	-0,073631	0,262713	0,810918	1
87	0,010722	0,460547	0,528731	1
88	-0,017484	0,183023	0,834461	1
89	0,01237	0,007593	0,980037	1
90	-0,019887	0,093658	0,926229	1
91	-0,022953	0,034379	0,988574	1
92	-0,074785	-0,055654	1,130438	1
93	-0,841259	1,993092	-0,151834	1

Chart 1: Growth Accounting for Food Processing (311), Iran

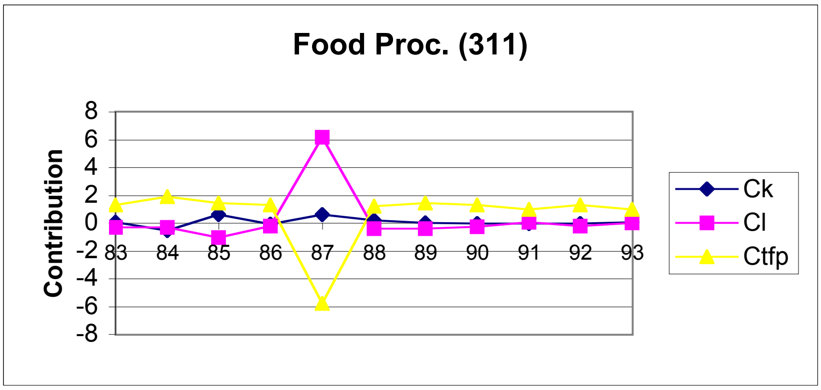


Chart 2: Growth Accounting for Petroleum Refineries (353), Iran

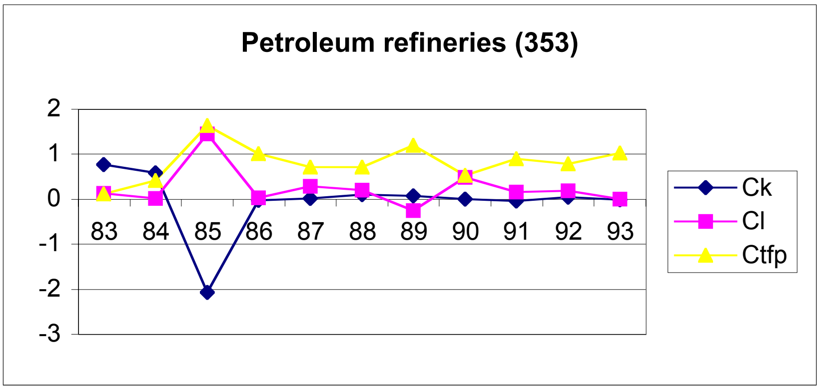
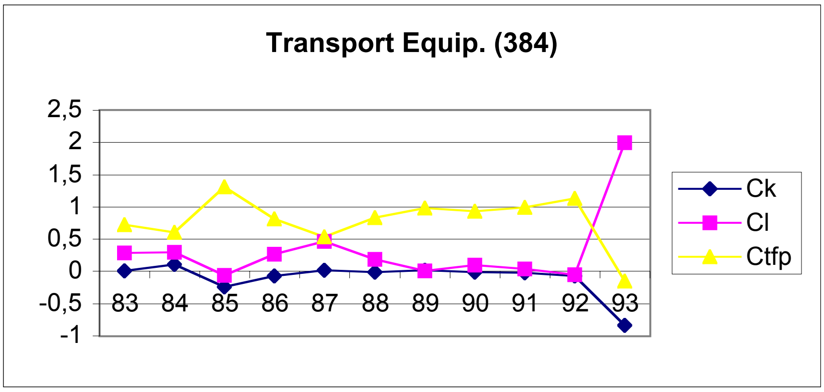


Chart 3: Growth Accounting for Transport Equipment (384), Iran



Appendix 3B: Select Sector Specific Growth Accounting for Egypt

Table 1: Growth Accounting for Food Processing (311), Egypt

Contribution of L, K and TFP to the Growth of Output

	CL	CK	CTFP	total
65	-0,0176	-0,1096	1,12713	1
66	0,03849	0,10479	0,85672	1
67	0,4221	0,42112	0,15678	1
68	-0,135	0,01651	1,1185	1
69	-1,1578	-0,7491	2,90687	1
70	-3,0726	-1,5548	5,62736	1
71	0,01671	0,02275	0,96055	1
72	-0,5385	-0,2121	1,75058	1
73	0,11198	0,0465	0,84152	1
74	0,03137	-0,01	0,97864	1
75	-0,5128	0,01273	1,50007	1
76	0,13417	0,09051	0,77532	1
77	-0,0511	-0,0342	1,08536	1
78	-0,0387	-0,0514	1,09004	1
79	0,0074	0,01997	0,97263	1
80	0,06178	0,06395	0,87427	1
81	-0,0067	-0,6011	1,60773	1
82	0,108	-0,3113	1,20326	1
83	0,13783	0,21275	0,64942	1
84	1,34778	8,06809	-8,4159	1
85	0,1364	-0,3253	1,18887	1
86	-0,156	-0,6343	1,79027	1
87	3,72753	1,45058	-4,1781	1
88	-0,0281	-0,1189	1,14695	1
89	-0,244	0,0514	1,1926	1
90	-0,3973	-0,0466	1,44396	1
91	2,89215	0,49503	-2,3872	1
92	0,29239	0,01807	0,68954	1
93	0,05507	0,01304	0,93189	1

Table 3: Growth Accounting for Transport Equipment (384), Egypt

Contribution of L, K and TFP to the Growth of Output

	CL	CK	CTFP	total
65	0,13178	0,05313	0,81509	1
66	1,78699	0,06896	-0,8559	1
67	1,4266	-0,1771	-0,2495	1
68	-0,1033	-0,0023	1,10556	1
69	5,48102	0,84121	-5,3222	1
70	0,2577	0,58861	0,15369	1
71	0,70828	-0,0998	0,39153	1
72	1,25531	0,21939	-0,4747	1
73	0,3272	0,06179	0,61101	1
74	0,82768	0,03626	0,13606	1
75	-1,4719	-0,1589	2,63085	1
76	0,02452	-0,1496	1,12511	1
77	-0,006	-0,006	1,01199	1
78	0,01464	0,02102	0,96435	1
79	-0,0925	0,17346	0,91902	1
80	-0,0624	-0,0709	1,13329	1
81	-0,051	0,16906	0,88192	1
82	0,06984	-0,3752	1,3054	1
83	0,05652	0,03043	0,91306	1
84	0,57417	-0,3136	0,73942	1
85	1,90899	0,38663	-1,2956	1
86	0,84275	0,05972	0,09753	1
87	6,13527	2,19765	-7,3329	1
88	0,26539	0,01097	0,72364	1
89	0,17171	-0,0181	0,84644	1
90	0,20061	0,03438	0,76501	1
91	0,38609	0,12238	0,49153	1
92	-0,6562	0,19147	1,46478	1
93	0,50242	0,06067	0,43691	1

Table 2: Growth Accounting for Other Chemicals (352), Egypt

Contribution of L, K and TFP to the Growth of Output

	CL	CK	CTFP	total
65	-0,0079	-0,0371	1,04498	1
66	0,1389	0,10928	0,75182	1
67	-0,5742	0,26166	1,31253	1
68	-1,4802	-1,7948	4,27504	1
69	0,05577	0,39858	0,54565	1
70	0,22656	-0,0742	0,84762	1
71	-0,1071	-0,2419	1,34907	1
72	-2,7901	0,90927	2,8808	1
73	0	-0,1197	1,11971	1
74	-0,0669	0,0371	1,02985	1
75	0,07012	0,06902	0,86086	1
76	0,03358	0,01656	0,94985	1
77	0,01004	-0,0099	0,99987	1
78	0,02764	0,01235	0,96001	1
79	0,02365	-0,0591	1,03541	1
80	0,39064	-0,1336	0,74298	1
81	0,12222	0,16452	0,71326	1
82	0,34931	-0,4535	1,10422	1
83	0,08616	0,10917	0,80467	1
84	0,45114	-0,3699	0,91874	1
85	0,95952	0,10723	-0,0667	1
86	0,11329	-0,1118	0,99848	1
87	17,1138	11,8375	-27,951	1
88	-0,0194	0,16947	0,84993	1
89	0,13526	-0,0141	0,87885	1
90	-1,0586	-0,1653	2,22391	1
91	-0,2968	0,16519	1,13158	1
92	-0,1123	-0,0276	1,13989	1
93	0,06959	-0,1357	1,0661	1

Chart 1: Growth Accounting for Food Processing (311), Egypt

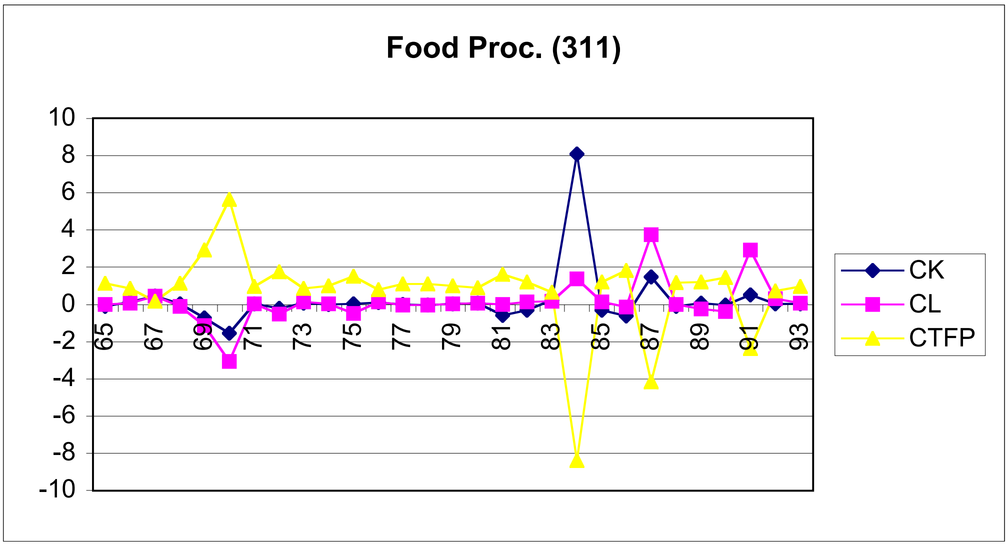


Chart 2: Growth Accounting for Other Chemicals (352), Egypt

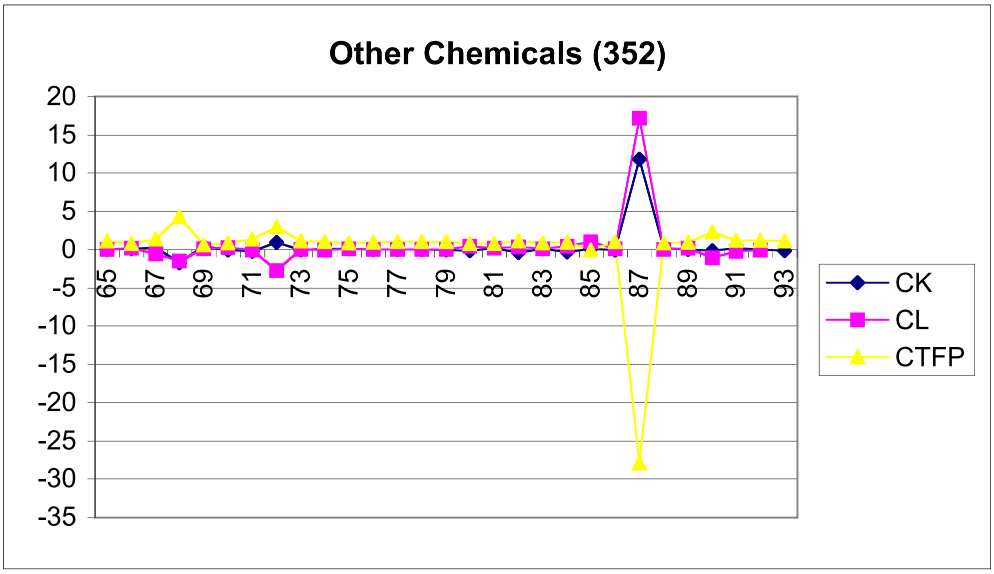
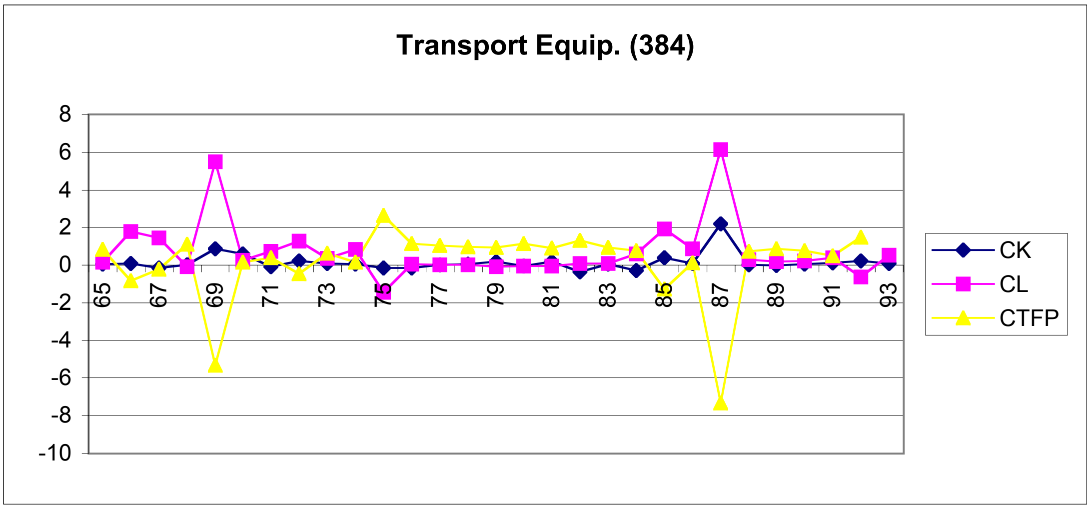
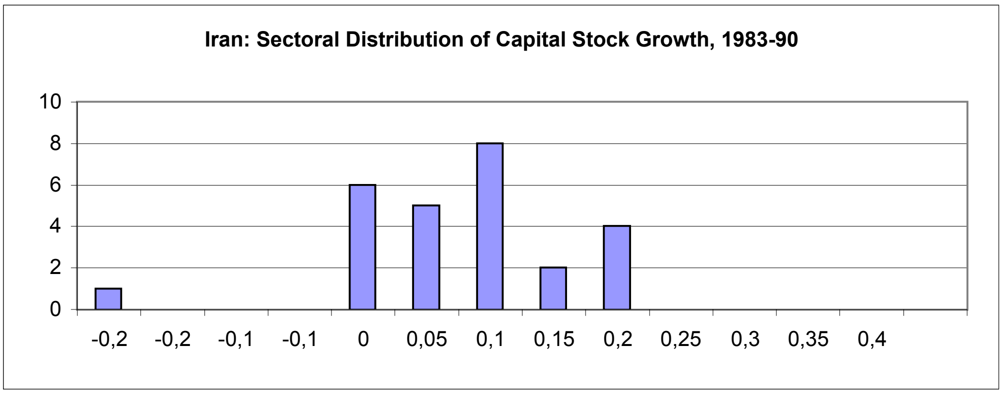
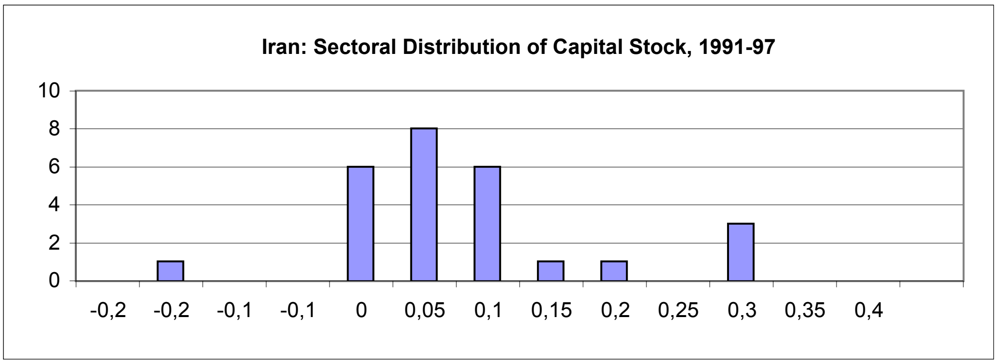


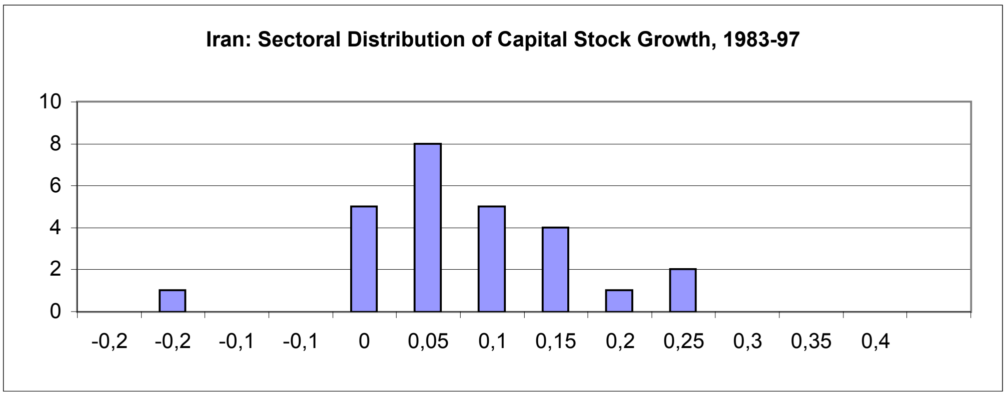
Chart 3: Growth Accounting for Transport Equipment (384), Egypt



Appendix 4A: Sectoral Distribution of Capital Stock Growth 1







Appendix 4B: Sectoral Distribution of Capital Stock for Egyp