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TOTAL FACTOR PRODUCTIVITY OF PHILIPPINE MANUFACTURING INDUSTRIES*

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INTRODUCTION

The Philippine economy performed poorly over the last three decades compared to its Asian neighbors. The Philippines grew an average of 1.5 percent per annum over the period 1981-1992, far below the growth performance of Singapore, South Korea, Thailand, Malaysia, and Indonesia (Figure 1). One of the major reasons behind this poor economic performance, as suggested in the literature on Philippine economic development, is the deterioration in productivity.

The declining productivity over the years is borne out in a number of productivity studies done at the macro level. Table 1 shows some of the estimates of total factor productivity (TFP). For example, Williamson (1969) estimated a declining TFP from 55 percent in the period 1947-1955 to 15 percent in 1955-1965. The results of Sanchez (1983) and Patalinghug (1984) showed relatively constant TFP growth in the 1960s up to the early 1980s. However, the results of Austria and Martin (1992) showed a big drop in TFP growth in the period 1950-1987 of -11 percent. According to the

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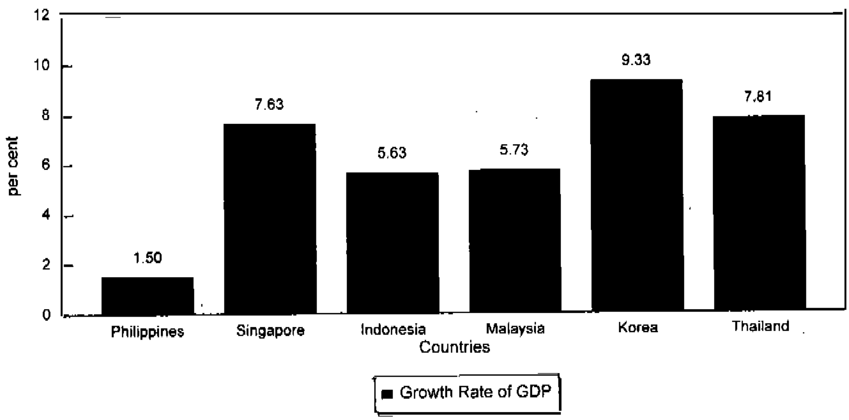
FIGURE 1

Growth Rate of GDP of Selected Asian Countries, 1981-1992



Source: *Asian Development Outlook,* 1993.

authors, this drop in productivity growth can be explained by the inability of the country to allocate its resources efficiently because of policies which intervened in the process of resource allocation.

Industry-level TFP estimates are rather limited. The last set of TFP growth estimates at the level of Philippine manufacturing industries was done by Hooley (1985), covering the period 1956-1980 for 25 large establishments (or establishments which employ 20 or more workers). The TFP methodology used in the study was the traditional, neoclassical growth-accounting approach, which according to the theoretical literature on TFP, gives biased estimates of factor productivity.

TABLE 1
Distribution of the Sources of Growth in the Philippines, Various Studies (In %)

	Williamson (1969)		Sanchez (1983)*	Patalinghug (1984)	Austria & Martin (1992)
Factors	**1947-1955**	**1955-1965**	**1960-1973**	**1960-1982**	**1950-1987****
Capital	9	25	24	48	87
Labor	33	54	52	23	24
Land	3	5	n.a.	n.a.	n.a.
Education	n.a.	n.a.	n.a.	6	n.a.
TFP	55	15	24	23	-11
Total	100	100	100	100	100
GDP growth	7.3	4.5	4.6	5.5	4.6

*Sanchez (1983) decomposed the growth of the Philippines for the period 1960-1973 only to use the data in comparison with Korea. TFP growth during this period was 1.1 percent, higher than her estimates of -0.8 percent for 1957- 1975.

**The output elasticities estimated from equation (5a) were multiplied by the average growth rate of capital and labor to arrive at the contribution of each factor to GDP growth. For the period 1950-1987, capital and labor grew at 6.2 and 3.0 percent, respectively.

Sources: Austria, Myrna and Will Martin, Economics Division Working Papers, *Macroeconomic Instability and Growth in the Philippines: A Dynamic Approach*. Research School of Pacific Studies, Australian National University, 1992.

Hooley's results are shown in Table 2. On the whole, the results of the study showed that "over the period 1956-1980, TFP decreased by 0.15 percent annually. Since 1975, TFP has been declining at an alarming rate of 2 percent or more per year. For the manufacturing sector as a whole, the data paint a very clear picture—one of slow TFP growth during the late fifties and sixties, unmistakable retardation after 1970, with rates of advance after 1975 assuming significantly larger negative dimensions. When certain additional adjustments for labor quality improvements are made, the average rates are uniformly lower for the entire period as well as for all subperiods."

There is, however, a few set of productivity studies estimated recently by the Philippine Institute for Development Studies (PIDS) under the project Development Incentives Assessment (DIA) on selected Philippine manufacturing industries. The productivity analysis, however, did not focus on TFP growth, but on a related concept called technical efficiency (TE).[1]

There are a number of approaches to TE estimation. In the PIDS-DIA project, the TE methodology applied was a static linear programming, deterministic approach. This approach, however, entails a major weakness that results in a bias in the estimates of technical efficiency coefficients.[2] Furthermore, although the PIDS-DIA estimates were done recently, the period under study was rather outdated, 1983 and 1988.

Technical efficiency coefficients for six industries are available in the PIDS-DIA study. Based on the technical efficiency coefficients, the major conclusion of the studies are:

(1) *Packaging Industry*. "Technical efficiency in the packaging industry appears to have declined between 1983 and 1988. Even the metal-based subsector, which was the only gainer in terms of technical efficiency between 1983 and 1988, was not efficient. At the plant level, the proportion

1. To be discussed in detail in the section on Framework of Analysis.

2. The technical efficiency measures using this approach are susceptible to extreme observations and measurement errors according to Forsund et al. (1980) and Kalirajan (1994).

TABLE 2

Annual Growth Rate of Total Factor Productivity, by Industry, 1957-1980 (Hooley's estimates)

Industry	Code	57-60	61-65	66-70	71-75	76-80	57-70	71-80	57-80
Food manufacturing	311-312	1.25	4.12	-1.48	-3.10	2.62	1.30	-0.24	0.66
Beverage	313	-1.80	1.76	3.00	7.28	-5.54	1.19	0.87	1.05
Tobacco	314	-0.65	3.88	5.38	5.98	4.74	3.12	5.36	4.05
Textile	321	-3.05	-2.08	-0.62	-0.60	-0.98	-1.84	-0.79	-1.40
Wearing apparel	322	0.88	3.64	-1.32	5.56	11.40	1.08	8.48	4.16
Leather	323	-1.58	-4.72	1.42	0.16	-2.12	-1.63	-0.98	-1.36
Footwear	324	2.03	1.18	-3.76	-4.82	5.80	-0.34	0.49	0.00
Wood products	331	1.43	-1.54	-0.92	2.88	12.00	-0.47	7.44	2.83
Furniture and fixture	332	-0.63	-1.02	-6.08	1.12	-5.06	-2.71	-1.97	-2.40
Paper products	341	-0.55	-4.42	3.50	-0.76	3.98	-0.49	1.61	0.39
Print and publishing	342	3.45	0.50	0.86	-1.22	-3.62	1.47	-2.42	-0.15
Industrial chemicals	351	-5.20	2.72	0.34	8.76	2.12	-0.39	5.44	2.04
Other chemicals	352	-0.10	-0.06	2.36	2.34	4.40	0.79	3.37	1.87
Petroleum products	353-354	0.00	-4.95	4.28	10.64	-5.80	0.18	2.42	1.36

TABLE 2 (Continued)

Industry	Code	57-60	61-65	66-70	71-75	76-80	57-70	71-80	57-80
Rubber products	355	1.13	-1.02	0.90	-0.94	0.38	0.28	-0.28	0.05
Plastic products	356	0.77	-0.64	0.50	3.62	4.06	0.12	3.84	1.74
Non-metallic products	361, 363, 364	3.10	4.28	-3.36	14.74	1.30	1.21	8.02	4.05
Glass products	362	1.60	-2.94	-1.42	-1.10	-5.04	-1.10	-3.07	-1.92
Steel	371	-3.10	-0.88	-2.50	-2.72	4.76	-1.82	1.02	-0.47
Non-ferrous	372	5.20	-16.30	3.72	-10.48	-6.70	-5.25	-8.59	-6.84
Fabricated metals	381	1.00	-1.32	0.16	1.18	-0.94	-0.13	0.12	-0.03
Machinery	382	6.05	-4.94	-1.74	-1.00	6.23	-0.66	2.21	0.47
Electrical machinery	383	0.73	-2.00	0.04	2.24	5.38	-0.49	3.81	1.30
Transport equipment	384	-3.20	-2.04	2.72	-0.26	-0.44	-0.67	-0.35	-0.54
ALL MANUFACTURING	3	1.18	-0.72	1.22	-0.78	-1.90	0.51	-1.34	-0.26

Source: Hooley, Richard. "Productivity Growth in Philippine Manufacturing: Retrospect and Future Prospects." *PIDS Monograph Series No. 9*. December 1985.

of efficient plants to the industry total dropped from 16 percent in 1983 to only 9 percent in 1988" (Medilo 1994).

(2) *Synthetic Resin and Plastic Industries.* "There was a dramatic shift toward technical efficiency between 1983 and 1988. The TE of the resin industry went up to 75 percent in 1988 from 59 percent in 1983. The TE of the plastic processing industry went up to 99 percent from 40 percent in the same years" (Banzon 1994).

(3) *Agricultural Machinery Industry.* "The calculation obtained an average TE of 71.29 percent and 52.26 percent in 1983 and 1988, respectively. The 1983 average TE was just slightly below the qualified efficient range of 75-100 percent, suggesting that the industry was not far from the industry's 'best practice'. Unfortunately, the picture changed differently in 1988 wherein the industry became technically inefficient" (Trabajo 1994).

(4) *Textile and Garments Industries.* "Among the textiles-primary industries, the most technically efficient was weaving mills in 1983 and hand weaving in 1988. The manufacture of women's, girls', and babies' garments proved to be not only the most competitive but also the most technically efficient among the garments industries. The manufacture of men's and boys' garments, and ready-made clothing also exhibited high technical efficiency in 1988. Nevertheless, the industries which experienced an improvement in technical efficiency were the same industries which had attained comparative advantage or international competitiveness" (Austria, 1994).

(5) *Appliance Industry.* "The average technical efficiency of plants dropped by more than half for the appliance industry from 61.28 percent in 1983 to 29.88 percent in 1988. For the radio-TV parts industry, there was an increase from 56.93 percent in 1983 to 65.90 percent in 1988. The number and proportion of technically efficient plants in the appliance industry fell from six (or 12.5 percent of the total) to three (5.45 percent).

For the radio and TV parts subsector, the number of efficient plants increased from four to six" (Lapid 1994).

(6) *Shipbuilding/Repair and Boatbuilding Industry.* "The subsector's TE showed a decrease from 39.46 percent in 1983 to only 29 percent in 1988. This means that the sector's efficiency in maximizing its output, given its resources, declined in spite of the fact that it became efficient in allocating its resources. The number of technically efficient plants dwindled from seven efficient plants in 1983 to only two plants in 1988" (Mendoza 1994).

Therefore, given the above productivity result gaps, the objectives of the present study are: (a) to provide an updated set of estimates (free from the possible estimate biases) of total factor productivity growth of the Philippine manufacturing industries over the period 1956-1992; (b) to decompose this industry productivity growth to technical progress and to technical efficiency; and (c) to analyze the patterns of industry productivity by looking at the possible determinants of TFP.

LIST OF INCLUDED INDUSTRIES

Table 3 shows the percent distribution of all Philippine manufacturing industries in the 1988 Census of Establishments. There are a total of 32 industries. In terms of the number of establishments in each of the industries, 'other food' ranks top, with 18.2 percent share to the total. It is followed by 'wearing apparel' with 14.1 percent share. In terms of the total value of output, 'food' ranks first (13.0 percent), while 'petroleum refineries' comes in second (12.3 percent). The biggest employer among the manufacturing industries is 'wearing apparel' which accounts for 16.9 percent of the total employment in the manufacturing sector.

Table 3 also shows the ratio of establishment with 20 or more workers' (or large establishments) to 'all establishments' (small and large establishments combined). It can be observed that the following industries are large ones among the Philippine manufacturing industries: (1) sugar milling

TABLE 3

Distribution of All Philippine Manufacturing Industries
1988 Census of Establishments (In percent)

PSIC	Industry Description	All establishments (1988)					Ratio of 20 or more workers with all establishments			
		No. of establish -ments	Total Output	Total Employ-ment	Ending Book Value	Total Cost of Interme-diate Inputs	Total Output	Total Employ-ment	Ending Book Value	Total Cost of Interme-diate Inputs
311	Food	8.3	13.0	7.8	6.9	13.9	96.6	90.6	93.5	96.6
312	Other food	18.2	9.5	10.8	9.4	8.8	95.8	82.4	97.1	95.4
3123	Sugar milling and refining	0.5	3.8	3.2	5.3	3.2	100.0	99.6	100.0	100.0
313	Beverages	0.8	2.9	2.9	2.2	2.5	99.6	98.7	99.8	99.6
314	Tobacco	0.2	4.4	1.7	0.7	4.0	100.0	99.8	100.0	100.0
321	Textiles	5.0	5.4	10.6	9.5	5.3	98.6	97.3	99.0	98.6
322	Apparel excluding footwear	14.1	4.1	16.9	1.7	3.2	92.7	92.4	92.1	95.7
323	Leather & leather products	1.1	0.1	0.6	0.1	0.1	88.6	85.9	86.9	90.1
324	Footwear excluding rubber	3.9	0.2	1.1	0.1	0.1	75.0	60.3	65.0	76.8

TABLE 3 (Continued)

		All establishments (1988)					Ratio of 20 or more workers with all establishments			
PSIC	Industry Description	No. of establish -ments	Total Output	Total Employ-ment	Ending Book Value	Total Cost of Interme-diate Inputs	Total Output	Total Employ-ment	Ending Book Value	Total Cost of Interme-diate Inputs
331	Wood and cork products	6.2	3.0	6.7	2.1	3.0	96.3	93.0	95.3	96.2
332	Furniture and fixture excluding metal	6.2	1.1	4.9	0.7	0.9	91.7	88.6	86.6	92.1
341	Paper & paper products	1.5	2.8	1.8	2.6	2.5	98.6	95.2	95.6	98.3
342	Printing & publishing	5.8	1.1	2.4	0.9	1.0	89.7	78.6	86.8	89.6
351	Industrial chemicals	1.0	3.9	1.3	15.1	3.9	97.2	95.7	98.9	97.2
352	Other chemicals	2.7	8.3	3.5	4.0	7.7	98.7	95.9	98.1	98.7
353	Petroleum refineries	0.0	12.3	0.3	4.1	14.6	100.0	100.0	100.0	100.0
354	Misc. production of petroleum and coal	0.1	0.1	0.1	0.1	0.1	96.2	81.0	79.1	97.0
355	Rubber products	1.2	1.6	2.8	1.4	1.4	97.3	97.2	95.3	98.1
356	Plastic products, n.e.c.	2.7	1.8	2.1	1.2	1.8	93.9	92.7	95.6	93.6
361	Pottery china & earthenware	0.5	0.2	0.6	0.4	0.2	98.9	93.3	97.6	99.0
362	Glass and glass products	0.3	0.8	0.7	0.9	0.5	99.3	97.0	99.3	98.9
363	Cement	0.2	1.5	0.7	4.1	1.5	100.0	100.0	100.0	100.0
369	Other non-metallic mineral products	3.2	0.5	1.3	0.8	0.5	90.3	78.6	83.7	90.4
371	Iron and steel	1.2	5.4	1.9	9.7	5.9	99.7	97.6	99.9	99.7

TABLE 3 (Continued)

PSIC	Industry Description	All establishments (1988)					Ratio of 20 or more workers with all establishments			
		No. of establish -ments	Total Output	Total Employ-ment	Ending Book Value	Total Cost of Interme-diate Inputs	Total Output	Total Employ-ment	Ending Book Value	Total Cost of Interme-diate Inputs
372	Non-ferrous metal	0.3	3.2	0.3	10.9	3.6	99.8	90.1	100.0	99.8
381	Fabricated metal products	4.3	1.6	2.5	1.2	1.7	94.9	87.4	94.1	95.3
382	Machinery excluding electric	3.2	0.9	2.2	0.8	0.9	92.9	80.3	85.7	94.3
383	Electrical machinery	2.0	7.0	6.5	5.5	7.0	99.7	98.7	99.6	99.7
384	Transport equipment	2.1	2.4	1.7	2.3	2.7	98.1	90.8	97.4	98.4
385	Professonal scientific measuring & control instruments	0.1	0.2	0.5	0.2	0.1	98.8	98.1	99.8	98.7
386	Furniture, metal	0.3	0.0	0.1	0.1	0.0	84.6	77.7	94.0	85.1
390	Other manufacturing industries	3.1	0.7	2.7	0.3	0.5	94.1	91.3	89.8	94.1
		100	**100**	**100**	**100**	**100**	**97.6**	**91.5**	**97.7**	**97.9**

and refining; (2) textiles; (3) petroleum refineries; and (4) cement. Their ratios are all 100 percent, which means that all these four industries employ 20 or more workers. The relatively small ones are footwear (75.0 percent) and metal furniture (84.6 percent).

Table 4 shows the list of manufacturing industries included in the study. There are 25 industries considered in the present analysis.[3] Of the 32 Philippine manufacturing industries, the 25 industries considered in the sample account for more than 90 percent of the total.

THE PHILIPPINE ECONOMY

Economic Performance

The growth of the Philippine economy decelerated over the past 40 years. In the period 1956-1970, real GDP grew an average of 4.7 percent per annum (Table 5). This increased slightly to 5.9 percent per annum in the period 1971-1980. However, it dropped drastically to 1.5 percent per annum in the period 1981-1992.

Focusing on the last 15 years, the economy had performed poorly, with a prolonged recession experienced in the period 1984-1985 when real per capita income contracted by -10.12 percent (Table 6). The recession was caused mainly by two factors: political uncertainty and unstable macroeconomic fundamentals. At the same time, the economy also proved to be highly unstable, with inflation rate surging to 35.2 percent.

During the first three years of the Aquino government, the economy recovered. Such recovery, however, was not sustained when political uncertainty and poor macroeconomic fundamentals once again plunged it into nearly zero growth in the early 1990s. This is when significant realignment and structural adjustments were installed.

There are now indications that the economy is starting to improve. In 1994 alone, the economy grew by 5 percent in real terms. It is, however, too early to tell whether the economy is now moving along a sustained

3. Note that in the study "food" and "other food" are lumped into one industry called "food."

TABLE 4
Distribution of 20 or More Workers
1988 Census of Establishments (In percent)

PSIC	Industry Description	No. of Establishments	Total Output	Total Employment	Ending Book Value	Total Cost of Intermediate Inputs
311	Food	6.7	12.3	7.4	6.3	13.3
312	Other food	8.8	9.0	9.4	8.9	8.3
3123	Sugar milling & refining	0.8	3.7	3.4	5.1	3.2
313	Beverages	1.5	2.8	3.0	2.1	2.4
314	Tobacco	0.5	4.3	1.7	0.7	4.0
321	Textiles	7.3	5.2	10.9	9.1	5.2
322	Apparel excluding footwear	13.2	3.8	16.5	1.5	3.0
323	Leather & leather products	1.0	0.1	0.6	0.1	0.1
324	Footwear excluding rubber	2.0	0.1	0.7	0.1	0.1
331	Wood and cork products	7.0	2.8	6.6	2.0	2.8
332	Furniture and fixtures excluding metal	5.6	0.9	4.6	0.6	0.8
341	Paper and paper products	2.2	2.7	1.8	2.4	2.5

TABLE 4 (Continued)

PSIC	Industry Description	No. of Establishments	Total Output	Total Employment	Ending Book Value	Total Cost of Intermediate Inputs
342	Printing & publishing	5.5	1.0	2.0	0.8	0.9
351	Industrial chemicals	1.7	3.7	1.3	14.5	3.8
352	Other chemicals	4.3	8.1	3.6	3.8	7.5
353	Petroleum refineries	0.1	12.1	0.3	4.0	14.4
355	Rubber products	1.8	1.5	2.9	1.3	1.4
356	Plastic products, n.e.c.	4.0	1.7	2.0	1.1	1.7
362	Glass and glass products	0.4	0.8	0.7	0.9	0.5
369	Other non-metallic mineral products	2.5	0.5	1.1	0.6	0.4
371	Iron & steel	2.1	5.3	1.9	9.4	5.9
372	Non-ferrous metal	0.3	3.2	0.3	10.5	3.6
381	Fabricated metal products	4.6	1.5	2.3	1.1	1.6
382	Machinery excluding electric	5.0	0.8	1.9	0.7	0.8
383	Electrical machinery	3.4	6.9	6.8	5.3	6.9
384	Transport equipment	2.5	2.4	1.6	2.2	2.6
		94.2	**93.6**	**92.0**	**89.9**	**94.4**

TABLE 5
Philippine Economy, 1956-1992

Indicators	Period 1956-1970	1971-1980	1981-1992
Real exports (growth in %)	3.5	10.3	4.2
Gross domestic product (growth in %)	4.7	5.9	1.5
Ratio of budget deficit w/ GDP (in %)	-0.1	-0.2	-2.7
Inflation rate	4.3	14.8	14.1

Sources: National Statistical Coordination Board.
National Statistics Office.

TABLE 6
Philippine Economic Indicators, 1956-1992

Indicators	1980-1983	1984-1985	1986-1989	1990-1992	1993	1994
GNP growth rate	3.04	-7.89	5.54	1.79	2.62	5.08
GNP per capita (real)	0.46	-10.12	3.07	0.8	0.12	2.59
Inflation rate	12.2	35.2	5.9	13.9	7.6	9
Savings-investment gap (% GNP)	-2.1	1.5	1.3	-3.5	-7.5	-6.14
Current account gap (% GNP)	-9.62	-2.0	-0.65	-3.37	-5.87	-4.6
Deficit						
NG (% GNP)	-3.09	-1.99	-3.18	-2.22	-1.44	1.03
CPSD (% GNP)	-2.78	-4.05	-3.75	-3.0	-2.2	-2.2

Sources: National Statistical Coordination Board.
National Statistics Office.

growth path or not because the process of readjustment has not yet been completed and the effects of the process on the economy have not been fully realized.

Industrial Structure/Policy

The present industrial structure of the Philippines remains dualistic. The manufacturing sector, which enjoys high effective protection since the 1950s, employs only a small fraction of the labor force. The bulk of the labor force is employed either in backward agricultural sector or in urban centers with very low productivity.

Tables 7 and 8 show the extreme dualism of the Philippine economy. The manufacturing sector which contributes about 25 percent to gross domestic product (GDP) employs only about 10 percent of the labor force. About two-thirds of the labor force is employed in agriculture, or in "other services" sector which contribute about one-fifth of GDP.

Industry, which in principle is supposed to absorb surplus labor from agriculture, failed to generate enough jobs to employ a labor force that has grown at almost 4 percent annually over the last decade.[4] In fact, the share of industrial employment, particularly manufacturing, declined from 12.1 percent in 1960 to 9.7 percent in 1990. The reason for this is clear. The manufacturing sector has not been able to grow at high rates to become a lead sector. Its contribution to GDP has stagnated at about 25 percent over the last 30 years.

However, the decline in the share of agriculture in total employment has been significant. This development, together with the stagnant share of industrial employment, implies that "it is services, a large part of which is the so called 'informal sector', which served as the receptacle for labor shed by agriculture but which industry failed to absorb. Therefore, the lack of employment opportunities in industry condemns the majority of the labor force to jobs with low productivity and poor pay" (De Dios 1992).

4. Labor force increased from 18.2 million in 1981 to 25.2 million in 1991, or 3.8 percent annually. This increase is much faster than the population growth rate of 2.5 percent.

TABLE 7
Sectoral Employment Shares (%)

Sector	1960	1965	1970	1975	1980	1985	1990
Agriculture	61.2	56.7	53.7	53.5	51.4	49.0	45.2
Industry	12.6	11.3	12.6	12.1	11.6	10.7	10.7
Manufacturing	12.1	10.9	11.9	11.4	10.6	9.7	9.7
Services	26.2	31.5	32.1	34.1	36.5	40.2	44.0

Source: *Philippine Statistical Yearbook*, various years.

TABLE 8
Sectoral Output Shares (%)

Sector	1960	1965	1970	1975	1980	1985	1990
Agriculture	26.5	27.2	29.5	30.3	25.2	24.6	22.1
Industry	31.3	31.1	31.9	35.0	38.8	35.0	35.1
Manufacturing	24.5	23.6	24.9	25.7	25.7	25.1	25.4
Services	42.2	41.7	38.6	34.7	36.1	40.3	42.8

Source: National Statistical Coordination Board.

The most important factor that contributed to this unfavorable economic structure is that most Philippine industries remain oriented toward a limited domestic market. This is especially true for the manufacturing sector which enjoys high effective protection.

The export performance of the manufacturing sector is shown in Tables 9 and 10. One can observe that exports of Philippine manufactured goods have grown both as a share of total exports and as a share of GDP. In fact, manufactured exports now contribute about 70 percent to total exports.

One might come to think that this is the effect of a major restructuring effort of redirecting the economy away from import substitution and toward the world market. Although this has been the objective of some policy pronouncements, the direction toward this end has been very modest in reality. This is because of the very high import content of Philippine manufactured exports. Most manufactured exports consist of electronics (primarily semiconductors) and garments. In both export goods, the Philippines adds a thin slice of value added to import components, and then re-export them. "Thus the manufactured export sector is in effect an enclave with surprisingly little linkage to the domestic economy" (Krugman et al. 1992).

As a result, the overall performance of Philippine export relative to its ASEAN neighbors is poor. Tables 11 and 12 show that the Philippines is fast losing market share in the world market. The Philippine share of total ASEAN export in 1970 was 17.7 percent. In 1985, this dropped to 6.9 percent. This share further declined to 5.9 percent in 1990.

The country's declining market share in the world market is evident in the comparative export performance of the Philippines and Thailand in the last six years. In 1985, exports of Thailand amounted to US$7 billion, about US$2.5 billion than that of the Philippines. In the last six years, exports of Thailand grew rapidly, averaging 26.2 percent growth per year, leaving the Philippines way behind. In 1991, Thailand's export was already US$28 billion, more than three times that of Philippine export value.

The present industrial structure is a result of a trade policy that generally provides strong incentives to import-substituting activities and heavy disin-

TABLE 9
Trade and Outward Orientation (%)

Indicators	1980	1985	1992
Share of GNP:			
Exports	17.9	19.2	18.3
Imports	23.9	26.6	27.0
Share of Exports:			
Manufacturing	34.5	41.4	74.7
of which			
Electronics	11.6	14.6	27.7
Garments	8.7	10.8	21.6
Non-Manufacturing	65.5	59.6	25.3

Source: National Statistical Coordination Board.

TABLE 10
Trade and Outward Orientation
(in million US $)

Indicators	1980	1985	1992
Exports	5,788	5,722	9,824
Imports	7,727	7,946	14,520
Share of Exports			
Manufacturing	1,996	2,369	7,337
Electronics	671	838	2,724
Garments	502	618	2,125

Source: National Statistical Coordination Board.

TABLE 11

Asean Export Growth

(% per annum)

Country	1965-1980	1981-1985	1986-1991	1986	1987	1988	1989	1990	1991
Philippines	4.7	-4.0	13.9	4.6	18.1	23.7	10.6	4.7	8.1
Indonesia	9.6	-2.7	11.0	-22.3	19.5	13.4	17.8	16.7	9.8
Malaysia	4.4	3.9	18.1	-10.5	31.1	17.4	18.3	17.1	17.3
Thailand	8.5	2.2	31.4	24.7	31.7	36.1	25.7	15.0	23.8
Singapore				-0.9	28.7	38.3	13.8	17.2	12.1

Source: *International Financial Statistics.*

TABLE 12
ASEAN Export
(in million US$)

Country	1970	1975	1980	1985	1990
Philippines	1,064	2,263	5,788	4,629	8,186
Indonesia	1,173	6,888	21,795	18,527	26,807
Malaysia	1,640	3,784	12,868	15,133	28,956
Thailand	686	2,177	6,449	7,059	22,811
Singapore	1,447	5,110	18,200	21,533	50,684
TOTAL	6,010	20,222	65,100	66,881	137,444

Source : *International Financial Statistics.*

TABLE 13
100+EPR for Key Sectors

Key Sectors		1985	1988
Exports:	Agriculture	77.3	86.3
	Manufacturing	79.1	85.8
Imports:	Manufacturing	171.7	156.6
Ratio (Manufacturing)		2.2	1.8

Source: Medalla (1990).

centives to export-oriented production. This has been the policy of the government since the 1950s. Although there were few changes implemented in the early and middle of 1980s, the basic orientation of the trade policy still favors import-substituting activities.

The bias against export trade is seen in the estimates of effective protection rates for key sectors (Table 13). The ratio of 100+EPR in export-oriented to that in import-replacing sectors is a rough guide to the overall orientation of the trade regime.

One can observe from the estimates that while there has been a slight move toward outward orientation, the overall picture remains the same: Exports of both agriculture and manufactures have not been encouraged strongly, while domestic production of manufactures for local consumption has been favored. This structure is implied in the greater-than-one ratio of EPRs.

Usually, countries that attempt to industrialize by providing manufacturers with a protected domestic market end up with an overvalued exchange rate that discourages exports. The Philippines is one example. Although the Philippine peso depreciated, both in nominal and real terms, compared to many developing countries, the depreciations were far less. In fact, the Philippine peso is far out of line compared to these countries. This is seen in Table 14.

TABLE 14
Real Exchange Rate Indices (1970=100)

Period	Philippines	Malaysia	Thailand	Indonesia	S. Korea
1970	100.0	100.0	100.0	100.0	100.0
1980-1982	106.4	79.7	80.9	89.9	84.5
1989	72.3	52.9	56.4	35.7	73.8
1990	69.9	51.4	54.4	35.7	72.8

Source: *International Financial Statistics*.

The table shows that the Philippine real exchange rate was, on the average, 6 percent stronger during the period 1980-1982 than it had been in 1970, compared to 10 percent depreciation for Indonesia and 20 percent depreciation for both Malaysia and Thailand. Since 1970, the peso has depreciated by just 30 percent in real terms, compared with 46 percent for Thailand, 49 percent for Malaysia, and 64 percent for Indonesia.

The overvaluation of the peso is clearly seen in Figure 2. One can observe that while Thailand, Indonesia and other Asia nations depreciated their currencies, the Philippines maintained an exchange rate of the peso to the US dollar at a level considered by most analysts and the market to be overvalued. In general, this policy stance was taken due to the preponderance of import-dependent industries in the economy and thus their pervasive influence on policy. The government was also very sensitive to the nominal size of its dollar-denominated burden of foreign debt which have ballooned in domestic currency terms with a devaluation of the peso.

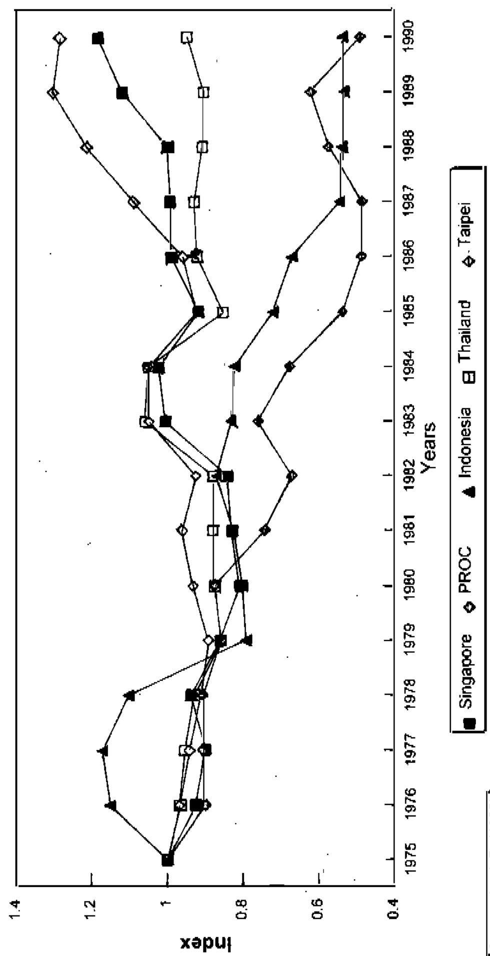
Recent Economic Reforms

The generally depressed performance of the economy over an extended period of time left the government with no choice but to introduce reforms. The reforms were aimed at: (a) restructuring the economy; (b) improving efficiency and competitiveness; and (c) building a solid foundation for a sustained growth. In the period 1986-1994, the government embarked on a series of major reforms in the following areas: fiscal, financial, foreign exchange market, capital markets, foreign investment, and competitive environment.

Corollarily, the government took an aggressive stance in 1986-1993 by pursuing a unilateral trade liberalization program. To illustrate, the number of regulated items was reduced drastically from 1,924 to only 183 within the period. Moreover, in 1991, the government put in place a five-year tariff reduction program that simplifies the tariff structure and puts a nine-band tariff structure, with most of the items concentrated at around 3, 10, 20 and 50 percent tariff rates. More recently, there has been an acceleration of the tariff reduction on textiles, garments, and chemical inputs.

FIGURE 2

Price Competitiveness Index:
Philippines vs. Selected Asian Countries



Source: Intal, P. (1992)

One of the major changes in the fiscal sector is the tax reform program which was instituted starting the second half of the 1980s. Among the major objectives of the program are to improve the elasticity of the tax system, tax administration and compliance by tax simplification; and to promote equity and growth by reducing highly distortive taxes. Furthermore, the government adopted the Value Added Tax (VAT) system in the second half of the 1980s which replaced several sales taxes.

To restructure the financial market, the government removed controls on interest rates, rationalized the credit programs of the government so as not to compete with the private financial institutions, privatized several government-controlled banks, and liberalized bank entry, especially the entry and scope of foreign banks. The government also initiated the rehabilitation of the rural banking system, stopped the operation of weak private commercial banks through either closure or merger with other stronger banks. Moreover, the Central Bank abandoned its selective credit control and instead imposed uniform rediscounting for all activities.

The old Central Bank (CB) was rehabilitated to form what is now known as the Bangko Sentral ng Pilipinas (BSP) which is "free" of the huge stock of non-performing assets that almost crippled the old Central Bank. In principle, the BSP should now be able to perform its mandated function of maintaining stability in the economy.

A substantial number of controls in the foreign exchange market were likewise removed in the hope of increasing the flow of funds between the country and the rest of the world. For instance, exporters are no longer required to surrender their export proceeds and to seek prior BSP approval for their other forex-related transactions. Controls on capital repatriation, dividend, and interest remittance were also dismantled. Furthermore, overseas contract workers (OCWs) are no longer required to remit to the Philippines a certain portion of their income. There are, however, still existing controls with respect to foreign borrowing by both the private and public sectors, especially those that are guaranteed by the national government or government financial institutions.

Four major policy reforms were introduced that have a direct bearing on the development of capital. *First*, the double taxation of dividend income was eliminated through the abolition of the tax on intercorporate dividends and the gradual phase-out of the tax on shareholder's dividend income. *Second*, the Security and Exchange Commission formally issued the "Rules and Regulations Governing Investment Companies" in October 1989, signalling the revival of mutual funds. *Third*, as part of the foreign exchange deregulation program, rules and regulations covering foreign investments in BSP-approved securities were relaxed. *Fourth*, the two stock exchanges in the Philippines were unified, thereby eliminating inefficiencies such as price arbitrage in a situation where two markets are allowed to list the same issue/company. All these changes are deemed to facilitate the inflow of investment into the country.

The Foreign Investment Act of 1991 liberalizes entry of foreign investors within the provisions of the Constitution of the Philippines. As a general rule, there are no restrictions on the extent of ownership of export enterprises (defined as those exporting 60 percent of their output). As for enterprises oriented to the domestic market, foreigners are allowed to invest as much as 100 percent, unless the participation is prohibited or limited to a smaller percentage by existing laws and/or the provisions of the Foreign Investment Act.

To promote competition in the domestic economy, the government removed entry barriers in crucial industries such as telecommunications, transportation (land, sea, and air), banking and cement. At the same time, the government aggressively pursued its privatization program. In 1993 alone, the government sold to the public 19 government-owned or controlled corporations, including several major ones such as Petron, Philippine Shipyard and Engineering Corp., and Oriental Petroleum and Minerals Corp.

Although the economic reforms instituted thus far are already substantial, they are still far from complete. Recent studies, for example, have pointed out that in spite of the series of tariff reduction programs, the protection of local industries still remains relatively high[5] and the incidence of tax evasion remains alarmingly high,[6] implying that substantial inefficiencies remain in the tax administration. Thus, more reforms are called for.

At present,the government is about to embark on a new tariff program which will further reduce and simplify the tariff structure to an across-the-board uniform tariff of 5 percent by the year 2004. The VAT system will also soon be expanded to cover other commodities and services which were not included in the first adoption of the system. Furthermore, Congress is now deliberating on a tax reform bill that will introduce more reforms to the existing tax structure and administration.

FRAMEWORK OF ANALYSIS

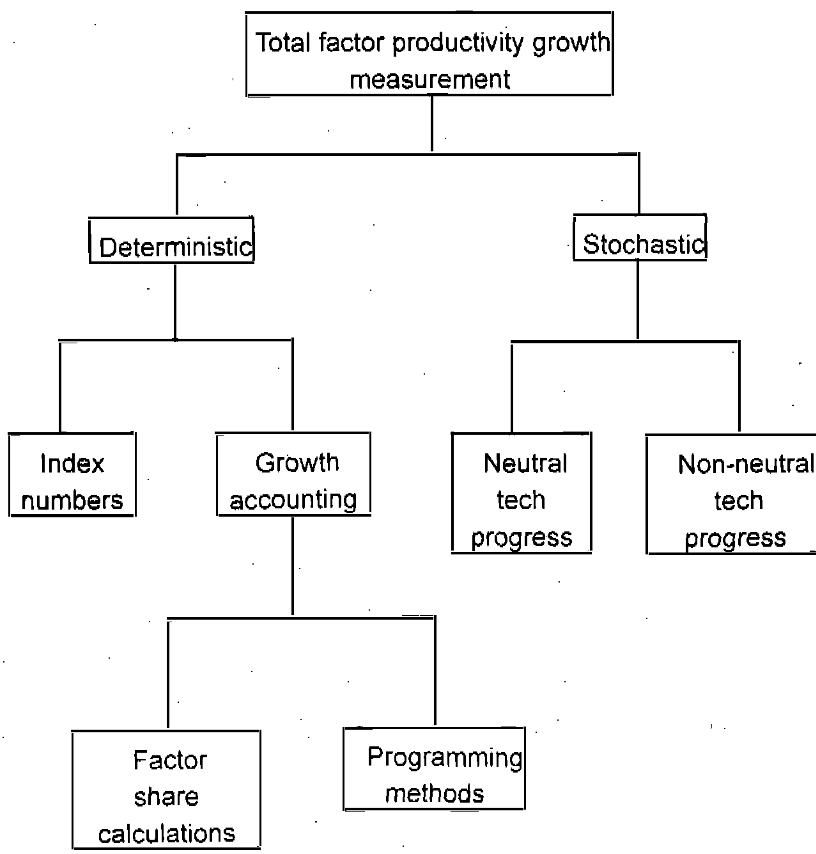
There are generally two major approaches to measuring TFP: (i) deterministic approach, and (ii) stochastic approach (Figure 3).[7] The deterministic approach may in turn be broken down into two branches: (a) the index number approach which does not require any explicit specification of production functions, and (b) the growth-accounting approach which requires the specification of production functions. The index number approach requires only the formulation of index numbers (usually based on distance functions), while the growth-accounting approach makes use of either factor share calculations (i.e., production function parameters are calculated as factor shares, using a given set of data), or programming methods (i.e., the production parameters are estimated using programming techniques within a deterministic framework).

5. Various issues of *PIDS Research Paper Series;* Medalla, E. (1990), AYC Consultants, (1995).

6. See Manasan R. (1993).

7. For a recent survey of the approaches and the list of references, see Kalirajan, Obwona and Zhao (1994), and Kalirajan and Shand (1994).

FIGURE 3
Total Factor Productivity Growth: Methods of Measurement



The Growth-Accounting Approach

Further elaboration of the growth-accounting approach is given below. It will be one of the methods that will be used in the study.

Consider a Cobb-Douglas production function

$$Q_t = A(t) \,.\, \Pi^{K}_{k=1}(X_{kt})^{\alpha k}\ \alpha k\ > 0. \qquad (1)$$

where Q_t is output, $A(t)$ is the catch-all variable which captures technical progress, X_{kt} are factor inputs, αk are the factor shares.

Take the time derivative of (1), divide the result by Q_t, and rearrange terms

$$\begin{aligned} A(t+1)/A(t) &= A/A \qquad (2)\\ &= q/q - \Sigma^{K}_{k=1}\, s_k\, x_k / x_k \end{aligned}$$

where the dots represent the time derivatives, and the s_k represents the k^{th} the input's share of output. Usually, the time derivatives are proxied by period differences of logarithmic values of Q and X, which are represented by their small letters, q and x. The term in the left-hand side of the equation represents the growth in total factor productivity, which is the difference between the growth of output and the weighted growth of factor inputs.

In this approach, it is assumed that the observed output is obtained by using the given technology to its full potential. This means that the realized or observed output level is the frontier output, which is 100 percent technically efficient. Therefore, the growth in $A(t)$ is interpreted only as the change in technology or shifts in the production function. In reality, however, an industry (or a firm, depending upon the unit of analysis) may ***not*** be operating along the production frontier. In cases where the industry operates below the frontier (this is also called the "best practice" frontier) the growth accounting method will give biased estimates of technical change.[8]

8. As pointed out in Kalirajan, Obwona, and Zhao (1994), there are two possible sources of inefficiency: (1) technical efficiency (i.e., production below the frontier); and (2) allocative efficiency (this will be reflected in the shares used to aggregate inputs).

Moreover, in the growth-accounting approach, factors of production are assumed to be paid according to the values of their marginal products. If this assumption does not hold, it can create another source of bias in the estimates of total factor productivity growth.

Stochastic Frontier Production Function Approach

The major distinguishing feature of the stochastic frontier production function approach to the growth-accounting method is the assumption regarding the existence of an unobservable production frontier function. This function corresponds to the set of maximum attainable output levels for a given combination of inputs. For each industry, this frontier, or best practice, production function can be represented as[9].

$$Q^F_t = f[X_t, t] \quad (3)$$

where Q^F_t is the potential output level on along the frontier production function at any particular time t, and X_t is the vector of factor inputs. The usual regularity conditions are assumed to be satisfied in $f[.]$, i.e., $f' > 0$, and $f'' < 0$.

Using (3), any actual or observed output Q_t can be expressed as

$$Q_t = Q^F_t \, . \, exp(u_t) = f[X_t, t] \, . \, exp(u_t) \quad (4)$$

where $u_t \leq 0$ and $exp(u_t)$ (with $0 < exp(u_t) \leq 1$) is the level of technical efficiency at the observed output Q_t. The variable u_t represents the combined effects of various nonprice and organizational factors which constrain the industry from obtaining its maximum possible output Q^F_t.

When there are no socio-economic constraints affecting the industry, u_t takes the value of zero. On the other, when the industry faces constraints, u_t takes the value of less than zero. The actual value of u_t depends on the

9. See Chyi and Wang (1994).

extent to which the industry is affected by the constraints. Thus, a measure of technical efficiency of the i[th] industry can be defined as

$$exp(u_t) = Q_t/Q^F_t \qquad (5)$$
$$= (Actual\ output)/(Maximum\ possible\ output)$$

Equation (5) is the basic model that is generally used for measuring technical efficiency. In this model, the numerator is observable, but the denominator is not. Various methods using different assumptions have been suggested in the literature to estimate the denominator.

Taking the total derivative of the logarithm of Equation (4) with respect to time yields the following growth accounting equation

$$Q_t/Q_t = f_x \ . \ (x_t/x_t) + f_t + (u_t) \qquad (6)$$

where f_x and f_t denote output elasticities (not partial derivatives) of *f[.]* with respect to input *X* and time *t*, respectively. The variables with dots indicate time derivatives. Thus, equation (6) shows that output growth can be decomposed into three main components: (i) the growth of inputs weighted by their respective output elasticities; (ii) the rate of outward shift of the best-practice frontier function (which also indicates technological progress); and (iii) the change in the level of technical efficiency at time *t*. Thus, the total factor productivity growth of industry *j* at time *t* is

$$TFP_{jt} = Q_{jt}/Q_{jt} - fx\ (x_{jt}/x_{jt}) \qquad 7)$$
$$= f_{jt} + (u_{jt})$$

Thus TFP growth is the sum of technological progress and the change in technical efficiency.

The decomposition of TFP growth of an industry using the stochastic approach is shown graphically in Figure 4.[10] The industry faces two

10. Based on Kalirajan, Obwona, and Zhao (1994).

production frontiers in periods 1 and 2: F_1 and F_2, respectively. If the industry was technically efficient, output would be Q^*_1 in period 1 and $Q^*_{2''}$ in period 2. However, the industry's realized output is Q_1 in period 1 and Q_2 in period 2, owing to technical inefficiency *TI*. Technical inefficiency is measured by the distance between the frontier output and the realized output of a given industry, i.e., TI_1 in period 1 and TI_2 in period 2. Therefore, the change in technical efficiency over time is the difference between TI_1 and TI_2. On the other hand, technical change, or technical progress, is measured by the distance between F_2 and F_1, i.e., $Q^*_{2''} - Q^*_2$ (using X_2 input levels) or $Q^*_{1''} - Q^*_1$ (using X_1 input levels).

The total output growth of the industry using this framework can be decomposed into (i) input growth; (ii) technical change; and (iii) technical efficiency change. Based on Figure 1, the decomposition is

$$
\begin{aligned}
D &= Q_2 - Q_1 \qquad (8)\\
&= A + B + C \\
&= [Q^*_1 - Q_1] + [Q^*_{1''} - Q^*_1] + [Q^2 - Q^*_{1''}] \\
&= [Q^*_1 - Q_1] + [Q^*_{1''} - Q^*_1] + [Q^2 - Q^*_{1''}] \\
&\quad + \{Q^*_{2''} - Q^*_{2''}\} \\
&= (Q^*_1 - Q_1) + (Q^*_{1''} - Q^*_1) - (Q^*_{2''} - Q_2) \\
&\quad + (Q^*_{2''} - Q^*_{1''}) \\
&= [(Q^*_1 - Q_1) - (Q^*_{2''} - Q_2)] + (Q^*_{1''} - Q^*_1) \\
&\quad + (Q^*_{2''} - Q^*_{1''}) \\
&= [TI_1 - TI_2] + \Delta T_c + \Delta Q_x
\end{aligned}
$$

where

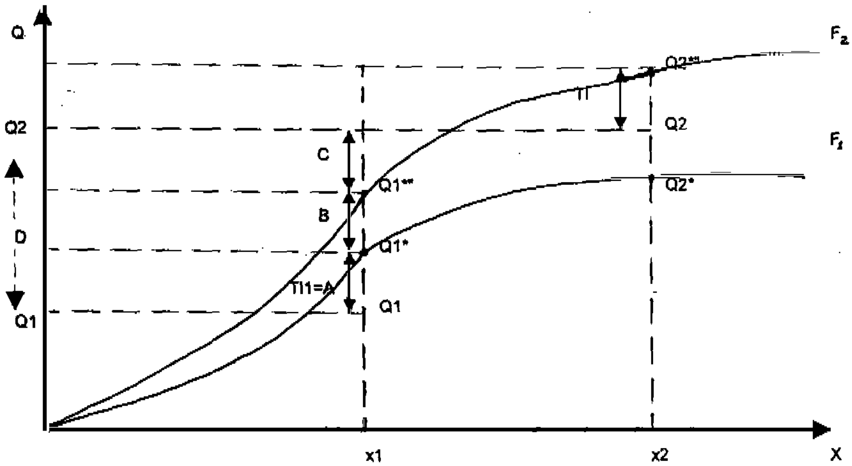
$Q_2 - Q_1$: production output growth

$TI_1 - TI_2$: technical efficiency change

ΔT_c : technical change or technical progress

ΔQ_x : change in output production due to factor input growth

FIGURE 4
Decomposition of Output Growth into Technical Efficiency Change, Technical Change, and Input Growth



From (8) total factor productivity growth consisting of changes in technical efficiency over time and shifts in technology over time can be measured by

$$\begin{aligned} TFP &= A + B \\ &= [TI_1 - TI_2] + \Delta T_c \end{aligned} \tag{9}$$

It is clear from these equations that the technical change component of productivity growth captures shifts in the frontier technology.

The distinction between technical progress and technical efficiency has very important policy implications. "For a given technology, it may be interesting to know whether the gap between the 'best-practice' technologies and realized production functions is diminishing or widening over time. Technical efficiency change can be substantial and may outweigh gains from technical progress itself. It is therefore, important to know how far a firm is off its frontier at any point in time, and how quickly it can reach the frontier. For instance, in the case of developing economies which borrow technology extensively from abroad, failures to acquire and adapt new technology will be reflected in the lack of shifts in the frontier over time. The movement of the frontier over time reflects the success of explicit policies to facilitate the acquisition of new technologies. Similarly, changes in technical efficiency over time and across individual firms will indicate the success or failure of a number of important industrial or agricultural policies."[11]

MODEL SPECIFICATIONS

The original specification of Equation (4) involves a production function with an error term with two components: one which accounts for random

11. See Kalirajan, Obwona and Zhao (1994).

effects, and another for technical inefficiency.[12] The model can be expressed as

$$Q_i = X_i \beta + (V_i - U_i), \qquad i = 1,\ldots,N \qquad (10)$$

where

- Q_i: is the production (or logarithm of the production) of the i^{th} industry;
- X_i: is the k'1 vector of th transformations of the input quantities of the i^{th} industry;
- β is a vector of unknown parameters;
- V_i: are random variables which are assumed to be independent and identically distributed (iid) as $N(0,\sigma_{V2})$. Also, this variable is independent of U_i.
- U_i in turn are the non-negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be iid as $N(0,\sigma_{U2})$.

In the literature, Equation (10) has been modified to a more general form like[13]

$$Q_{it} = X_{it} \beta + (V_{it} - U_{it}), \quad i=1,\ldots,N;\ t=1,\ldots T \qquad (11)$$

with

$$U_{it} = (U_i exp(-n(t-T)))$$

where

- Q_{it}: is the production (or logarithm of the production) of the i^{th} industry in the t^{th} period;

12. See Aigner, Lovell and Schmidt (1977), Meeusen and van den Broeck (1977), and Coelli (1994).

13. See Battese and Coelli (1992).

X_{it} is the k^x1 vector of the transformations of the input quantities of the i^{th} industry in the t^{th} period;

β is a vector of unknown parameters (as defined above);

V_{it}: are random variables which are assumed to be independent and identically distributed (iid) as $N(0, \sigma_{V2})$. Also, this variable is independent of U_{it}.

U_i: in turn are the non-negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be iid as $N(0, \sigma_{U2})$.

In the parameterization of (11) σ_{V2} and σ_{U2} are replaced with $\sigma^2 = \sigma V2 + \sigma U2$ and $y = \sigma U2/(\sigma V2 + \sigma U2)$, respectively.[14] Equation (11) can be estimated using maximum-likelihood methods.

With (11) one can experiment with different assumptions on U_{it}. For example, if η is set to zero, technical efficiency does not vary with time. If μ is set to zero, U_{it} will have a half-normal. In the present study, four different combinations of η and μ were experimented.

(1) η and $\mu = 0$, *i.e,* time-invariant and half-normal
(2) $\eta = 0$ and $\mu = 0$, *i.e,* time-invariant and truncated-normal
(3) $\eta \neq 0$ and $\mu = 0$, *i.e,* time-varying and half-normal
(4) η and $\mu \neq 0$, *i.e,* time-varying and truncated-normal

An additional specification of U_{it} has been supplied by Battese and Coelli (1993). The specification is the same as in (11), except that it is iid $N(m_{it}, \sigma_{U2})$, where

$$m_{it} = z_{it} \delta \tag{12}$$

14. See Battese and Corra (1977).

where z_{it} is a px1 vector of variables which may influence the efficiency of an industry; and δ is a 1x p vector of parameters to be estimated.

The specification of the production, on the other hand, can take the form of the restrictive Cobb-Douglas production function, or the flexible Translog production function. The Cobb-Douglas specification is

$$\ln(Q_{it}) = \beta_0 + \beta_1 \ln(L_{it}) + \beta_2 \ln(K_{it}) + \beta_3 \ln(RM_{it}) + (V_{it} - U_{it}) \quad (13)$$

where Q_{it}, L_{it}, and RM_{it} are output, labor, capital, and raw materials, respectively of industry *i* at time *t*. The Translog production function specification, on the other hand, is

$$\begin{aligned} ln(Q_{it}) = {} & \beta_0 + \beta_1 ln(L_{it}) + \beta_2 ln(K_{it}) + \beta_3 ln(RM_{it}) \quad (14) \\ & + \beta_4(\ln(L_{it}))^2 + \beta_5(\ln(K_{it}))^2 + \beta_5(\ln(RM_{it}))^2 \\ & + \beta_6 ln(L_{it})\, ln(K_{it}) + \beta_7 ln(L_{it})\, ln(RM_{it}) + \beta_8 ln(K_{it})\, ln(RM_{it}) \\ & + (V_{it} - U_{it}) \end{aligned}$$

In the present study, these different forms of the production function and the technical efficiency were experimented using the computer software "Frontier Version 4.1" developed by Coelli (1994) which computes for the maximum-likelihood estimates (MLEs) of the parameters of the model and the predictors for technical efficiencies.[15] The program uses a three-step procedure: (1) it computes for the ordinary least squares (OLS) estimates of the parameters of the production function; (2) a grid search of the μ, η, and other parameters is conducted using the OLS estimates of the β parameters; and (3) the values selected in the grid search are used as starting values in an iterative procedure using the Davidson-Fletcher-Powell method to obtain the final MLE estimates.

15. The Project Team gives special thanks to Tim Coelli of the University of New England (Australia) who sent his recent Frontier Program (version 4.1) to us. Without the program, the Team could not have incorporated the stochastic frontier approach to the TFP growth analysis.

There is still one possible source of estimate bias left, though, in the above stochastic frontier approach to TFP estimation. It employs a restrictive assumption of Hicks-neutral technical change. Kalirajan and Obwona (1994) provide an alternative specification which relaxes this Hicks-neutral shifts assumption in the production function. The alternative method is called "stochastic coefficients frontier production function" approach (SCFP). This method can also be implemented empirically using the computer software program developed by Kalirajan. Unfortunately, the Project Team did not have the opportunity to get hold of the program.

RESEARCH RESULTS

This section presents two sets of TFP growth estimates for the 25 Philippine manufacturing industries. One set was derived using the growth-accounting approach, while another set was estimated using the stochastic frontier approach.

TFP Using Growth-Account Approach

This approach uses Equation (2) to estimate industry TFP growth. The data set used in the estimation consisted of gross value of output, and three factor inputs: labor, capital services, and raw materials (all expressed in real per establishment basis).[16]

The study focused on industry classification which covers only '20 or more workers', or what is considered as big or large establishments. Hooley (1985) presented two major reasons why one must focus on big or large establishments in the analysis of industrial productivity. *First,* large establishments may serve as better approximation of firm production functions than smaller ones. It was cited in the argument that "for very small firms, it is reasonable to view the production decision as an integral part of the household decision on the (household) allocation of time. In contrast, our

16. See Cororaton, et al. (1995). Capital services series for each industry was derived by multiplying the computer capacity utilization index and the capital stock series.

(Hooley's) model postulates the existence of an explicit production function and maximization behavior within that context — an assumption which is reasonable for larger firms where production decisions are distinct from household decisions." *Second*, information for large establishments are likely to be of better quality than small ones because the former are more likely to keep accounting books "along conventional accounting lines, yielding both better quality data and more detail on greater variety of variables." It was further argued that these inferences are borne out of the Survey: "data are available on a wider variety of variables for establishment with 20 or more workers and, where error measures have been calculated by the National Census and Statistical Office (NCSO), they are smaller for the larger establishments."

The factor shares used in Equation (2) were derived through the OLS estimation of a Cobb-Douglas production function for each industry.[17] The results of the estimation are shown in Appendix 2.

Table 15 presents the industry TFP growth estimates for the period 1956-1992 using the growth-accounting approach. There are two sets of period breakdown in the results: one is the five-year breakdown, and another is the 10-year breakdown. Some industries do not have TFP estimates, especially in the 1960s and 1970s, because there are no industry production data available. Also, there are no TFP growth estimates for two industries: other chemicals, and non-ferrous metal. This is because of severe data problems.

Focus was on the number of industries which registered negative TFP growth. The number of industries with declining TFP growth increased through time. In the period 1961-1965, there were only two industries with negative TFP growth: wood products and furniture and fixtures. Since then, there has been a significant increase in the number of industries with negative TFP growth. In fact, in the period 1991-1992, there were already 16 industries with contracting TFP growth. It is interesting to note that it was

17. Under certain assumptions, the factor elasticities of a Cobb-Douglas production represent the shares of the factors to total output (see Appendix 1 for the derivation).

TABLE 15

Average Growth Rate of Total Factor Productivity by Industry, 1957-1992 (Using Growth-Accounting Approach)

PSIC	Industry	57-60	61-65	66-70	71-75	76-80	81-85	86-90	91-92	57-70	71-80	81-92
311-312	Food manufacturing	1.49	2.31	0.21	-5.17	-2.60	-5.66	-3.79	-2.58	1.33	-3.74	-4.35
3123	Sugar milling				8.78	3.33	-7.99	7.35	1.68		7.41	0.01
313	Beverages	-7.96	3.66	-0.68	-0.83	-0.71	-6.74	-4.39	0.11	-1.21	-0.77	-4.42
314	Tobacco products	-4.18	7.74	7.34	10.36	-1.99	2.53	2.42	-3.66	4.19	4.18	1.45
321	Textiles	-1.39	4.21	3.31	-0.43	-0.92	-1.51	-0.82	-1.51	2.29	-0.67	-1.22
322	Wearing apparel				-11.88	-2.75	3.21	-8.52	6.91		-6.17	-1.06
323	Leather products	7.51	6.65	4.93	-0.93	3.46	1.26	0.36	-1.16	6.28	1.27	0.49
324	Footwear	-8.83	2.68	-2.73	-8.56	5.35	-3.18	-5.12	5.39	-2.54	-1.61	-2.56
331	Wood products	0.52	-0.08	6.73	1.57	-2.39	-0.37	0.37	-0.30	2.52	-0.41	-0.05
332	Furniture and fixtures	-1.14	-2.85	5.87	0.35	7.31	0.75	3.44	4.58	0.75	3.44	4.58
341	Paper and paper products	-12.44	9.71	-0.10	2.31	0.32	4.99	0.52	-4.99	-0.12	1.32	1.47
342	Printing and publishing	6.37	4.76	7.07	0.62	5.92	0.64	3.85	-3.98	6.04	3.27	1.21

TABLE 15 (Continued)

PSIC	Industry	57-60	61-65	66-70	71-75	76-80	81-85	86-90	91-92	57-70	71-80	81-92
351	Industrial chemicals	-10.55	3.93	-0.20	4.19	5.90	1.60	-5.58	0.41	-1.68	5.04	-1.59
353	Petroleum products				0.17	-9.53	-1.75	-0.20	-20.16		-5.89	-4.18
355	Rubber products	-7.11	0.85	4.02	-2.69	0.24	1.85	4.06	0.66	0.84	-1.22	2.57
356	Plastic products				-1.26	0.53	0.28	-3.75	-1.74		-0.23	-1.74
362	Glass products				3.60	2.63	-7.01	-2.83	-4.60		2.90	-4.86
369	Non-metallic mineral products	3.64	2.86	-2.41	1.03	-1.42	-4.55	-1.06	-1.70	1.01	-0.33	-2.45
371	Iron and steel basic industries	8.49	6.96	-8.44	0.60	-8.44	-0.63	-3.24	-3.98	0.80	-4.42	-2.27
381	Fabricated metal products	0.77	7.01	2.89	3.75	4.47	6.17	1.39	-2.38	3.75	4.11	2.75
382	Machinery	-	6.82	4.36	1.10	1.80	0.61	-0.44	-8.99	5.587*	1.45	-1.43
383	Electric machinery	2.68	1.78	6.97	4.16	4.78	-5.65	15.54	-6.49	3.89	4.47	3.04
384	Transport equipment	-5.56	1.75	3.32	1.00	-1.00	-0.70	-0.20	-4.32	0.22	0.00	-1.09
	No. of industries w/ declining TFP growth	**9**	**2**	**6**	**8**	**10**	**12**	**13**	**16**	**4**	**12**	**14**
	Maximum	**8.49**	**9.71**	**7.34**	**10.36**	**7.31**	**6.17**	**15.54**	**6.91**	**6.28**	**7.41**	**4.58**
	Minimum	**-12.44**	**-2.85**	**-8.44**	**-11.88**	**-9.53**	**-7.99**	**-8.52**	**-20.16**	**-2.54**	**-6.17**	**-4.86**

during the second half of the 1980s and early 1990s when the TFP growth of the manufacturing industries deteriorated. It was also during this period when the government implemented a series of structural and macroeconomic adjustment policies to check the chronic macroeconomic imbalances of the economy. Off hand, it may be hard to tell whether the decline in productivity was due to these policies, but it would certainly be an interesting research topic to pursue.

In the period 1981-1992, the industries with the biggest drop in TFP growth are: food manufacturing, beverages, petroleum products, and glass products. TFP of these industries shrunk by more than 4 percent per year. On the other hand, industries with the largest increase in TFP growth are: furniture and fixtures (4.58 percent per year), electrical machinery (3.04 percent), fabricated metal products (2.75 percent), and rubber products (2.57 percent).

TFP Using Stochastic Frontier Approach

Equation (11) was estimated using five different assumptions on the variable which accounted for the technical inefficiency parameter. As discussed above, five assumptions can be tested:

(a) time-invariant and half-normal distribution
(b) time-invariant and truncated-normal
(c) time-varying and half-normal
(d) time-varying and truncated-normal
(e) Equation (12)

Furthermore, two types of production functions were tested: Cobb-Douglas and translog production functions. The results of the estimations were compared using the likelihood ratio tests which are chi-square distributed. The results of the experiments are presented in Appendix 3.

It can be observed that all specifications have generally high likelihood test ratios. The Cobb-Doulgas specifications have higher likelihood test ratios than the translog.

The likelihood test ratios are at least 400. This means that all of the assumptions cannot be rejected, i.e., assumptions are statistically significant. Given this, the question is: how does one choose the specification to use among the statistically significant specifications? The Team decided to select **Model H** for two reasons: *one*, it is based on a translog production function (this specification is a lot flexible than the restrictive Cobb-Douglas),[18] and *two*, the technical efficiency is time-varying, i.e., the technical efficiency coefficient varies through time. Thus, all of the remaining discussions in the paper will be based on Model J. The technical efficiency estimates derived using this model are presented in Appendix 4.

To reiterate, technical efficiency shown in the results are ratios of the actual industry output and the maximum possible output [see Equation (5)]. Thus, the higher is the ratio, the nearer is the industry to the frontier or 'best practice' curve. In the extreme case, if the industry operates along the frontier, then it is 100 percent technically efficient. Table 16 shows the period averages (1956-1992 for some industries, and 1972-1992 for a few industries) of the technical efficiency coefficients of the industries. Based on the results, the top three technically efficient industries are: 'food manufacturing', and 'sugar', with technical efficient of above 80 percent. The least technically efficient industries are: 'wearing apparel' and 'furniture and fixtures', with technical efficiency coefficient of below 55 percent.

The TFP growth estimates using the stochastic frontier approach are shown in Table 17. Generally, the same declining productivity appears in the results. Through time, the number of industries which registered negative or contracting TFP growth increased. In the period 1956-1970, there were three industries with negative TFP growth. In the period 1971-1980, the number increased to nine industries. In the period 1981-1992, the number of industries with declining TFP growth increased further to 10.

Comparison Between the Two TFP Estimates

As discussed above, TFP growth estimates using the growth-accounting approach are biased because the method assumes that industries operate along the production frontier. This problem is well addressed in the

18. See Christensen, Jorgensen, and Lau (1973).

TABLE 16

Average Technical Efficiency Coefficient and Ranking, 1956-1992

Industry No.	Industry Description	TEC*	Rank
1	Food manufacturing	0.870	1
2	Sugar	0.809	2
11	Paper and paper products	0.769	3
18	Glass products	0.759	4
16	Plastic products	0.740	5
3	Beverages	0.738	6
13	Industrial chemicals	0.732	7
23	Transport equipment	0.728	8
15	Rubber products	0.713	9
4	Tobacco products	0.708	10
5	Textiles	0.707	11
17	Non-metallic mineral	0.682	12
19	Iron and steel basic industry	0.665	13
7	Leather products	0.655	14
21	Machinery	0.650	15
9	Wood products	0.647	16
14	Other chemicals	0.633	17
20	Fabricated metal products	0.603	18
12	Printing and publishing	0.598	19
8	Footwear	0.575	20
22	Electrical machinery	0.564	21
6	Wearing apparel	0.541	22
10	Furniture and fixtures	0.509	23

* Technical Efficiency Coefficient

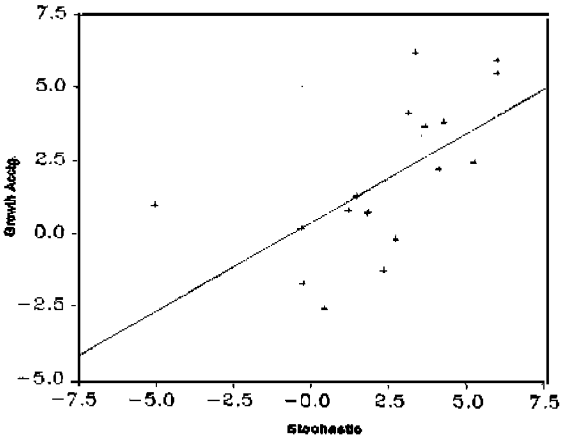
TABLE 17
Total Factor Productivity Growth, Using Stochastic Frontier Approach

Industry Description	1956-1970	1971-1980	1981-1992	1956-1992
Food manufacturing	1.42	0.43	2.41	1.49
Sugar milling		1.45	-0.15	0.38*
Beverages	2.30	2.76	-0.47	1.56
Tobacco products	3.08	-0.24	-3.51	0.25
Textiles	4.08	0.63	0.56	1.77
Wearing apparel		-9.47	-0.68	-4.56*
Leather products	3.29	0.75	-4.74	0.09
Footwear	0.42	0.24	3.61	1.34
Wood products	5.18	-0.10	0.88	2.38
Furniture and fixtures	1.76	9.51	2.58	4.23
Paper and paper products	2.70	0.58	1.65	1.81
Printing and publishing	5.91	2.57	1.16	3.43
Industrial chemicals	-0.28	5.17	-0.22	1.39
Other chemicals		-1.24	2.30	0.94*
Rubber products	1.18	-0.48	1.48	0.76
Plastic products		-7.25	-1.75	-3.95*
Non-metallic mineral products	-5.08	2.50	2.06	-0.01
Glass products		-4.78	-3.24	-4.12*
Iron and steel basic industries	1.80	-0.87	-1.52	0.43
Fabricated metal products	3.61	3.63	2.59	3.24
Machinery	5.92	3.08	0.15	3.40
Electric machinery	4.21	4.52	2.90	3.78
Transport equipment	-0.34	-1.63	-3.29	-1.79
No. of industries w/ declining TFP growth	**3**	**9**	**10**	**5**
Maximum	**5.92**	**9.51**	**3.61**	**4.23**
Minimum	**-5.08**	**-9.47**	**-4.74**	**-4.56**

*1972-1992

FIGURE 5

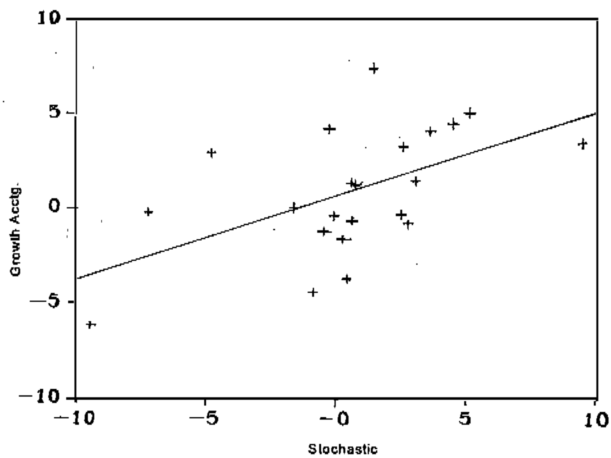
Growth Accounting vs. Stochastic (56-70)



correlation coefficient = 0.626

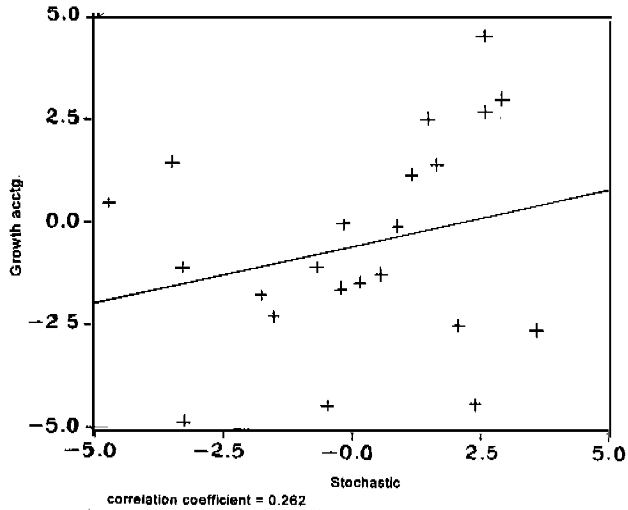
FIGURE 6

Growth Accounting vs. Stochastic (71-80)



correlation coefficient = 0.538

FIGURE 7
Growth Accounting vs. Stochastic (81-92)



stochastic frontier approach. Thus it would be interesting to compare the two sets of estimates.

Figures 5 to 7 show the comparison between the two sets. The comparison was done on a per period. Figure 5 shows that the TFP growth estimates for the period 1956-70 using both approaches move generally in the same direction. In fact, the correlation coefficient between the two sets is 0.625.

In the period 1971-80, the correlation coefficient is somewhat lower, 0.538. Thus, the two sets of estimates started to diverge in this period. Figure 6 shows this.

In the last period, the correlation coefficient is much lower, 0.262. Figure 7 shows that the two sets differ a lot. The technical explanation for the divergence of the two sets of TFP growth estimates, especially in the last period, is the very restrictive assumption used in the growth-accounting approach which requires that all industries operate along the frontier. This implies that all industries are 100 percent technically efficient. This assumption is indeed too restrictive considering the fact that the economy was highly unstable during the 1980s and early 1990s. The foreign exchange crisis in the mid-1980s put to an almost halt a number of heavily import dependent industries. A few car assembly companies, for example, closed shop during this period because of the shortage of foreign exchange. The foreign exchange crisis and the import levy in the early 1990s also impacted negatively on a number of local industries. The economic constraints during this period therefore must have adversely affected the productivity performance of the local industries. The 100 percent technical efficiency assumption under the growth-accounting approach is therefore unrealistic and presents a big bias in the estimates of industry TFP growth. Thus, *the succeeding discussion will be based on the estimates derived using the stochastic frontier approach.*

Decomposition Analysis

Table 18 presents the decomposition of industry TFP growth. The growth of TFP is decomposed into two growth components: technical progress (TP) and technical efficiency (TE). To reiterate, TP implies shifts in the frontier. In the literature on productivity, in the case of developing countries which borrow technology extensively from abroad, the lack of shifts in the frontier over time will indicate the failure to acquire and adapt new technology. Furthermore, the movement of the frontier over time reflects the success of explicit policies to facilitate the acquisition of new technology. On the other hand, changes in the TE over time and across industries will indicate the success or failure of important industrial policies.

One can observe from the results that, in terms of absolute TP growth, there has been indeed a deterioration in technical progress. In the period 1956-1970, there were eight industries with negative TP growth. In the period 1971-1980, the number increased to 17 industries. In the last period, 1980-1992, the number of industries with dropping TP growth further increased to 21. Overall, there has not been a shift in the frontier in the Philippine manufacturing sector. This set of results implies that there has been a big gap or failure in the approach to acquiring and adapting new

TABLE 18

Decomposition of Total Factor Productivity Growth Using Stochastic-Frontier Approach: TFP, TP and TE

Industry Description	1956-1970			1971-1980			1981-1992			1956-1992		
	TFP	TP	TE	TFP	TP	TE	TFP	TP	TE	TFP	TP	TE
Food manufacturing	1.42	-0.17	1.59	0.43	-2.19	2.63	2.41	-0.14	2.54	1.49	-0.70	2.19
Sugar milling				1.45	-0.26	1.71	-0.15	-2.95	2.80	0.38	-2.10	2.48 *
Beverages	2.30	0.59	1.71	2.76	0.35	2.41	-0.47	-2.86	2.39	1.56	-0.57	2.13
Tobacco products	3.08	1.34	1.74	-0.24	-2.41	2.17	-3.51	-5.59	2.08	0.25	-1.73	1.97
Textiles	4.08	2.62	1.46	0.63	-2.16	2.79	0.56	-2.11	2.68	1.77	-0.46	2.23
Wearing apparel				-9.47	-11.79	2.32	-0.68	-5.59	4.90	-4.56	-8.43	3.87
Leather Products	3.29	-0.15	3.44	0.75	-2.39	3.14	-4.74	-7.23	2.49	0.09	-2.95	3.04
Footwear	0.42	-1.34	1.76	0.24	-2.85	3.09	3.61	1.76	1.85	1.34	-0.82	2.16
Wood products	5.18	3.74	1.44	-0.10	-2.91	2.80	0.88	-2.18	3.06	2.38	0.02	2.36
Furniture and fixtures	1.76	-1.49	3.25	9.51	7.77	1.74	2.58	-0.18	2.76	4.23	1.56	2.67
Paper and paper products	2.70	1.05	1.66	0.58	-1.83	2.41	1.65	-0.64	2.29	1.81	-0.26	2.08
Printing and publishing	5.91	3.50	2.41	2.57	-0.31	2.88	1.16	-1.57	2.74	3.43	0.78	2.65
Industrial chemicals	-0.28	-2.48	2.20	5.17	3.36	1.81	-0.22	-3.20	2.98	1.39	-0.96	2.35
Other chemicals				-1.24	-4.57	3.34	2.30	-0.51	2.81	0.94	-2.07	3.00*
Rubber products	1.18	-1.64	2.82	-0.48	-3.57	3.09	1.48	-0.83	2.31	0.76	-1.96	2.72*
Plastic products				-7.25	-9.92	2.67	-1.75	-4.65	2.90	-3.95	-6.76	2.81

TABLE 18 (Continued)

Industry Description	1956-1970 TFP	1956-1970 TP	1956-1970 TE	1971-1980 TFP	1971-1980 TP	1971-1980 TE	1981-1992 TFP	1981-1992 TP	1981-1992 TE	1956-1992 TFP	1956-1992 TP	1956-1992 TE
Non-metallic mineral products	-5.08	-7.18	2.10	2.50	-0.06	2.57	2.06	-0.46	2.52	-0.01	-2.38	2.37
Glass products				-4.78	-7.41	2.63	-3.24	-6.43	3.19	-4.12	-7.09	2.97*
Iron and steel basic industries	1.80	0.87	0.93	-0.87	-4.10	3.23	-1.52	-4.38	2.85	0.43	-1.86	2.29
Fabricated metal products	3.61	0.69	2.92	3.63	1.26	2.38	2.59	-0.41	2.99	3.24	0.45	2.79
Machinery	5.92	3.23	2.68	3.08	1.02	2.07	0.15	-2.54	2.69	3.40	0.90	2.50
Electric machinery	4.21	2.53	1.68	4.52	2.79	1.73	2.90	0.58	2.32	3.78	1.88	1.91
Transport equipment	-0.34	-2.02	1.68	-1.63	-3.36	1.73	-3.29	-5.61	2.32	-1.79	-3.69	1.91
Number of industries with declining TFP growth	**3**	**8**	**0**	**9**	**17**	**0**	**10**	**21**	**0**	**5**	**17**	**0**
Maximum	**5.92**	**3.74**	**3.44**	**9.51**	**7.77**	**3.34**	**3.61**	**1.76**	**4.90**	**4.23**	**1.88**	**3.87**
Minimum	**-5.08**	**-7.18**	**0.93**	**-9.47**	**-11.79**	**1.71**	**-4.74**	**-7.23**	**1.85**	**-4.56**	**-8.43**	**1.91**

*1972-1992

TFP- Total Factor Productivity

TP - Technical Progress

TE - Technical Efficiency

technology or foreign technology. This could be the main reason why the Philippines has constantly been lagging behind Asian "tigers" in terms of economic growth through the years.

The results on the absolute TE growth, on the other hand, point otherwise. All industries have registered positive TE growth through the years.

Table 19 shows the period difference of the growth of TFP. The results in this table can indicate how the growth of TFP, TP and TE changed over time.

The declining productivity in the manufacturing sector again shows up in the results. However, three interesting points can be observed: *One,* although all of the industries have registered positive TE growth through the years, their growth through time decelerated. For example, in the period 1956-1980, there were five industries with decelerating TE growth. However, in the period 1971-1992, the number of industries with decelerating TE growth increased to 12. *Two,* wearing apparel (one of the country's leading export item) showed negative TFP growth over the years. Interestingly, in terms of the rate of change of TFP, TP and TE growth through the years, the wearing apparel is the top performer. This implies that although the productivity indices are still negative for the industry, there has been a drastic improvement in productivity over the years. *Three,* electric machinery (which includes semi-conductor, another leading export item of the country at present) registered positive TFP growth over the years. However, the growth has been tapering off. This is shown in the negative period difference of TFP growth, and TP growth in the period 1971-1992 for the industry. In the period, TFP growth decelerated by -1.62 percent per year, while TP growth by -2.21 percent per year.

Decomposition of Output Growth

Table 20 shows the decomposition of industry output growth (also called sources of growth) into five components: (a) labor, (b) capital, (c) raw materials, (d) technical progress, and (e) technical efficiency. The period

TABLE 19
Period Difference of Total Factor Productivity

Industry Description	(1980-1971) - (1956-1970)			(1981-1992) - (1971-1980)		
	TFP	TP	TE	TFP	TP	TE
Food manufacturing	-0.98	-2.02	1.04	1.97	2.06	- 0.08
Sugar milling				-1.60	-2.69	1.09
Beverages	0.46	-0.25	0.71	-3.23	-3.21	-0.02
Tobacco products	-3.32	-3.75	0.42	-3.26	-3.17	-0.09
Textiles	-3.45	-4.78	1.33	-0.07	0.05	-0.11
Wearing apparel				8.79	6.21	2.58
Leather products	-2.54	-2.24	-0.30	-5.49	-4.84	-0.65
Footwear	-0.18	-1.51	1.33	3.37	4.61	-1.24
Wood products	-5.29	-6.65	1.36	0.99	0.73	0.26
Furniture and fixtures	7.75	9.26	-1.51	-6.93	-7.95	1.02
Paper and paper products	-2.12	-2.87	0.75	1.06	1.19	-0.12
Printing and publishing	-3.34	-3.82	0.48	-1.40	-1.26	-0.14
Industrial chemicals	5.44	5.84	-0.39	-5.39	-6.56	1.17

TABLE 19 (Continued)

Industry Description	(1980-1971) - (1956-1970)			(1981-1992) - (1971-1980)		
	TFP	**TP**	**TE**	**TFP**	**TP**	**TE**
Other chemicals				3.54	4.06	-0.52
Rubber products	-1.66	-1.93	0.28	1.96	2.74	-0.78
Plastic products	-	-	-	5.50	5.27	0.23
Non-metallic mineral products	7.59	7.12	0.47	-0.44	-0.39	-0.05
Glass products	-	-	-	1.53	0.97	0.56
Iron and steel basic industries	-2.67	-4.97	2.30	-0.66	-0.28	-0.38
Fabricated metal products	0.03	0.57	-0.54	-1.05	-1.66	0.62
Machinery	-2.83	-2.22	-0.61	-2.93	-3.55	0.62
Electric machinery	0.31	0.26	0.05	-1.62	-2.21	0.59
Transport equipment	-1.29	- 1.34	0.05	-1.66	- 2.25	0.59
No. of industries with declining TFP growth	**12**	**13**	**5**	**14**	**13**	**12**
Maximum	**7.75**	**9.26**	**2.30**	**8.79**	**6.21**	**2.58**
Minimum	**-5.29**	**-6.65**	**-1.51**	**-6.93**	**-7.95**	**-1.24**

TABLE 20 (A)

Decomposition of Output Growth

Industry Description	1956-1970						1971-1980					
	Output	Labor	Capital	Raw Materials	TP	TE	Output	Labor	Capital	Raw Materials	TP	TE
Food manufacturing	9.02	1.79	2.48	3.34	-0.17	1.59	1.93	-0.19	0.58	1.11	-2.19	2.63
Sugar milling							0.32	-0.05	-0.04	-1.04	-0.26	1.71
Beverages	9.17	1.48	3.05	2.35	0.59	1.71	8.08	1.68	1.69	1.95	0.35	2.41
Tobacco products	10.52	2.27	1.76	3.41	1.34	1.74	9.90	0.66	0.56	8.93	-2.41	2.17
Textiles	14.58	5.00	0.55	4.95	2.62	1.46	2.48	0.97	-0.01	0.89	-2.16	2.79
Wearing apparel							10.15	3.08	1.96	14.59	-11.79	2.32
Leather products	2.60	0.19	-1.88	1.00	-0.15	3.44	1.87	1.08	-0.39	0.43	-2.39	3.14
Footwear	8.25	1.97	5.55	0.32	-1.34	1.76	7.41	0.29	4.78	2.10	-2.85	3.09
Wood products	10.60	1.28	3.24	0.90	3.74	1.44	3.14	0.99	0.89	1.37	-2.91	2.80
Furniture and fixtures	2.44	0.40	0.75	-0.47	-1.49	3.25	12.65	0.70	1.40	1.03	7.77	1.74
Paper and paper products	9.10	1.21	3.01	2.18	1.05	1.66	7.56	0.81	0.60	5.57	-1.83	2.41
Printing and Publishing	6.00	-0.04	0.01	0.12	3.50	2.41	3.00	-0.26	0.16	0.53	-0.31	2.88

TABLE 20 (A) (Continued)

	1956-1970						1971-1980					
Industry Description	Output	Labor	Capital	Raw Materials	TP	TE	Output	Labor	Capital	Raw Materials	TP	TE
Industrial chemicals	5.93	0.89	4.29	1.03	-2.48	2.20	10.76	0.77	1.66	3.16	3.36	1.81
Other chemicals							0.73	1.45	0.00	0.51	-4.57	3.34
Rubber products	1.92.	-0.49	1.05	0.19	-1.64	2.82	1.68	2.08	-1.57	1.64	-3.57	3.09
Plastic products							4.07	2.45	4.74	4.14	-9.92	2.67
Non-metallic mineral products	6.98	1.42	8.62	2.02	-7.18	2.10	4.71	0.43	0.91	0.87	-0.06	2.57
Glass products							19.29	7.31	0.18	16.57	-7.41	2.63
Iron and steel basic industries	12.96	0.74	5.40	5.01	0.87	0.93	2.50	1.36	-0.34	2.34	-4.10	3.23
Fabricated metal products	3.74	0.24	-0.55	0.44	0.69	2.92	5.19	1.12	-0.27	0.71	1.26	2.38
Machinery	9.11	0.95	1.27	0.97	3.23	2.68	1.59	-0.26	-0.20	-1.03	1.02	2.07
Electrical machinery	11.92	2.80	1.81	3.10	2.53	1.68	10.90	1.96	0.81	3.62	2.79	1.73
Transport equipment	0.88	-0.12	0.43	0.91	-2.02	1.68	11.61	3.35	3.91.	5.98	-3.36	1.73

*1972-1992

TABLE 20 (B)
Decomposition of Output Growth

Industry Description	1981-1992						1956-1992					
	Output	Labor	Capital	Raw Materials	TP	TE	Output	Labor	Capital	Raw Materials	TP	TE
Food manufacturing	4.66	0.19	1.15	0.91	-0.14	2.54	5.60	0.72	1.44	1.95	-0.70	2.19
Sugar milling	2.00	-1.19	0.15	3.19	-2.95	2.80	1.44	-0 80	0.06	1.80	-2.10	2.48*
Beverages	4.14	0.42	1.09	3.10	-2.86	2.39	7.19	1.19	1.96	2.48	-0.57	2.13
Tobacco products	8.62	1.77	0.32	10.03	-5.59	2.08	9.71	1.69	0.91	6.87	-1.73	1.97
Textiles	2.54	1.11	-0.23	1.09	-2.11	2.68	7.21	2.63	0.10	2.70	-0.46	2.23
Wearing apparel	-0.38	0.66	0.39	-0.74	-5.59	4.90	3.84	1.64	0.99	5.76	-8.43	3.87*
Leather products	5.49	1.26	3.55	5.42	-7.23	2.49	3.36	0.83	0.15	2.29	-2.95	3.04
Footwear	13.63	1.29	8.08	0.65	1.76	1.85	9.81	1.25	6.27	0.95	-0.82	2.16
Wood products	0.44	-0.59	0.51	-0.36	-2.18	3.06	5.14	0.55	1.59	0.62	0.02	2.36
Furniture and fixtures	4.73	-0.37	-0.64	3.15	-0.18	2.76	6.04	0.21	0.49	1.11	1.56	2.67
Paper and paper products	4.29	1.16	0.64	0.84	-0.64	2.29	7.07	1.09	1.46	2.71	-0.26	2.08
Printing and Publishing	3.04	-0.05	1.83	0.10	-1.57	2.74	4.18	-0.11	0.63	0.23	0.78	2.65

TABLE 20 (B) (Continued)

Industry Description	1981-1992						1956-1992					
	Output	Labor	Capital	Raw Materials	TP	TE	Output	Labor	Capital	Raw Materials	TP	TE
Industrial chemicals	0.91	0.17	1.15	-0.19	-3.20	2.98	5.60	0.62	2.36	1.23	-0.96	2.35
Other chemicals	2.87	-0.50	-0.04	1.12	-0.51	2.81	2.09	0.27	-0.02	0 89	-2.07	3.00*
Rubber products	3.92	0.61	0.99	0.84	-0.83	2.31	2.52	0.65	0.28	0.83	-1.96	2.72
Plastic products	1.15	0.57	1.12	1.21	-4.65	2.90	2.32	1.35	2.52	2.40	-6.76	2.81 *
Non-metallic mineral products	4.39	0.23	1.40	0.70	-0.46	2.52	5.49	0.72	3.50	1.28	-2.38	2.37
Glass products	-0.30	0.37	0.01	2.56	-6.43	3.19	7.53	3.26	0.06	8.34	-7.09	2.97*
Iron and steel basic industries	3.86	-0.07	1.08	4.38	-4.38	2.85	7.02	0.68	1.78	4.13	-1.86	2.29
Fabricated metal products	0.81	-0.28	-1.08	-0.42	-0.41	2.99	3.17	0.32	-0.64	0.24	0.45	2.79
Machinery	6.94	-0.44	5.87	1.36	-2.54	2.69	6.28	0.17	2.16	0.55	0 90	2.50
Electrical machinery	9.07	1.74	1.12	3.30	0.58	2.32	10 69	2.25	1.31	3.34	1.88	1.91
Transport equipment	5.53	0.73	2.18	5.91	-5.61	2.32	5.41	1.10	2.28	3.82	-3.69	1.91

*1972-1992

differences of these growth are interesting, especially the results for labor and capital. The differences are shown in Table 21.

The period difference shows that under labor for the period 1956-1980, there were 11 industries with negative values. This implies that there were 11 industries with declining labor contribution to output growth. The results under capital show that there were 13 industries with negative values. However, when one compares these results with the succeeding period, 1971-1992, one can see that the number for labor increased to 16 industries with negative values, whereas for capital it decreased to 12. Thus, over time the contribution of labor to industry growth has declined, whereas the contribution of capital increased. These results support our earlier discussion on the Philippine economy that the manufacturing sector as a whole failed to absorb the growing labor force.

Productivity vs. Protection Rate

This section compares the productivity results of the industries with the degree of protection afforded to them and their index of comparative advantage.

The level of protection is indicated by the effective rate of protection (EPR). The EPR is defined as the proportionate increase in domestic value added over free trade value added, and as such it measures the extent to which protection policy raises domestic prices above free trade prices, i.e., through tariffs, advance sales taxes on imports, mark-ups, and other non-tariff or quantitative trade barriers. A higher EPR thus means a higher level of protection.

On the other hand, index of comparative advantage is measured by domestic resource cost (DRC) and shadow exchange rate (SER). DRC is a cost-benefit ratio representing the social valuation of domestic resources used per unit of foreign exchange earned (or saved) by the export (or import substitution) of a given product (Bautista and Power 1979). When compared with the shadow exchange rate (SER), or the social value of foreign exchange, the DRC/SER ratio serves as a measure of allocative efficiency and comparative advantage. A DRC/SER ratio less than or equal to one

TABLE 21

Period Difference of Output Growth

Industry Description	(1971-1980) - (1956-1970)						(1981-1992) - (1971-1980)					
	Output	Labor	Capital	Materials	TP	TE	Output	Labor	Capital	Materials	TP	TE
Food manufacturing	-7.09	-1.98	-1.90	-2.23	-2.02	1.04	2.73	0.39	0.57	-0.20	2.06	-0.08
Sugar milling	-	-	-	-	-	-	1.69	-1.14	0.19	4.23	-2.69	1.09*
Beverages	-1.09	0.20	-1.36	-0.39	-0.25	0.71	-3.94	-1.26	-0.60	1.15	-3.21	-0.02
Tobacco products	-0.62	-1.61	-1.20	5.51	-3.75	0.42	-1.28	1.12	-0.24	1.11	-3.17	-0.09
Textiles	-12.10	-4.03	-0.56	-4.06	-4.78	1.33	0.05	0.14	-0.22	0.20	0.05	-0.11
Wearing apparel	-	-	-	-	-	-	-10.53	-2.42	-1.58	-15.32	6.21	2.58*
Leather products	-0.72	0.90	1.49	-0.57	-2.24	-0.30	3.62	0.18	3.94	4.99	-4.84	-0.65
Footwear	-0.84	-1.67	-0.77	1.79	-1.51	1.33	6.22	1.00	3.30	-1.45	4.61	-1.24
Wood products	-7.45	-0.28	-2.35	0.47	-6.65	1.36	-2.70	-1.59	-0.37	-1.73	0.73	0.26
Furniture and fixtures	10.21	0.31	0.65	1.50	9.26	-1.51	-7.92	-1.07	-2.04	2.12	-7.95	1.02
Paper and paper products	-1.54	-0.40	-2.41	3.39	-2.87	0.75	-3.28	0.35	0.04	-4.73	1.19	-0.12
Printing and publishing	-3.00	-0.22	0.15	0.41	-3.82	0.48	0.04	0.21	1.67	-0.43	-1.26	-0.14
Industrial chemicals	4.84	-0.12	-2.63	2.14	5.84	-0.39	-9.85	-0.60	-0.52	-3.35	-6.56	1.17
Other chemicals	-	-	-	-	-	-	2.14	-1.96	-0.05	0.61	4.06	-0.52*

TABLE 21 (Continued)

	1981-1992						1956-92					
Industry Description	**Output**	**Labor**	**Capital**	**Materials**	**TP**	**TE**	**Output**	**Labor**	**Capital**	**Materials**	**TP**	**TE**
Rubber products	-0.24	2.57	-2.61	1.46	-1.93	0.28	2.24	-1.47	2.56	-0.80	2.74	-0.78
Plastic products	-	-	-	-	-	-	-2.93	-1.88	-3.62	-2.92	5.27	0.23*
Non-metallic mineral products	-2.28	-1.00	-7.71	-1.15	7.12	0.47	-0.31	-0.20	0.50	-0.16	-0.39	-0.05
Glass products	-	-	-	-	-	-	-19.59	-6.95	-0.17	-14.01	0.97	0.56*
Iron and steel basic industries	-10.46	0.62	-5.74	-2.67	-4.97	2.30	1.37	-1.43	1.42	2.04	-0.28	-0.38
Fabricated metal products	1.46	0.88	0.28	0.27	0.57	-0.54	-4.38	-1.40	-0.81	-1.13	-1.66	0.62
Machinery	-7.52	-1.21	-1.47	-2.00	-2.22	-0.61	5.34	-0.17	6.07	2.38	-3.55	0.62
Electrical machinery	-1.02	-0.84	-1.00	0.52	0.26	0.05	-1.84	-0.21	0.32	-0.32	-2.21	0.59
Transport equipment	10.73	3.47	3.48	5.06	-1.34	0.05	-6.08	-2.62	-1.73	-0.07	-2.25	0.59
Number of industries with declining TFP growth	**14**	**11**	**13**	**7**	**13**	**5**	**13**	**16**	**12**	**14**	**13**	**12**
Maximum	**10.73**	**3.47**	**3.48**	**5.51**	**9.26**	**2.30**	**6.22**	**1.12**	**6.07**	**4.99**	**6.21**	**2.58**
Minimum	**-12.10**	**-4.03**	**-7.71**	**-4.06**	**-6.65**	**-1.51**	**-19.59**	**-6.95**	**-3.62**	**-15.32**	**-7.95**	**-1.24**

*1972-1992

means an industry has a comparative advantage in its economic activities; a value greater than one means that the price of foreign exchange is lower than the social value of foreign exchange saved (or earned) in producing the import-substitute (or export good), i.e., the industry is at a comparative disadvantage. Some studies use 1.2 as the benchmark to give allowance to measurement errors.

Table 22 shows the EPR, DRC, and SER estimates of Tecson (1995) for the Philippine manufacturing industries for two periods, 1983 and 1988. It can be observed from the numbers that the industries which are least protected have the highest degree of comparative advantage. For example, in 1983 'other non-metallic mineral products' has the highest EPR of 280.3. In terms of comparative advantage, it is the lowest, with DRC/SER ratio of 6.6. On the other hand, 'footwear excluding rubber' has a negative EPR of -6.5, but it is the most competitive among the industries.

Among the highly protected industries are tobacco (60.6%), metal furniture and fixtures (75.9%), printing and publishing (72.4%), petroleum refineries (59.6%), iron and steel (80.5%), and fabricated metal products (66.3%). The least protected industries are wearing apparel (3.9%), footwear (-5.3%), non-metal furniture and fixtures (1.9%), leather (1.7%), wood (4.5%), industrial chemicals (8.5%), etc.

On the other hand, among the highly competitive industries (or with high degree of comparative advantage) based on DRC/SER are: 'food', 'beverages', 'tobacco', 'apparel', 'footwear', 'other chemicals', 'products of coal and petrol', and 'rubber.'

The structure in 1988, however, changed drastically. The overall EPR level reduced significantly in 1988 from 1983. This could be the result of economic reforms. However, there are still industries which are competitive in terms of DRC/SER index, but penalized in terms of effective protection. One such industry is 'footwear excluding rubber.'

The hypothesis that industries with high productivity are also industries with high comparative advantage or international competitiveness are not well reflected in the results. Also, the relationship between productivity performance and degree of protection is not borne out in the estimates. The

TABLE 22

Effective Protection and Domestic Resource Cost of Philippine Manufacturing Industries, 1983 and 1988

		1983		1988	
PSIC	INDUSTRY	EPR	DRC/ SER	EPR	DRC/ SER
	TOTAL MANUFACTURING	42.8	1.7	28.3	1.5
	CONSUMER GOODS				
311	Food	32.9	1.6	22.3	1.1
312	Other food	11.0	1.3	21.3	1.0
313	Beverages	83.7	1.9	52.0	1.2
314	Tobacco	147.0	1.7	60.6	1.2
322	Apparel excluding footwear	3.1	0.9	3.9	1.0
324	Footwear excluding rubber	-6.5	0.9	-5.3	1.1
332	Furniture and fixture excluding metal	-2.6	0.9	1.9	0.9
386	Furniture and fixture of metal	182.7	4.1	75.9	2.7
	INTERMEDIATE GOODS				
321	Textiles	92.8	4.9	30.6	3.5
323	Leather & leather products	-13.9	1.3	1.7	1.6
331	Wood & cork products	2.1	1.1	4.5	1.4
341	Paper and paper products	65.0	2.8	29.2	1.9
342	Printing and publishing	68.3	2.7	72.4	1.9
351	Industrial chemicals	53.2	2.2	8.5	3.1

TABLE 22 (CONTINUED)

PSIC	INDUSTRY	1983 EPR	1983 DRC/SER	1988 EPR	1988 DRC/SER
352	Other chemical products	37.7	1.7	44.8	1.2
353	Petroleum refineries	56.6	1.5	59.6	1.8
354	Products of coal and petrol	74.5	2.0	-5.5	0.6
355	Rubber products	129.3	2.1	18.9	0.9
356	Plastic products, etc.	119.7	2.6	20.9	1.2
361	Pottery and china	224.1	6.6	4.7	1.3
362	Glass ang glass products	67.1	2.6	20.9	1.2
363	Cement	79.2	3.4	42.4	3.1
369	Other non-metallic mineral products	280.3	6.6	17.4	1.8
	CAPITAL GOODS				
371	Iron and steel	38.3	1.7	80.5	2.3
372	Non-ferrous metal basic products	-9.7	1.3	-11.3	1.7
381	Fabricated metal products	82.3	2.6	66.3	1.8
382	Machinery exluding electric	28.1	2.8	11.7	1.4
383	Electrical machinery	4.5	2.9	30.9	3.9
384	Transport equipment	50.6	2.4	48.8	1.4
385	Professional and scientific equipment	-13.2	1.1	21.0	2.7
	OTHERS				
390	Other manufactures	8.1	1.3	4.6	1.2

Source of basic data: Tecson, G. *Catching Up With Asia's Tigers*, Vol. II.

correlation between industry productivity growth (TFP, TP and TE growth) with effective protection rate (EPR) and comparative advantage (DRC/SER) for both 1983 and 1988 is very low. The correlation coefficients range between -0.22 and 0.159 (Table 23).

Determinants of TFP

An attempt was made to relate industry productivity performance (TFP, and TP) through the years with some economic variables. Regression runs were conducted to relate these productivity indices to the following variables: the ratio of budget balance to GDP, foreign direct investment, GDP growth, inflation, the ratio of research and development expenditure to GDP, growth in real minimum wage rate, and growth in total exports. Industry dummy variables were included in the regression to account for the across industry differences of the impact of these explanatory variables on industry productivity.

Table 24 shows the regression results with industry TFP growth as the dependent variable. The coefficient for the budget balance to GDP ratio is positive and statistically significant at 5 percent level. This, therefore, implies that when the budget balance of the government is in deficit, its impact on TFP growth is negative. Therefore, the higher the budget deficit relative to GDP, the lower is the industry TFP growth. Fischer (1993) did a cross- country study, involving a large group of developing countries, investigating the role of macroeconomic factors in growth and productivity. One of his major conclusions is that large budget deficits are associated with lower growth, and therefore lower productivity. "Most of the results suggest also that these relationship are to some extent causal. The positive association between the budget surplus and growth appears particularly robust..." This is interesting because normally developing countries suffering from large budget deficit are highly unstable. Economic instability, therefore, negatively impacts productivity performance. Economic stabilization therefore plays a major role in improving productivity performance.

The coefficient for inflation is statistically significant, but it has a wrong sign. It is positive. Theories in which inflation distorts price signal suggest

TABLE 23
Correlation Coefficient:
Productivity vs. Protection and Comparative Advantage

Variables	Correlation Coefficient
TFP - EPR83	-0.02
TFP - EPR88	-0.17
TFP - DRC/SER83	0.13
TFP - DRC/SER88	0.10
TP - EPR83	0.03
TP - EPR88	-0.13
TP - DRC/SER83	0.16
TP - DRC/SER88	0.12
TE - EPR83	-0.20
TE - EPR88	-0.13
TE - DRC/SER83	-0.17
TE - DRC/SER88	-0.09

where:
TFP - Total Factor Productivity
TP - Technical Progress
TE - Technical Efficiency
EPR83 - Effective Protection Rate in 1983
EPR88 - Effective Protection Rate in 1988
DRC/SER83 - Domestic Resource Cost Over Shadow Exchange Rate in 1983
DRC/SER88 - Domestic Resource Cost Over Shadow Exchange Rate in 1988

TABLE 24
TFP vs. Some Factors: Regression Results

Variables	**Results**
Dependent Variable:	TFP Growth
Independent Variable:	
Constant	-5.416
	(-1.599)
BB/GDP	+1.273
	(2.929)
INF	+0.301
	(3.546)
GDP	+0.403
	(1.691)
EXPORTS	+0.012
	(1.631)
FDI	+0.003
	(1.214)
WAGE	+0.083
	(1.421)
DRD1	+0.403
	(0.401)
R squared = 0.076	

BB/GDP : Budget balance/GDP
INF : Inflation rate
GDP : Growth of gross domestic product
EXPORTS : Real growth of exports
FDI : Foreign direct investment
WAGE : (Min. wage/CPI) x 100
DRD1 : (RD/GDP)t - (RD/GDP)t-1
where RD is the total Research and Development (R&D) expenditures

that uncertainty about inflation should have negative impact on growth and therefore on productivity. The regression result on inflation shown in the table is essentially due to data problem, because if one examines the inflation in the Philippines, one notices that the inflation rate reached a peak of more than 50 percent in 1984. There has been a general decline in inflation rate since that peak. The recent peak of 1990 was only about 20 percent. During this period, the economy witnessed a drastic drop in total factor productivity. Thus, given this set of data, one would get a positive coefficient between productivity and inflation.

Going back to the paper of Fischer, although his results support the view that uncertainty about inflation negatively impacts on growth and productivity (the coefficient for inflation is negative) the coefficient is not statistically significant. Based on this, he makes the following statement: "Thus, the evidence from the regression and from case studies is consistent with the view that the causation is not fully from low growth to high inflation, and therefore that countries that are able to reduce the inflation rate in a sustainable way can on average expect higher growth to follow." He presented a set of data from the World Bank database that some countries have experienced rapid growth at high inflation rates. "During the period 1961-88, at least 14 countries in the World Bank database experienced an annual inflation rate of greater than 50 percent in at least one year. Growth in some of these countries exceeded 5 percent during a year or more of the 50 percent or more inflation."

The coefficient for foreign direct investment is positive, but not statistically significant even at 10 percent level. This might be due to the fact that, thus far, foreign direct investment (FDI) into the Philippine has not been very successful in bringing in technology to the local economy. This is a very important issue because, as we will discuss in the policy implication section, FDI in the literature is a major vehicle for the transfer of foreign technology. However, the market for technology is highly imperfect because of asymmetric information.

The coefficient for GDP is positive and signifcant at 10 percent level. This means that growth and productivity move together. The coefficient for exports is also positive, but not very statistically significant. The coefficient for real minimum wage is also positive, but not very statistically significant. The last variable is the ratio of aggregate research and development (R&D) expenditure to GDP. Although the coefficient for this variable is positive, its T-test is very small, only 0.6889. This could be due to two factors; (1) the aggregate data series on R&D expenditure is poor; and (2) the specification above may not be the right one. It would have been more appropriate to correlate productivity indices with industry-specific information on R&D expenditure.

There are two interesting results from the regression using technical progress (TP) growth as the dependent variable (Table 25). *First,* the coefficient for FDI is negative and statistically significant. This implies that FDI policies have generally failed in terms of bringing in, and therefore upgrading, local technology. This is a very important issue especially that the government has open the gate for foreign direct investment. Whether that would bring in foreign technology is still a very big issue to resolve. Separate industry cases studies would have to be conducted to look closely into this issue. *Second,* the coefficient for R&D is negative and statistically significant.

SUMMARY OF FINDINGS

The study finds that:

- Using both the growth-accounting method and the stochastic frontier approach to measure total factor productivity (TFP) growth, the results show that there has been a drastic drop in productivity performance in the manufacturing sector. The number of industries with negative TFP growth increased especially in the 1980s and early 1990s. It is interesting to note that the drop in the productivity performance of the manufacturing sector occurred during the period when the government applied a series of structural and economic adjustment policies. Off hand, it may be hard to tell whether the drop

TABLE 25
TP vs. Some Factors: Regression Results

Variables	**Results**
Dependent Variable:	TP Growth
Independent Variable:	
Constant	-8.762
	(-2.434)
DBB/GDP	+0.965
	(+2.380)
INF	+0.298
	(+3.346)
GDP	+0.563
	(+2.209)
DFDI	-0.010
	(-2.216)
WAGE	+0.064
	(+0.940)
DRD	-2.610
	(-2.195)
R squared = 0.076	

DBB/GDP : (BB/GDP)t - (BB/GDP)t - 1
where BB - Budget balance
INF : Inflation rate
GDP : Growth of gross domestic product
DFDI : (FDI)t - (FDI)t - 1
where FDI - Foreign direct investment
WAGE : (Min. wage/CPI) x 100
DRD : (RD/GDP)t - (RD/GDP)t - 1
where RD is the total Research and Development (R&D) expenditures

in the productivity performance was due to these adjustment policies, but it would certainly be an interesting research topic to pursue.

- The growth-accounting method results in a big bias in the estimate of TFP growth. The bias is evident in the 1980s and early 1990s, when the economy was highly unstable. This is because this approach makes use of the assumption that industries always operate along their frontier, i.e., they are always 100 percent technically efficient. The economic constraints during the period was highly unstable, e.g., the series of foreign exchange crisis, will surely make this particular assumption unrealistic. Stochastic frontier approach addresses this estimate bias adequately. It takes into account that industries usually operate below their frontier or 'best practice' curve. It is only in extreme cases when they can operate along their frontier.

- The growth of TFP can be decomposed into the growth of technical progress (TP) and technical efficiency. When the decomposition was done, it was observed that there has been a deterioration in the growth of technical progress. This would imply that there has not been a shift in the frontier of the Philippine manufacturing sector. Based on the literature in this area, this implies that there has been a big gap or a general failure in the approach to acquiring and adapting new technology or foreign technology. This could be the main reason why the Philippines has constantly been lagging behind the Asian "tigers" in terms of economic growth through the years.

- The growth of TE, on the other hand, is encouraging. All industries showed positive growth in TE. However, when the period difference of TE growth was computed, it was observed that the TE growth for some industries was decelerating through the years. This could be due to the fact that there has been a deterioration in the growth of technical progress. That is, although the industries are moving toward the frontier, the frontier itself has not been growing, in fact, deteriorating through time.

- Wearing apparel, one of the country's leading export items, showed negative TFP growth over the years. However, in terms of the rate of change in the growth of TFP, TP and TE, the wearing apparel industry was the top performer. Thus, productivity of the industry is improving through time. On the other hand, electric machinery, (which includes semi-conductor, another leading export item of the country at present) registered positive TFP growth over the years. However, the growth has been tapering off.

- In general, the contribution of labor to output growth of the manufacturing sector has declined over the years while the contribution of capital to output growth increased. With very high growth in labor force of almost 4 percent, this implies that the manufacturing sector has not been able to provide employment.

- The hypothesis that industries with high productivity are also industries with high comparative advantage or international competitiveness are not well reflected in the results. Also, the relationship between productivity performance and degree of protection is not borne out in the estimates.

- It was shown in the results that a higher budget deficit negatively impacts productivity performance of the industries. This is interesting because, normally, developing countries suffering from large budget deficit are highly unstable. Economic instability therefore negatively impacts productivity performance. Economic stabilization therefore plays a major role in improving productivity performance.

- The coefficient for foreign direct investment is positive but not statistically significant. This might be due to the fact that, thus far, foreign direct investment into the Philippines has not been very successful in bringing in foreign technology to the local economy. This is a very important issue because in the literature, FDI is a major vehicle for transferring foreign technology. However, the market for technology is highly imperfect because of information asymmetry.

- The coefficient for aggregate R&D is not statistically significant, although it has a positive sign. This might be due to the mispecification of R&D expenditure in the regression equation used in the present study. It would have been more appropriate to specify industry-specific R&D expenditure in the regression equation. Unfortunately information is not available.

POLICY IMPLICATIONS

One of the major findings of the study is the deterioration in the growth of technical progress (TP) through time. This means that there has ***not*** been a shift in the frontier of the Philippine manufacturing sector. In the literature, this implies that there has been a ***general failure*** in the approach or strategy of acquiring and adapting new technology or foreign technology.

Another important finding is that foreign direct investment (FDI) has not generally been contributing to the technical progress of the manufacturing sector when, in fact, it is supposed to be a major vehicle for transferring foreign technology to the local economy. This finding supports the survey results of Lindsey (1989) on the manufacturing sector in which he finds that: (1) most of the equipment brought in by investors are already in use in the Philippines; (2) research and activities are limited to quality control instead of basic research; (3) there is minimal diffusion of technology to local firms; and (4) the processes used are very simple, leaving little room for skills development. Based on these findings he concludes that there was little technology transfer by the transnational corporations to the Philippines.

These two findings are very important in the light of what has been happening in the policies on FDI. FDI policies have been subjected to a number of changes in recent past. Policies have been liberalized, especially with the Foreign Investment Act of 1991 which virtually opens the country to foreign investors. Some critics/analysts have regarded the series of change to be significant and too liberal, making the Philippines more open than its neighboring countries. Yet the liberalization of FDI has not considered adequately the fact that the market for technology is highly imperfect. There are distortions in the market for technology because of two reasons: *One,* there is asymmetric information. The suppliers of technology (usually developed countries) know their products well, but the buyers (usually developing countries), because of insufficient and lack of technological capability to assess the technology, may end up getting equipment that may not be totally appropriate to suit the local environment. Furthermore, because of inadequate technological capability, developing countries which attempt tp borrow directly techniques employed in developed countries will end up distorting their own factor prices, employing an incorrect choice of technique, and therefore substituting capital for labor (Pack 1992). There are a number of local industries which are at present suffering from inappropriate foreign technology. *Two,* the price charged for the technology tends to be oligopolistic and consequently there is a considerable scope for abuse and rent-seeking activities (Stewart 1979). Thus, developing countries end up paying exorbitant price for the acquired technology, making them uncompetitive in the international market.

One of the major concerns in the liberalization of FDI is that it can help bring in the much needed foreign exchange to the economy and therefore can provide some degree of stability in the external sector. This is mostly short-term consideration. But the most important aspect in FDI is how to utilize it so that it can be truly used as a major vehicle for transferring foreign technology. Outright FDI liberalization may not be totally productive. Transnational corporations (TNCs) may not have the incentives to transfer the right and appropriate technology to the local counterparts if the FDI policies are too relaxed. Thus, it may be true that local counterparts of TNCs may remain and stagnate as "assemblers" and therefore cannot go into higher value-added production.

One of the major reasons why Japan, South Korea, and Taiwan have progressed quite significantly in their technological capability build-up is their selective FDI policies (Nagaoka 1989). "As in Japan, the case of the Korean automobile industry is a classical example of the infant industry promotion. The development was selected, well-staged, financed and promoted until the industry could succeed in a competitive market. Technology acquisitions and adaptation were also carefully staged and selected from importing labor-intensive, sometime secondhand machines, to domestic production of parts and machinery" (Kakazu 1990).

Moreover, there is now a growing literature[19] in the light of the rapid growth of the Asian "tiger' economies. The literature says that while the reform towards a more liberalized policy regime is a necessary condition for a more rapid industrialization, it may not be sufficient. Judicious, more effective and selective interventions are also needed, and are in fact very important.

A recent book has come out strongly advocating the role of liberalization in the process of catching up with the Asian "tigers".[20] Although it is important to recognize this, the process of catching up with these "tigers" is not an easy job, in fact a very tough one specially that the Philippines is seriously facing the problem of declining productivity and technical progress. Technical progress plays an equally important role, if the not the center, in the process of improving the economic performance of the country. But the market for technology is highly imperfect. Thus, although moving toward a regime of neutral policy may be necessary in the process of industrialization, it may not be sufficient especially in cases where severe market failures are present.

19. This is the literature on endogenous growth theory which is revisited by Lucas (1988), and Romer (1986, 1991). At the heart of the theory is the old debate between the Keynesian school (for intervention) and the neoclassical camp (for purely market forces) [Chaudri and Wilson, 1994].

20. Medalla, Tecson, Bautista, and Power (1995).

APPENDIX 1
Cobb-Douglas Production Function

$$Q = A L^{\alpha} K^{\beta} M^{\delta}$$

where	Q	= output	A	= efficiency parameter
	K	= capital	α	= elasticity of Q with respect to L
	L	= labor	β	= elasticity of Q with respect to K
	M	= raw materials	δ	= elasticity of Q with respect to M

and where $0 < \alpha, \beta, \delta < 1$; $\alpha + \beta + \delta = 1$

Taking the first derivative with respect to K, L and M:

$$MP_K = \alpha A L^{\alpha-1} K^{\beta} M^{\delta}$$
$$MP_L = \beta A L^{\alpha} L^{\beta-1} M^{\delta}$$
$$MP_M = \delta A L^{\alpha} K^{\beta} M^{\delta-1}$$

MP_L, MP_K and MP_M can also be expressed as:

$$MP_L = \alpha (Q/L)$$
$$MP_K = \beta (Q/K)$$
$$MP_M = \delta (Q/M)$$

If the firm is a price-taker and a profit-maximizer, then

$$\frac{MP_K}{MP_L} = \frac{r}{w} \quad \text{and} \quad \frac{MP_M}{MP_L} = \frac{m}{w}$$

where r, w and m are the respective prices of K, L and M. Also

$$\frac{MP_K}{MP_L} = \frac{r/p}{w/p} \quad \text{and} \quad \frac{MP_M}{MP_L} = \frac{m/p}{w/p}$$

where p is output price. Thus, transposing

$$\alpha (Q/L) = w/p, \quad \beta(Q/K) = r/p \quad \text{and} \quad \delta(Q/K) = m/p \quad \text{gives}$$
$$\alpha = wL/pQ, \quad \beta = rK/pQ \quad \text{and} \quad \delta = mM/pQ$$

That is, α, β and δ represent the shares of L, K and M in total output.

APPENDIX 2
Production Function
Coefficients of Factor Inputs (weights)
(Note: Figures in parentheses are t-stats)

Industry	Constant	Labor	Capital	Raw Materials	Time	AR	ADJ. R2	DW	F stat
1 Food manufacturing	1.296	0.303	0.247	0.45	-	0.523	0.931	1.876	158.04
	(5.419)	(2.155)	(2.908)						
2 Sugar milling	-0.437	0.403	0.562	0.035	-0.037	-	0.519	1.194	7.83
	(-0.719)	(3.000)	(3.190)						
3 Beverages	1.491	0.321	0.656	0.023	-0.012	0.551	0.984	1.779	531.505
	(11.554)	(2.683)	(6.674)		(-1.940)				
4 Tobacco	0.293	0.586	0.135	0.279	0.0433	0.614	0.986	2.019	541.253
	(1.484)	(5.134)	(1.136)		(6.609)	(4.126)			
5 Textiles	0.857	0.731	0.208	0.061	-	0.598	0.967	1.4	345.475
	(17.562)	(5.968)	(2.805)						
6 Wearing apparel	43.802	0.264	0.466	0.27	-0.229	0.556	1.619	9.348	
	(2.392)	(1.804)	(3.388)		(-2.481)				
7 Leather products	1.15	0.271	0.679	0.05	-	0.854	0.878	1.243	85.009
	(5.662)	(3.225)	(5.706)			(11.372)			
8 Footwear	-1.904	0.253	0.674	0.073	-0.01	0.699	0.931	1.529	120.2
	(-8.839)	(2.579)	(10.796)		(-1.790)	(5.286)			
9 Wood and wood products	0.685	0.332	0.612	0.056	0.018	0.581	0.96	1.637	211.329
	(4.474)	(2.176)	(6.923)		(3.762)	(3.779)			
10 Furniture and fixtures	-105.375	0.533	0.425	0.042	0.0525	0.696	0.889	2.34	71.291
	(-5.289)	(4.655)	(4.193)		(5.244)	(5.227)			

APPENDIX 2 (Continued)

Industry	Constant	Labor	Capital	Raw Materials	Time	AR	ADJ. R2	DW	F stat
11 Paper and paper products	0.534	0.194	0.506	0.3	0.031	0.495	0.961	1.635	218.618
	(5.424)	(2.908)	(6.173)		(7.429)	(3.223)			
12 Printing and publishing products	0.068	0.576	0.35	0.074	0.033	0.672	0.915	1.947	95.128
	(0.573)	(4.989)	(3.593)		(7.733)	(4.738)			
13 Industrial chemicals	0.857	0.477	0.302	0.221	0.02	0.542	0.956	1.453	191.575
	(3.404)	(3.971)	(3.899)		(5.008)	(3.877)			
14 Petroleum refineries	2.995	0.147	0.456	0.397	-0.044	0.043	0.861	1.629	30.544
	(3.717)	(0.822)	(8.719)		(-8.176)	(0.142)			
15 Rubber products	0.496	0.437	0.258	0.305	0.022	0.294	0.754	2.189	26.376
	(5.842)	(6.326)	(3.849)		(5.851)	(1.523)			
16 Plastic products	1.049	0.443	0.174	0.383	-0.013	-	0.477	2.076	7.093
	(9.779)	(2.835)	(1.803)		(-2.031)				
17 Non-metallic mineral products	0.631	0.612	0.219	0.169	0.009	-	0.962	1.456	305.791
	(11.198)	(7.054)	(5.990)		(3.509)				
18 Glass and glass products	0.964	0.361	0.134	0.505	-0.005	-0.155	0.945	1.941	82.879
	(11.495)	(2.445)	(1.861)		(1.185)	(-0.630)			
19 Iron and steel industries	0.656	0.368	0.253	0.379	-	0.665	0.974	2.061	420.123
	(6.225)	(7.118)	(4.025)			(6.156)			
20 Fabricated metal products	-0.299	0.347	0.544	0.109	0.041	0.578	0.898	1.561	78.807
	(-1.896)	(3.091)	(3.517)		(7.153)	(3.761)			
21 Machinery	-7.126	0.204	0.604	0.192	0.003	0.796	0.913	1.731	85.558
	(-0.248)	(2.061)	(6.097)		(0.189)	(7.110)			
22 Electrical machinery	0.525	0.293	0.219	0.488	-	0.911	0.966	2.1	334.937
	(1.413)	(1.671)	(1.076)			(12.946)			
23 Transportation equipment	1.157	0.535	0.299	0.166	0.009	0.605	0.981	1.63	462.209
	(6.372)	(7.824)	(4.167)		(1.954)	(4.200)			

APPENDIX 3

MLE Estimates, Using Frontier (Version 4.1)

Specification: Cobb-Douglas

Variables:	**Model**	**A**	**B**	**C**	**D**	**E**
Constant	Bo	0.462	0.465	0.585	0.528	-0.046
		(6.214)	(5.783)	(5.836)	(8.165)	(-1.085)
Labor	B1	0.477	0.482	0.427	0.428	0.272
		(13.117)	(12.694)	(11.919)	(11.551)	(9.693)
Capital	B2	0.188	0.188	0.196	0.192	0.162
		(10.700)	(10.438)	(10.973)	(11.175)	(10.718)
Raw Materials	B3	0.340	0.342	0.383	0.374	0.640
		(12.526)	(12.577)	(13.574)	(13.274)	(32.335)
Time	B4	0.008	0.008	0.004	0.005	0.011
		(20.526)	(18.988)	(3.123)	(4.219)	(15.904)
sigma-squared		0.142	0.046	0.029	0.099	0.129
		(3.479)	(2.939)	(2.617)	(3.104)	(9.662)
Gamma		0.142	0.817	0.716	0.914	0.870
		(53.298)	(12.886)	(7.661)	(32.669)	(47.513)
mu		0.000	0.315	0.291	0.000	—
			(4.905)	(3.628)		
eta		0.000	0.000	0.011	0.010	—
				(3.831)	(2.535)	
delta 0		—	—	—	—	2.756
						(-3.368)
delta 1		—	—	—	—	0.069
						(3.012)
Likelihood Ratio		702.161	706.835	714.228	709.377	408.919
Restrictions		1	2	3	2	3
Number of Obs.		761	761	761	761	761

APPENDIX 3 (CONTINUED)

Specification: Translog

Variables:	Model	F	G	H	I	J
Constant	Bo	1.556	1.579	1.704	1.412	0.617
		(6.283)	(6.625)	(6.929)	(5.755)	(2.696)
Labor	B1	0.128	0.073	-0.027	0.056	0.168
		(.565)	(0.325)	(-0.118)	(0.247)	(0.629)
Capital	B2	0.815	0.778	0.765	0.741	0.789
		—	(6.894)	(6.430)	(6.215)	(6.898)
Raw Materials	B3	-0.731	-0.671	-0.414	-0.372	-0.128
		(-4.571)	(-4.317)	(-2.835)	(-2.443)	(-0.983)
Labor-squared	B4	-0.055	-0.038	-0.013	-0.054	-0.087
		(-0.674)	(-0.472)	(-0.158)	(-0.689)	(-0.989)
Capital-squared	B5	0.044	0.024	-0.048	-0.067	-0.113
		(1.781)	(0.980)	(-2.524)	(-2.839)	(-8.264)
Raw Materials-squared	B6	0.035	0.032	0.083	0.065	0.200
		(0.697)	(0.664)	(1.597)	(1.229)	(3.894)
Labor-capital	B7	-0.274	-0.245	-0.088	-0.057	0.191
		(-4.094)	(-3.802)	(-1.376)	(-0.833)	(3.058)
Labor-Raw Materials	B8	0.479	0.444	0.246	0.256	0.030
		(4.267)	(4.090)	(2.327)	(2.335)	(0.301)
Capital-Raw Materials	B9	-0.088	-0.066	-0.064	-0.045	-0.192
		(-1.524)	(-1.159)	(-1.110)	(-0.782)	(-3.834)

APPENDIX 3 (CONTINUED)

Specification: Translog

Variables:	Model	F	G	H	I	J
Time	B10	0.008	0.008	-0.003	-0.001	0.002
		(18.462)	(16.271)	(-2.611)	(-0.389)	(2.017)
sigma-squared		0.170	0.031	0.020	0.041	0.028
		(3.349)	(13.684)	(8.194)	(2.750)	(4.319)
Gamma		0.953	0.745	0.626	0.809	0.546
		(67.326)	(30.742)	(20.876)	(11.370)	(4.386)
mu		0.000	0.301	0.224	0.000	—
			(30.743)	(7.629)		
eta		0.000	0.000	0.026	0.030	—
				(11.938)	(6.975)	
delta 0		—	—	—	—	0.286
						(6.951)
delta 1		—	—	—	—	0.022
						(-3.736)
Likelihood Ratio		483.614	482.221	523.471	509.365	471.139
Restrictions		1	2	3	2	3
Number of Obs.		761	761	761	761	761

APPENDIX 4

Projected Technical Efficiency Using Translog Production Function, Truncated Normal Distribution-Time Varying Technical Efficiency

Industry Description	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
1 Food manufacturing	0.807	0.812	0.816	0.820	0.825	0.829	0.833	0.837	0.840	0.844	0.848	0.851	0.855
2 Sugar													
3 Beverages	0.624	0.632	0.639	0.647	0.654	0.661	0.668	0.675	0.682	0.689	0.695	0.702	0.708
4 Tobacco products	0.584	0.592	0.600	0.608	0.616	0.624	0.631	0.639	0.646	0.653	0.660	0.667	0.674
5 Textiles	0.584	0.592	0.600	0.607	0.615	0.623	0.630	0.638	0.645	0.653	0.660	0.667	0.674
6 Wearing apparel													
7 Leather products	0.517	0.526	0.534	0.543	0.552	0.560	0.568	0.577	0.585	0.593	0.601	0.609	0.616
8 Footwear	0.421	0.430	0.439	0.449	0.458	0.467	0.476	0.486	0.495	0.504	0.512	0.521	0.530
9 Wood products	0.508	0.517	0.525	0.534	0.543	0.551	0.560	0.568	0.576	0.584	0.592	0.600	0.608
10 Furniture and fixtures	0.346	0.356	0.365	0.375	0.384	0.394	0.403	0.412	0.422	0.431	0.441	0.450	0.459
11 Paper and paper products	0.666	0.673	0.680	0.686	0.693	0.699	0.706	0.712	0.718	0.724	0.730	0.736	0.742
12 Printing and publishing	0.448	0.457	0.467	0.476	0.485	0.494	0.503	0.512	0.521	0.529	0.538	0.547	0.555
13 Industrial chemicals	0.617	0.624	0.632	0.639	0.646	0.654	0.661	0.668	0.675	0.682	0.688	0.695	0.701
14 Other chemicals													
15 Rubber products			0.598	0.606	0.614	0.622	0.629	0.637	0.644	0.651	0.659	0.666	0.673
16 Plastic products													
17 Non-metallic mineral	0.552	0.560	0.568	0.577	0.585	0.593	0.601	0.609	0.616	0.624	0.632	0.639	0.646
18 Glass products													
19 Iron and steel basic industry			0.538	0.546	0.555	0.563	0.571	0.580	0.588	0.596	0.604	0.612	0.619
20 Fabricated metal products	0.453	0.463	0.472	0.481	0.490	0.499	0.508	0.517	0.526	0.534	0.543	0.551	0.560
21 Machinery	-	-	-	0.523	0.532	0.540	0.549	0.557	0.566	0.574	0.582	0.590	0.598
22 Electrical machinery	0.407	0.417	0.426	0.436	0.445	0.454	0.463	0.473	0.482	0.491	0.500	0.509	0.518
23 Transport equipment	0.611	0.619	0.627	0.634	0.642	0.649	0.656	0.663	0.670	0.677	0.684	0.691	0.697

APPENDIX 4 (Continued)

Industry Description	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1 Food manufacturing	0.858	0.862	0.865	0.868	0.871	0.874	0.877	0.880	0.883	0.886	0.889	0.891	0.894
2 Sugar				0.758	0.764	0.769	0.774			0.789	0.794	0.799	0.803
3 Beverages	0.714	0.720	0.726	0.732	0.738	0.744	0.750	0.755	0.761	0.766	0.771	0.776	0.781
4 Tobacco products	0.681	0.688	0.694	0.701	0.707	0.714	0.720	0.726	0.732	0.738	0.743	0.749	0.755
5 Textiles	0.680	0.687	0.694	0.700	0.707	0.713	0.719	0.725	0.731	0.737	0.743	0.748	0.754
6 Wearing apparel				0.453	0.462	0.471	0.480	0.489	0.498	0.507	0.516	0.525	0.534
7 Leather products	0.624	0.632	0.639	0.646	0.654	0.661	0.668	0.675	0.681	0.688	0.695	0.701	0.708
8 Footwear	0.539	0.547	0.556	0.564	0.572	0.581	0.589	0.597	0.605	0.612	0.620	0.628	0.635
9 Wood products	0.616	0.624	0.631	0.639	0.646	0.653	0.660	0.667	0.674	0.681	0.688	0.694	0.701
10 Furniture and fixtures	0.468	0.478	0.487	0.496	0.505	0.514	0.522	0.531	0.540	0.548	0.557	0.565	0.573
11 Paper and paper products	0.748	0.753	0.759	0.764	0.769	0.774	0.780	0.785	0.789	0.794	0.799	0.803	0.808
12 Printing and publishing	0.564	0.572	0.580	0.588	0.596	0.604	0.612	0.620	0.627	0.635	0.642	0.649	0.657
13 Industrial chemicals	0.708	0.714	0.720	0.726	0.732	0.738	0.744	0.749	0.755	0.760	0.766	0.771	0.776
14 Other chemicals					0.560	0.568	0.576	0.585	0.593	0.601	0.609	0.616	0.624
15 Rubber products	0.679	0.686	0.693	0.699	0.706	0.712	0.718	0.724	0.730	0.736	0.742	0.748	0.753
16 Plastic products				0.679	0.686	0.693	0.699	0.706	0.712	0.718	0.724	0.730	0.736
17 Non-metallic mineral	0.654	0.661	0.668	0.675	0.682	0.688	0.695	0.701	0.708	0.714	0.720	0.726	0.732
18 Glass products				0.702	0.709	0.715	0.721	0.727	0.733	0.739	0.745	0.750	0.756
19 Iron and steel basic industry	0.627	0.634	0.642	0.649	0.656	0.663	0.670	0.677	0.684	0.691	0.697	0.704	0.710
20 Fabricated metal products	0.568	0.576	0.585	0.593	0.601	0.609	0.616	0.624	0.631	0.639	0.646	0.654	0.661
21 Machinery	0.606	0.614	0.622	0.629	0.637	0.644	0.651	0.658	0.666	0.672	0.679	0.686	0.693
22 Electrical machinery	0.526	0.535	0.544	0.552	0.561	0.569	0.577	0.585	0.593	0.601	0.609	0.617	0.625
23 Transport equipment	0.704	0.710	0.716	0.722	0.728	0.734	0.740	0.746	0.751	0.757	0.762	0.767	0.773

APPENDIX 4 (Continued)

Industry Description	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Ave.
1 Food manufacturing	0.896	0.899	0.901	0.904	0.906	0.908	0.911	0.913	0.915	0.917	0.919	0.870
2 Sugar	0.808	0.812	0.816	0.821	0.825	0.829	0.833	0.837	0.841	0.844	0.848	0.809
3 Beverages	0.786	0.791	0.796	0.800	0.805	0.809	0.814	0.818	0.822	0.826	0.830	0.738
4 Tobacco products	0.749	0.755	0.760	0.765	0.771	0.776	0.781	0.786	0.791	0.795	0.800	0.804
5 Textiles	0.759	0.765	0.770	0.775	0.780	0.785	0.790	0.795	0.800	0.804	0.809	0.707
6 Wearing apparel	0.542	0.551	0.559	0.568	0.576	0.584	0.592	0.616	0.623	0.541	0.600	0.608
7 Leather products	0.714	0.720	0.726	0.732	0.738	0.744	0.749	0.755	0.760	0.704	0.711	0.575
8 Footwear	0.643	0.650	0.657	0.664	0.671	0.678	0.685	0.691	0.698	0.760	0.765	0.647
9 Wood products	0.707	0.714	0.720	0.726	0.732	0.738	0.743	0.749	0.755	0.651	0.658	0.509
10 Furniture and fixtures	0.582	0.590	0.598	0.606	0.613	0.621	0.629	0.636	0.644	0.651	0.658	0.509
11 Paper and paper products	0.812	0.817	0.821	0.825	0.829	0.833	0.837	0.841	0.844	0.848	0.852	0.769
12 Printing and publishing	0.664	0.671	0.678	0.684	0.691	0.698	0.704	0.710	0.717	0.723	0.729	0.598
13 Industrial chemicals	0.781	0.786	0.791	0.796	0.800	0.805	0.809	0.814	0.818	0.822	0.826	0.732
14 Other chemicals	0.631	0.639	0.646	0.653	0.661	0.668	0.675	0.681	0.688	0.695	0.701	0.633
15 Rubber products	0.759	0.764	0.769	0.774	0.780	0.785	0.789	0.794	0.799	0.803	0.808	0.713
16 Plastic products	0.742	0.748	0.753	0.759	0.764	0.769	0.774	0.779	0.784	0.789	0.794	0.740
17 Non-metallic mineral	0.738	0.744	0.749	0.755	0.760	0.766	0.771	0.776	0.781	0.786	0.791	0.682
18 Glass products	0.761	0.767	0.772	0.777	0.782	0.787	0.792	0.796	0.801	0.806	0.810	0.759
19 Iron and steel basic industry	0.716	0.722	0.728	0.734	0.740	0.746	0.751	0.757	0.762	0.768	0.773	0.665
20 Fabricated metal products	0.668	0.675	0.681	0.688	0.695	0.701	0.708	0.714	0.720	0.726	0.732	0.603
21 Machinery	0.699	0.706	0.712	0.718	0.724	0.730	0.736	0.742	0.747	0.753	0.759	0.650
22 Electrical machinery	0.632	0.640	0.647	0.654	0.661	0.668	0.675	0.682	0.689	0.695	0.702	0.564
23 Transport equipment	0.788	0.783	0.788	0.793	0.797	0.802	0.806	0.811	0.815	0.819	0.824	0 728

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