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Total Factor Productivity in the Philippines

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Philippine Institute for Development Studies
Surian sa mga Pag-aaral Pangkaunlaran ng Pilipinas

Total Factor Productivity in the Philippines

Caesar B. Cororaton

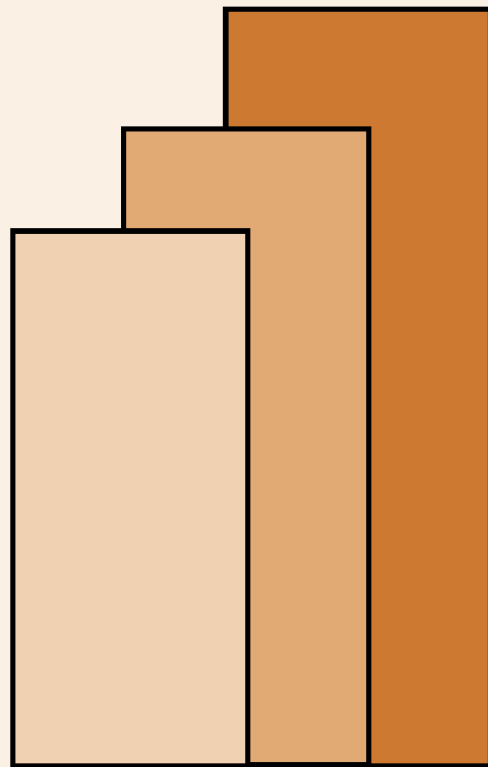
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**Total Factor Productivity
In the Philippines**

Caesar B. Cororaton

Philippine Institute for Development Studies

Revised Final Report
March 26, 2002

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Caesar B. Cororaton

Abstract

The paper presents estimates of total factor productivity (TFP) from 1967 to 2000. It was observed that while TFP growth was mostly negative in the last thirty-five years, its contribution to economic growth improved from -4.26 percentage points in the middle of 1980s to +0.93 in 1998-2000. It is interesting to note that this coincides with the period in which major economic policy reforms were pursued vigorously.

In spite of the increasing share of skilled labor to the total, its contribution to TFP growth is observed to have declined through time. This may imply a number of things, among the critical ones include: (a) deterioration in the quality of education necessary for productivity improvement; in particular the marginal productivity of workers with higher education, as well as the efficiency of education itself, has declined; and (b) negative brain drain effect on productivity of massive Filipinos working abroad.

Efficiency improvements seem to have been gained from the movement of labor out of agriculture.

Sound macroeconomic fundamentals, price stability and opening up to foreign trade and investment are critical factors affecting TFP growth. Spill over effects are observed to be far significant from the growth in manufacturing than in agriculture and service sectors.

Keywords: Total Factor Productivity

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Total Factor Productivity In the Philippines¹

Caesar B. Cororaton²

I. Introduction

A series of articles that appeared in the recent World Bank Economic Review³ highlights the important role of total factor productivity (TFP) in the process of economic growth of countries. While these articles do not downplay the critical role of factor accumulation in economic growth, "there are something else besides factor accumulation that play prominent role in explaining differences in economic performance across countries" (Easterly and Levine, 2001). In fact, "major empirical regularities of economic growth emphasize the role of something else besides factor accumulation." It is therefore important to understand the forces that underlie these "residual" determinants of growth and income. This is the basic motivation of the present paper. It attempts to quantify TFP in the Philippines and its contribution to economic growth. Furthermore, the paper attempts to understand the possible factors that might have caused movements in TFP over a period of time.

The paper is organized in seven sections, with the first section giving the introduction and motivation of the present research. The second section presents a brief survey of the work done in the Philippines that quantified TFP and its contribution to growth. The third section outlines briefly the Philippine economic growth performance and some major policies implemented. The fourth section describes the methodology adopted in the paper. The fifth section discusses the data and its sources. The sixth section presents and analyzes the empirical results. Lastly, Section 7 gives a short conclusion.

II. Short Review of Literature

Research works have been done in the past that attempt to quantify TFP and its contribution to Philippine economic growth. Briefly, this section discusses some insights from the more recent TFP studies.

¹Funded by the Asian Productivity Organization (APO). The paper greatly benefited from the valuable comments of Prof. Noriyoshi Oguchi. However, gaps and errors in the paper are the sole responsibility of the author. Comments may be directed to ccororaton@mail.pids.gov.ph.

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³The World Bank Economic Review, Volume 15, 2001, Number 2.

Cororaton and Cuenca (2001) updated the TFP estimates of Cororaton and Caparas (1999) from 1980-1996 to 1980-1998, using growth accounting method in translog form at the level of the economy and major sectors of the economy. Some insights were drawn from the estimates. At the sectoral level, the results are mixed. Some sectors showed improving TFP in the 1990s, while others have declining TFP, especially the non-tradable service sectors, like real estate. Because of this the economy as a whole saw declining in TFP in 1990s. The decline may be due to movement of capital towards the non-tradable sectors during the period when foreign capital inflow surged, which in turn aggravated by the prolonged real appreciation of the local currency.

Silva (2001) also applied growth accounting method to estimate TFP. Her estimation period was much longer, from 1971 to 1998. The major finding of the work indicates, "From 1990 to 1997, the average TFP growth is estimated at -0.8 percent, only a slight improvement from the average rate estimated for the 1980s". On the whole the paper implied that "The movements of total factor productivity (TFP) indicate that it did not drive the growth of real output during the past 25 years."

Austria (1998), using a macrodynamic model with output and inflation interaction, showed that the TFP for an extended period of time, 1967 to 1997 declined by -0.47 percent. Lim (1998), using a Cobb-Douglas production function showed negative TFP for industry and services, sectors that account for 75 percent of GDP.

However, Cororaton and Abdula (1998) showed slightly positive TFP for the manufacturing sector. However, in the TFP study conducted on specific industries within the manufacturing sector by Cororaton et al. (1996) it was observed that number of manufacturing industries with negative TFP increased from 1956 to 1992, while the above average TFP for the entire manufacturing sector was slightly above zero.

There seems to be one general conclusion from the various studies on TFP conducted in the Philippines: That TFP growth has not been encouraging. In fact, estimates seem to suggest negative TFP growth, and therefore has not been a source of economic growth.

III. Philippine Growth Performance and Policies

The last 35 years saw a "roller coaster" Philippine economic growth performance. Growth was highest during the 1973-82 period, averaging 5.5 percent per year (Table 1). This was the peak period of the Marcos regime. This was not

sustained, however, as dissatisfaction among Filipinos on the military regime mounted that eventually led to a political uprising in the following period, 1983-85. The political crisis triggered economic crisis that resulted in an economic collapse. The economy contracted by -4.1 percent per year during this period. The Marcos administration was finally forced out in the early 1986, which gave way to Aquino government. Thus, in the following period, 1986-90, the euphoria brought about economic recovery under the new government. Growth was averaging 4.5 percent per annum during this period. However, towards the end of the Aquino administration political tug-of-war led to a series of military coup attempts. Although the attempts failed, they created political uncertainties and instability. This, together with the series of natural calamities and energy crisis, brought the economy to a halt in the 1991-93 period. The economy contracted again by -0.1 percent per year during the period.

The leadership of the Ramos administration revived the economy with a growth averaging 4.9 percent per year from 1994 to 1997. However, the Asian financial crisis, the El Nino effects on agriculture production in 1998, and the political scandals that wreaked havoc on the Estrada administration took a heavy toll on the economy. Growth slid to 3.5 percent per year in the 1998-2000 period. Indeed, the last 35 years was a period of boom and bust growth cycle. Economic growth could not be sustained. Political and well as weak economic fundamentals were believed to be the major forces behind such performance.

As regards to employment performance, it was not as generally disappointing. Employment growth was averaging more than 3 percent per year over the years, except for the last period, 1998-2000, when it contracted by -0.3 percent per year.

Major economic policy shifts occurred when the Aquino government took over in 1986. Structural reforms like trade liberalization, foreign exchange liberalization, investment reforms, banking reforms, privatization, among others were implemented. These reforms intensified in the 1990s. The reforms are still being pursued at present.

One of the major results of these reforms is the increasing share of foreign trade in the Philippine economy. From 13.6 percent export-to-GDP ratio in the 1967-72 period, the share increased to 45.8 percent in 1998-2000. Similarly, import-to-GDP ratio increased from 17.4 percent to 43.2 percent over the same period. The rise in the trade sector is mainly attributed to the recent surge in the demand for semi-

conductor in the world market. To date, almost 60 percent of the country's export is the highly raw-material-import-dependent semi-conductor.

However, in spite of the reforms and the dramatic rise in foreign trade, apparent signs of structural weaknesses prevail in the local economy. These are seen in the stagnating share of industry in general and of manufacturing in particular in the last 35 years (Table 2). The share of industry picked up from 31.7 percent in the 1967-72 period to 37.4 percent in 1983-85. It declined since then and continued its decent to 30.9 percent share in 1998-2000. Similar dismal record for the manufacturing sector is observed over the same period. The drop in the share of agriculture showed up in the increasing share of the service sector.

The disappointing and stagnating share of industry and manufacturing sectors is also observed in the structure of employment. Employment share in industry is about 15 percent, while in manufacturing 10 percent. These shares have practically stagnated as compared to the rising employment share in the service sector.

The contrasting performance of the foreign trade sector and the industrial sector in general and the manufacturing sub-sector in particular in terms of output and employment generation in the midst of policy reforms indicate the absence of trickle down effects. Considering that these policy reforms have been pursued for quite sometime, the lack of concrete trickle down effects would strongly imply a high degree of duality existing between the local and foreign sectors. These structural defects need to be identified and addressed appropriately. Perhaps, one good starting point is the assessment of productivity performance in the country.

IV. Methodology

Output growth (Q_t^*) may be due to two broad factors: (a) factor accumulation, which in turn may be broadly broken into growth of capital input ($s_K K_t^*$), and growth of labor input ($s_L L_t^*$), (b) growth of total factor productivity (TFPG $_t^*$). That is,

$$(1) \quad Q_t^* = \text{TFPG}_t^* + s_K K_t^* + s_L L_t^*$$

In estimating (1) using actual data the paper applied the traditional growth accounting approach to measuring TFP. In particular, it uses a translog-based growth accounting formula

$$(2) \quad \text{TFPG}_t = [\ln Q_t - \ln Q_{(t-1)}] - v_L * [\ln L_t - \ln L_{(t-1)}] - \\ v_K * [\ln K_t - \ln K_{(t-1)}]$$

where $v_L = \frac{1}{2} * (v_{Lt} + v_{L(t-1)})$ and $v_K = \frac{1}{2} * (v_{Kt} + v_{K(t-1)})$; \ln is natural logarithm operator; Q output, L employment, and K capital input v_L , and v_K average factor shares. The application of this formula to Philippine data yielded what is called in the paper as the unadjusted TFPG.

Four different refinements were applied on the unadjusted TFPG to net out the effects of business fluctuations; two types of labor inputs; three types of capital inputs; and sectoral movements of labor. The last three adjustments were based on the method that utilizes factors in efficiency units to decompose TFP growth. This method was proposed by Oguchi (2001).

Business Fluctuations Adjustment. Unadjusted TFPG estimates derived using (2) is usually sensitive to business cycle, making it difficult to determine which part is driven by business cycle and which part is due to the real change in TFP. There is no standard way of netting out the effects of business fluctuations on TFPG. The approach applied in the paper is due to Oguchi (2001), which involves the estimation of a production function using actual output data and the computation "theoretical" output level that is compared with the actual output. In particular, the following steps were applied: (a) estimate a Cobb-Douglas production function⁴; (b) compute the "theoretical" value of output using the estimated production function; (c) take the ratio of the actual output to the theoretical value of output, which will yield an indicator of capacity utilization rate; and (d) take the rate of change of the estimated capacity utilization and subtract it from the estimated TFPG to obtain the adjusted TFPG;

Furthermore, to smoothen the kinks in the estimates, a three-year moving average was applied on the adjusted TFPG.

⁴The estimated equation is:

$$\begin{aligned} \text{lgdpl} = & 0.869 + 0.627 * \text{lkstockl} - 0.011 * \text{trend} - 0.139 * \text{d85_87} \\ & (t=4.709) \quad (t=13.228) \quad (t=-8.757) \quad (t=-6.530) \\ & -0.059 * \text{d92_93} + 0.114 * \text{d2000} \\ & (t=-2.302) \quad (t=3.090) \end{aligned}$$

$R^2 = 0.889$, $R^2_{\text{bar}} = 0.870$, $DW = 1.361$, $F=46.487$, OLS, sample: 1966-2000, lgdpl is \ln of GDP/labor, lkstockl is \ln of capital stock/labor. Other variables in the equation are dummy variables that capture turbulent years.

Decomposition of TFP Growth. Consider a production function⁵

$$(3) \quad Q = A * f(L, K)$$

Q is output, L is simple aggregation of labor (aggregate of all kinds of labor skills), K is simple aggregation of capital (aggregate of all types of capital), and A is TFP (or TFP_A). The basic assumption in this formulation is that all types of labor have the same marginal productivity. Similarly, all marginal productivity of all types of capital is the same. In reality this may not be true. Different types of factor inputs may not have uniform marginal productivities. This means that the corresponding TFP estimate, A, may not also be true. "True" TFP can be derived if factor inputs are disaggregated into their different types. That is, if the whole spectrum of labor and capital is lined up as independent arguments in the production function, then the true production function should take the following form

$$(4) \quad Q = B f(l_1, l_2, \dots, k_1, k_2, \dots)$$

Q is the same output as in (3), l_1 is type 1 labor, l_2 is type 2 labor, etc, and k_1 is type 1 capital, k_2 is type 2 capital, etc. The parameter B in (4) is the "true" TFP (or TFP_B).

Equations (3) and (4) provide an opportunity for capturing and decomposing the effects of quality of factor inputs from TFP growth. That is, if TFP computed using (3) and (4) then the difference, which is

$$(5) \quad \text{TFP}_A - \text{TFP}_B$$

may give indications of the effects of changes in the quality of factor inputs on TFP.

The above framework was utilized to analyze the effects, one at a time, on TFP of: (a) skilled and unskilled labor, (b) sectoral labor movement, and (c) structure, durable equipment and other capital. In using the framework, factor inputs have to be converted into efficiency units. Oguchi (2001) has shown that in terms of growth in variables, Equation (3) in discrete form can be written as

⁵This is similar to (1), except that (1) is in the form of growth of variables.

$$(6) \quad Q_g^t = TFP_g^{t^{**}} + s_k K_g^{t^{**}} + s_l L_g^{t^{**}}$$

$$\text{where } s_l L_g^{t^{**}} = 0.5(s_{l1}^t + s_{l1}^{t-1}) * (\ln L_1^t - \ln L_1^{t-1}) + \\ 0.5(s_{l2}^t + s_{l2}^{t-1}) * (\ln L_2^t - \ln L_2^{t-1}) + \dots \\ 0.5(s_{ln}^t + s_{ln}^{t-1}) * (\ln L_n^t - \ln L_n^{t-1})$$

$$\text{and } s_k K_g^{t^{**}} = 0.5(s_{k1}^t + s_{k1}^{t-1}) * (\ln K_1^t - \ln K_1^{t-1}) + \\ 0.5(s_{k2}^t + s_{k2}^{t-1}) * (\ln K_2^t - \ln K_2^{t-1}) + \dots \\ 0.5(s_{kn}^t + s_{kn}^{t-1}) * (\ln K_n^t - \ln K_n^{t-1})$$

Assuming 2 types of labor $s_l L_g^{t^{**}}$ can be written as

$$(5) \quad s_l L_g^{t^{**}} = \frac{w^*(L_1 + L_2)}{Q} * (w_1/w) * \frac{dL_1 + (w_2/w_1)*dL_2}{(L_1 + L_2)}$$

or

$$= \frac{w^*(L_1 + L_2)}{Q} * \frac{(w_1/w)*dL_1 + (w_2/w)*dL_2}{(L_1 + L_2)}$$

$$\text{where } w = \frac{w_1 * L_1 + w_2 * L_2}{L_1 + L_2} \quad (\text{average wage})$$

$$\text{and } \frac{dL_1 + (w_2/w_1)dL_2}{L_1 + L_2}$$

is the growth rate of labor in efficiency units ($dL_1 + (w_2/w_1)dL_2$) is the efficiency weighted increase in labor.

In applying this method to analyze the effects of skilled and unskilled labor on TFP, L_1 is considered as unskilled and L_2 as skilled. Skilled labor is defined as those who are at least high school graduate. W_1 is minimum wage, the wage rate for unskilled labor, while W_2 is the wage for skilled labor, which is computed residually.

Similar method was applied to analyze the effects of sectoral labor movement on TFP. Three sectoral labor types were considered: L_a agriculture labor, L_i industry labor, and L_s service sector labor. W_a is agriculture wage, W_i , industry wage, and W_s service sector wage, which is computed residually.

In the analysis of the effects of types of capital on TFP, Equation (5) was used to three types of capital; namely K_1 durable equipment, K_2 structure, and K_3 other capital, and their respective capital prices.

Determinants of TFP. TFP, as a residual, could be due to a host of factors. In the literature, in giving a theoretical sense to the residual, Grossman and Helpman (1991), Romer (1990), and Aghion and Howitt (1998) attempted to put in the role of technology, i.e., better instructions for combining raw materials into useful products and services. Romer (1986), Lucas (1988) and others tried to incorporate the critical role of externalities, including spillovers, economies of scale, and various complementarities in explaining TFP. However, in present paper the possible determinants of TFP in the Philippines are investigated using regression analysis. No formal theorizing was attempted to sort out the possible determining factors, but rather ad hoc regression specifications were experimented on Philippine data. The possible factors analyzed include: foreign trade indicators (exports and imports); availability of credit; foreign direct investments; macroeconomic fundamentals and stability (budget deficit and price changes); economic structure; expenditure on research and development; and structure of national government budget. These factors were tested for statistical significance using standard tests in regression analysis.

V. The Data

The Appendix describes in detail the data requirement in the analysis as well as the sources of economic information. There are no official data series on capital stock. Thus, work on TFP in the Philippines devised various methodologies on capital estimation. In the present work, the estimation of the capital stock made use of official data on investment as far back as 1946.

Labor data used is employment by head count. Output data is GDP at factor cost. Factor prices, which are key in the analysis of netting out TFP with quality of factor inputs, were either constructed out of existing official available information or proxied by other variables.

VI. Results and Analysis

Business-Fluctuation-Adjusted TFP. Annual TFP estimates from 1967 to 2000 are presented in Table 5, while the three-year moving average of the business-fluctuation-adjusted TFP is shown in Figure 1. One may observe that in most of the years in the last thirty-five years, TFP fell below zero.

Positive estimates are seen in the second half of the 1980s and towards 2000.

Interesting results may be observed in the analysis of the decomposition of output growth in Figure 2 in which TFP is considered as one of the contributing factors during the different critical sub-periods over the past thirty-five years. While it may be true that the contribution of TFP to the overall economic growth has been negative, in terms of trend in an extended period it has improved. For example, from -4.26 percentage points in GDP growth in the sub-period 1983-85, it improved through the years to reach a contribution of +0.93 in the last sub-period, 1998-2000. This may be due to the effects of various economic policy reforms pursued in the last decade.

Through the years, the largest contributor to growth has been capital.

Decomposition of TFP Growth. There have been sizeable changes in the structure of labor quality over the years. The share of skilled workers, loosely defined as those who have at least finished high school, increased from 19 percent in 1967-72 to 45 percent in 1998-2000 (Figure 3).

The structure of capital has not changed as much over the years. The share of capital structure hovers around 47 percent (Figure 4). The share of durable equipment on the other hand improves from 30 percent in 1967-72 to 39 percent in 1998-2000.

There are however noticeable movements of labor across sectors. Agriculture, which used to employ 56 percent of labor in 1967-72, has declining employment share. In 1998-2000, its employment share dropped to 38 percent. Labor moved to the service sector and not to the industry sector. The share of service sector employment increased from 29 percent in 1967-72 to 45 percent in 1998-2000. Employment share in industry hovers around 16 percent.

What are the effects of these factor changes on TFP? Table 6 presents the results of decomposing the effects of labor quality on TFP using Equation 6. The results are presented per sub-period. The second column is the unadjusted TFP, which are period averages of the same estimates that appeared in Table 5. The third column presents the results for TFP growth adjusted for quality of labor. The last two columns compare the estimates by taking the difference and the ratio. A higher difference will imply a bigger the contribution of labor quality to TFP growth. In terms of ratio, the further it deviates from 1 the bigger its TFP contribution.

One may observe from the results that in spite of the increasing share of skilled labor to total employment its contribution to TFP has declined. The drop is quite evident in Figure 6. From 2.11 percentage points contribution to TFP growth, it declined to 0.16 in 1991-93. It started to recover however in the succeeding subperiods, still way below the contribution in the earlier periods.

This decline may imply a number of things. First, it may be true that skilled labor, as loosely defined in terms of level of schooling, may not have captured the actual skill development of labor. Second, the quality of education that could have produced the necessary skills to improve productivity may have declined through time. There are available facts that may support this. Cororaton (1998) has observed that while the Philippines is one of the countries that has produced one of the highest number of college graduates in the region, it has produced one of the lowest number of graduates specializing in science and technology and engineering. Third, the results may imply that the marginal productivity of workers with higher education, as well as the efficiency of education itself, has deteriorated. Fourth, the increasing number (in fact, massive) of Filipinos working abroad may have resulted in brain drain, resulting in losses in productivity in the local economy.

There could be other reasons, but the results could imply a number of things, among the crucial ones are: (a) that the drive to improve education in the country should somehow get reflected in productivity improvement, otherwise the whole exercise could become frustrating if it will only result in a situation wherein trained Filipinos will end up seeking employment elsewhere; and (b) that the structure incentives, particularly labor incentives, would have to be examined quite closely. The structure of incentives could include the structure of relative factor wages to address the problems related to the graduates specializing in science and technology. The efficiency of the educational system, including the curriculum, books and manuals, training of teachers and professors, has to be looked at closely.

The effects of incorporating different types of capital into TFP are negligible as presented in Table 7. Although nil, the effects through the years vary, as shown in Figure 7.

Lastly, the effects of movement of labor across sectors on TFP have improved through the years, indicating efficiency effects, however small, from labor movement out of agriculture (Table 8). Except for the sub-period 1991-93, the effect on TFP has increased through time as shown in Figure 8. One

wonders whether labor movement to industry, or to the manufacturing sector in particular, instead of the service sector could have contributed to higher TFP growth or not.

Determining Factors of TFP. A number of regression experiments were conducted on the computed TFP and the various determining factors listed earlier. Of the experiments only two regression specifications resulted in better test results. These are presented in Table 10.

Focus on the results for Regression No. 1. Trade indicators, exports and imports lumped together, are positive determinants of TFP growth. The reason for lumping these variables together is because exports and imports generally grow in the same direction as shown in Table 1. This is because the country's exports are highly import-dependent. This potentially creates problems of multicollinearity as shown in Regression No. 2. The coefficient of the combined trade indicator is statistically significant. The positive effect of exports on TFP implies that exports can bring about economies of scale with larger export market. It can also expose local producers to international best practice in production. Furthermore, foreign competition in the export market can translate into improved efficiency in the production operations of local producers. On the other hand, the positive effect of imports on TFP indicates transfer of modern technology into the local economy since imports is one major vehicle for moving in appropriate foreign technology. Therefore a higher volume of imports necessarily decreases the technological gap between local and foreign technology in terms of modern equipment, production processes, and management.

Foreign direct investments (FDI) lagged one year is not only positively affecting TFP growth but also highly statistically significant. FDI is another major vehicle for transferring foreign technology.

Price changes, an indicator of economic stability and fundamentals, is negatively related to TFP growth. This means high and unstable prices create a lot of economic uncertainties that discourage investors from investing in productivity-improving projects.

The share of gross value added of manufacturing to total gross domestic product was included to capture externalities and spill over effects of production technology to the rest of the economy. The share of agriculture and service sectors were experimented but turned out to be statistically insignificant. The positive and highly statistically significant coefficient of the share of manufacturing indicates that this sector has

far greater spill over effects to the rest of the economy than other sectors. Its development therefore is an important factor affecting TFP growth.

Expenditure on research and development lagged two years is positive and statistically significant, indicating that it is also another important factor determining TFP growth.

VII. Conclusion

The following insights can be drawn from the paper:

1. Although the last thirty-five years saw mostly negative TFP growth in the Philippines, there is an underlying trend that is encouraging: the contribution of TFP growth to the overall economic growth consistently improved from -4.26 percentage points in the middle of 1980s to +0.93 in 1998-2000. It is important to note that during this period major economic policy reforms were pursued.

2. In spite of the increasing share of skilled labor to the total, loosely defined as those who have at least finished high school, its contribution to TFP growth is observed to have declined through time. This could imply a number of things, among the critical ones include: (1) deterioration in the quality of education necessary for productivity improvement, (2) deterioration in the marginal productivity of workers with higher education and in the efficiency of education itself, and (3) brain drain due to the surge in the number of Filipinos working abroad. These are critical issues in the Philippines that need to be looked at quite closely.

3. Efficiency improvements seem to have been gained from the movement of labor out of agriculture.

4. Sound macroeconomic fundamentals, price stability, and opening up of the economy to foreign trade and investments are critical factors affecting TFP growth. Spill over effects on TFP from manufacturing seem to be far significant than from service and agriculture sectors. Expenditure on research and development is also another important factor affecting TFP.

TABLES

Table 1: The Philippine Economy

	GDP Growth	Employment Growth	Export/GDP	Import/GDP
1967-72	4.8%	3.3%	13.6%	17.4%
1973-82	5.5%	3.1%	16.0%	22.8%
1983-85	-4.1%	3.2%	15.4%	20.4%
1986-90	4.5%	2.1%	17.4%	23.0%
1991-93	-0.1%	3.7%	19.5%	30.2%
1994-97	4.9%	3.3%	24.5%	39.3%
1998-2000	3.5%	-0.3%	45.8%	43.2%

Sources: National Income Accounts, Philippine Statistical Yearbook, and Selected Philippine Economic Indicators

Table 2: Production Structure

	Gross value added shares			
	Agriculture	Industry	Manufacturing	Services
1967-72	29.3%	31.7%	24.7%	39.0%
1973-82	27.9%	36.8%	25.6%	35.3%
1983-85	23.9%	37.4%	24.7%	38.7%
1986-90	23.1%	34.7%	25.0%	42.2%
1991-93	21.5%	33.2%	24.4%	45.4%
1994-97	20.7%	32.2%	22.8%	47.0%
1998-2000	17.2%	30.9%	21.9%	52.0%

Sources: National Income Accounts, Philippine Statistical Yearbook

Table 3: Employment Structure

	Employment Shares				Quality of Labor	
	Agriculture	Industry	Manufacturing	Services	unskilled*	skilled**
1967-72	55.1%	15.5%		29.4%	79.6%	20.4%
1973-82	52.5%	14.7%		32.7%	71.9%	28.1%
1983-85	50.0%	14.6%	9.9%	35.5%	68.6%	31.4%
1986-90	46.9%	15.0%	10.0%	38.0%	64.3%	35.7%
1991-93	45.3%	15.9%	10.4%	38.9%	61.0%	39.0%
1994-97	43.0%	16.2%	10.1%	40.7%	58.3%	41.7%
1998-2000	38.4%	16.3%	9.8%	45.3%	54.5%	45.5%

Sources: Philippine Statistical Yearbook

* From no formal schooling to those who have not finished high school

** At least high school graduate

Table 4: Wages

	Growth in Real Minimum Wage	Growth in Real Sectoral Wage Rate			
		Total	Agriculture	Industry	Services
1967-72					
1973-82	3.9%	-3.3%	-7.6%	-0.1%	-3.3%
1983-85	-1.9%	-8.8%	-0.9%	-10.4%	-11.8%
1986-90	4.6%	6.3%	3.6%	3.1%	8.0%
1991-93	-0.3%	-4.3%	-6.4%	-6.3%	-1.6%
1994-97	-1.4%	3.1%	-2.0%	-1.0%	3.8%
1998-2000	0.7%	5.2%	7.3%	4.1%	3.1%

Sources: Philippine Statistical Yearbook and Selected Philippine Economic Indicators

Table 5 : Estimated Philippine Total Factor Productivity

	Unadjusted TFP	Business Fluctuation Adjustment Factor	Business Fluctuation Adjusted TFP	3-yr Mov Ave Adjusted TFP
1967	-5.11	-3.8206	-1.293	
1968	1.13	1.1588	-0.032	0.280
1969	6.79	4.6197	2.166	0.670
1970	0.67	0.7964	-0.125	0.033
1971	-4.71	-2.7647	-1.943	-0.976
1972	-0.15	0.7088	-0.859	-0.884
1973	5.53	5.3769	0.151	-0.217
1974	-1.95	-2.0102	0.056	-0.021
1975	-4.32	-4.0452	-0.272	0.535
1976	7.07	5.2500	1.822	0.859
1977	1.01	-0.0134	1.027	0.331
1978	-7.45	-5.5928	-1.855	-0.170
1979	0.98	0.6572	0.318	-0.485
1980	3.72	3.6401	0.083	-0.146
1981	-1.69	-0.8533	-0.840	-0.373
1982	-0.76	-0.3997	-0.360	-0.701
1983	-4.20	-3.3004	-0.902	-0.875
1984	-8.77	-7.4009	-1.364	-5.901
1985	-8.36	7.0756	-15.438	-6.014
1986	1.78	3.0208	-1.239	-5.938
1987	1.23	2.3696	-1.136	3.410
1988	6.28	-6.3261	12.606	3.444
1989	1.51	2.6487	-1.138	3.517
1990	0.69	1.6101	-0.916	-1.104
1991	-4.92	-3.6642	-1.258	-3.103
1992	-3.50	3.6341	-7.134	-3.160
1993	-1.22	-0.1330	-1.089	-1.147
1994	0.56	-4.2166	4.781	0.869
1995	1.35	2.4392	-1.086	0.827
1996	1.60	2.8100	-1.214	-1.085
1997	1.06	2.0206	-0.956	-1.041
1998	-1.36	-0.4103	-0.954	-0.954
1999	2.50	3.4493	-0.951	2.818
2000	4.74	-5.6227	10.360	

Table 6: Effects of Labor Quality on TFP

Period	Unadjusted TFP	TFP Adjusted for Labor Quality	Difference: (Unadjusted - Adjusted)	Ratio: (Unadjusted/ Adjusted)
1967-72	(0.23)	(2.34)	2.11	0.10
1973-82	0.21	(0.89)	1.10	(0.24)
1983-85	(7.11)	(7.57)	0.46	0.94
1986-90	2.30	1.66	0.64	1.39
1991-93	(3.21)	(3.38)	0.16	0.95
1994-97	1.14	0.71	0.44	1.61
1998-2000	1.96	1.44	0.52	1.36

Table 7: Effects of Capital Types on TFP

Period	Unadjusted TFP	TFP Adjusted for Capital Type	Difference: (Unadjusted - Adjusted)	Ratio: (Unadjusted/ Adjusted)
1967-72	(0.23)	(0.27)	0.04	0.84
1973-82	0.21	0.21	(0.00)	1.00
1983-85	(7.11)	(7.38)	0.27	0.96
1986-90	2.30	2.31	(0.01)	1.00
1991-93	(3.21)	(3.29)	0.08	0.98
1994-97	1.14	1.05	0.10	1.09
1998-2000	1.96	1.93	0.03	1.01

Table 8: Effects of Sectoral Labor Movement on TFP

Period	Unadjusted TFP	TFP Adjusted for Sectoral Labor Movement	Difference: (Unadjusted - Adjusted)	Ratio: (Unadjusted/ Adjusted)
1967-72	(0.23)	(0.48)	0.25	0.48
1973-82	0.21	0.16	0.05	1.31
1983-85	(7.11)	(7.51)	0.40	0.95
1986-90	2.30	1.85	0.45	1.25
1991-93	(3.21)	(3.04)	(0.18)	1.06
1994-97	1.14	0.57	0.58	2.02
1998-2000	1.96	1.40	0.55	1.40

Table 9 : Estimated Philippine Total Factor Productivity, Unadjusted and Adjusted

	Unadjusted TFP	Business Fluctuation Adjusted TFP	Labor Quality Adjusted TFP	Capital Type Adjusted TFP	Sectoral Labor Movement Adjusted TFP
1967	-5.01	-3.82	-6.10	-5.04	-4.78
1968	0.17	1.16	-0.76	0.13	0.29
1969	3.78	4.62	2.81	3.76	3.22
1970	-0.20	0.80	-1.26	-0.21	-1.24
1971	-4.05	-2.76	-5.16	-4.07	-4.86
1972	-0.34	0.71	-1.46	-0.35	0.65
1973	4.53	5.45	3.36	4.54	4.21
1974	-2.91	-2.08	-4.15	-2.90	-1.35
1975	-4.99	-4.05	-6.17	-5.01	-6.56
1976	4.84	5.25	3.70	4.85	4.52
1977	-0.54	-0.01	-0.11	-0.53	-0.84
1978	-7.01	-5.59	-7.51	-7.01	-6.99
1979	-0.07	0.66	-0.57	-0.08	-0.24
1980	2.38	3.64	2.12	2.33	2.66
1981	-2.12	-0.85	-2.11	-2.20	-1.62
1982	-1.94	-0.40	-2.29	-2.00	-1.78
1983	-4.63	-3.30	-4.56	-4.68	-4.90
1984	-8.82	-7.40	-9.06	-8.86	-9.27
1985	-7.81	7.09	-7.89	-7.82	-7.68
1986	2.30	3.02	2.28	2.29	2.60
1987	1.26	2.37	0.88	1.27	0.75
1988	6.29	-6.33	6.14	6.29	5.79
1989	1.51	2.65	1.38	1.49	0.99
1990	0.13	1.61	-0.05	0.11	-0.08
1991	-4.63	-3.66	-4.65	-4.65	-4.53
1992	-3.41	3.64	-3.52	-3.43	-3.34
1993	-1.26	-0.13	-1.22	-1.29	-1.08
1994	0.47	-4.20	0.42	0.44	0.28
1995	2.09	3.33	1.91	2.05	1.56
1996	0.91	1.90	0.67	0.88	0.73
1997	0.48	1.82	0.47	0.46	-0.20
1998	-2.02	-0.76	-2.30	-2.04	-2.60
1999	2.61	4.01	2.51	2.59	2.50
2000	4.27	-5.62	4.10	4.26	3.70

Table 10: Determinants of Total Factor Productivity

<i>Dependent Variable: 3-year moving average of TFP</i>						
Regression No.	Regression No. 1			Regression No. 2		
Method	OLS			OLS		
Sample	1975-1999			1976-1999		
	Coefficient	Standard Error	t-Statistic	Coefficient	Standard Error	t-Statistic
Variables:						
Constant	-89.4	17.1	-5.2	-86.3	16.6	-5.2
Exports				26.2	6.9	3.8
Imports(-1)				8.7	8.1	1.1
Exports+Imports	18.7	4.9	3.8			
Foreign Direct Investment (-1)	304.8	54.3	5.6	325.0	53.8	6.0
Research and Development(-2)	1943.2	766.4	2.5	2193.8	754.5	2.9
Price Changes	-6.7	3.1	-2.2	-7.8	3.0	-2.6
Share of Manufacturing	300.0	61.0	4.9	289.9	58.9	4.9
D83	9.0	2.2	4.1	8.9	2.1	4.3
D87	7.1	1.4	5.0	6.8	1.4	5.0
D91	-4.7	1.4	-3.3	-4.5	1.4	-3.2
R-squared	0.849			0.870		
Adjusted R-squared	0.769			0.787		
DW	2.122			2.226		
F-Statistics	10.576			10.447		

Definition of variables

Exports	: exports/GDP
Imports(-1)	: one year lag of imports/GDP
ExportsImports	: (exports+imports)/GDP
Foreign Direct Investment (-1)	: one year lag of foreign direct investment/GDP
Share of Manufacturing	: manufacturing GVA/GDP
Research and Development(-2)	: two year lag of Research and Development Expenditure/GDP
Price Changes	: annual change in GDP deflator
D83, D87, D91	: dummy variables

FIGURES

Figure 1 : Three-Year Moving Ave. Business-Fluctuation-Adjusted TFP Growth

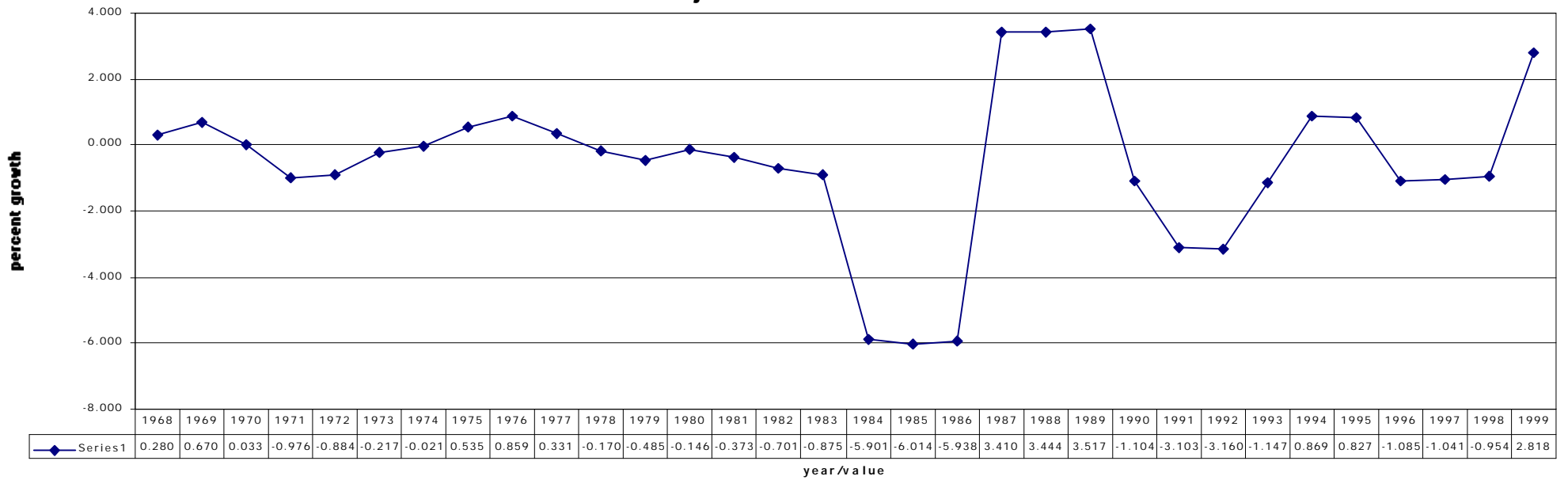
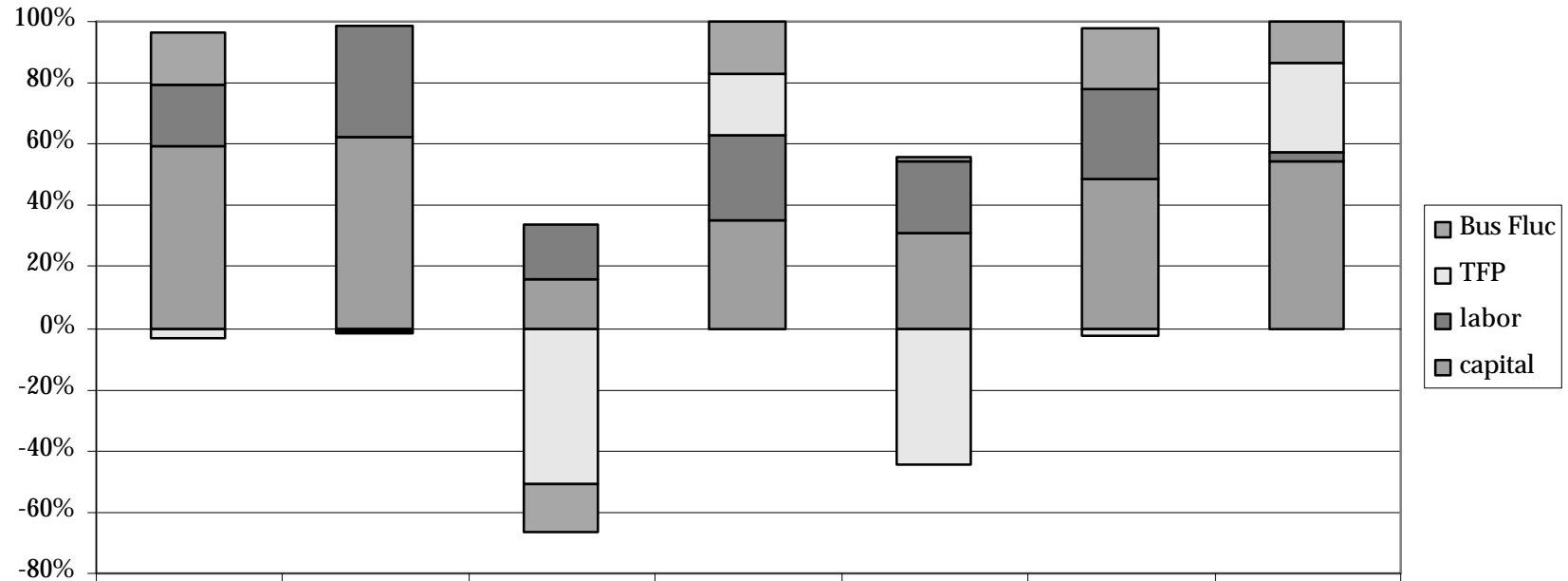


Figure 2 : Decomposition of Output Growth



	1967-72	1973-82	1983-85	1986-90	1991-93	1994-97	1998-2000
■ Bus Fluc	0.88	-0.05	-1.34	0.58	0.08	0.90	0.41
□ TFP	-0.18	-0.04	-4.26	0.67	-2.47	-0.11	0.93
■ labor	1.06	1.93	1.46	0.94	1.28	1.31	0.08
■ capital	3.07	3.33	1.38	1.18	1.73	2.22	1.71

Figure 3 : Types of Labor

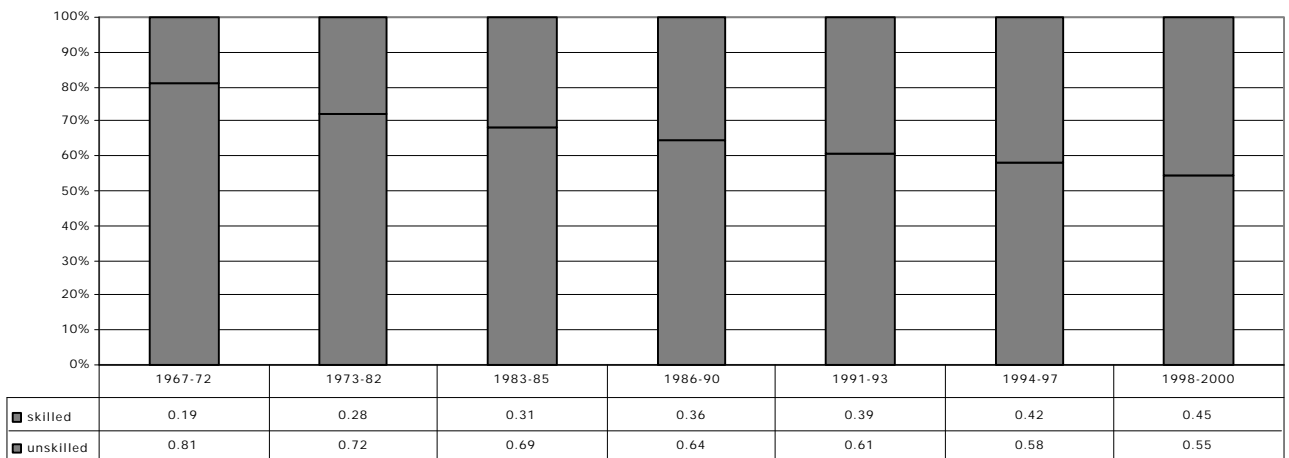


Figure 4 : Types of Capital

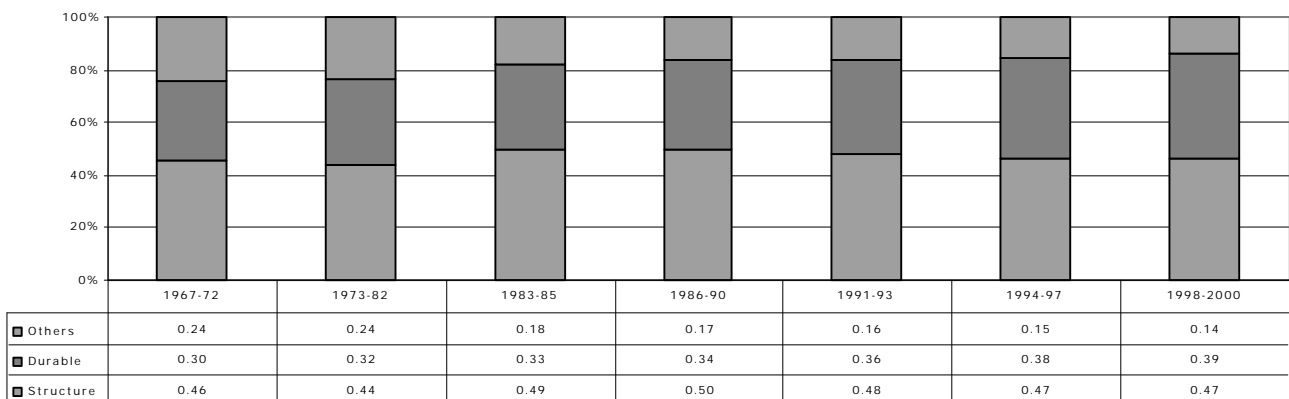


Figure 5 : Movements of Labor

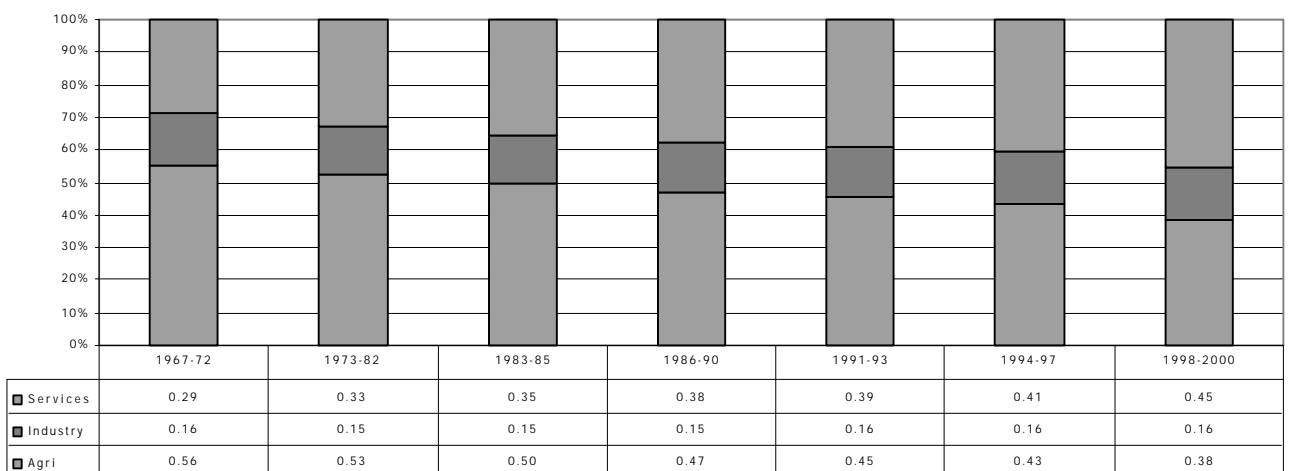


Figure 6: Contribution of Labor Quality to TFP Growth

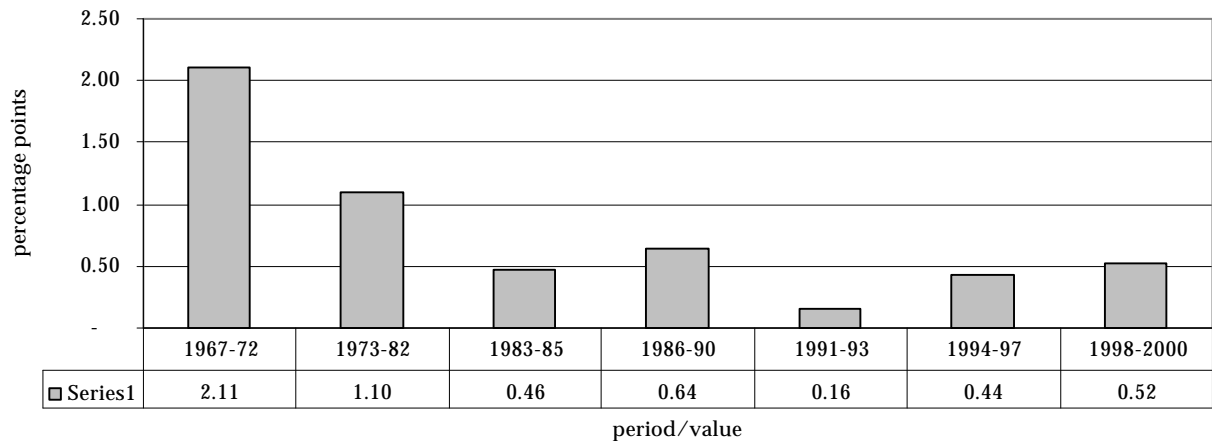


Figure 7: Contribution of Capital Types to TFP Growth

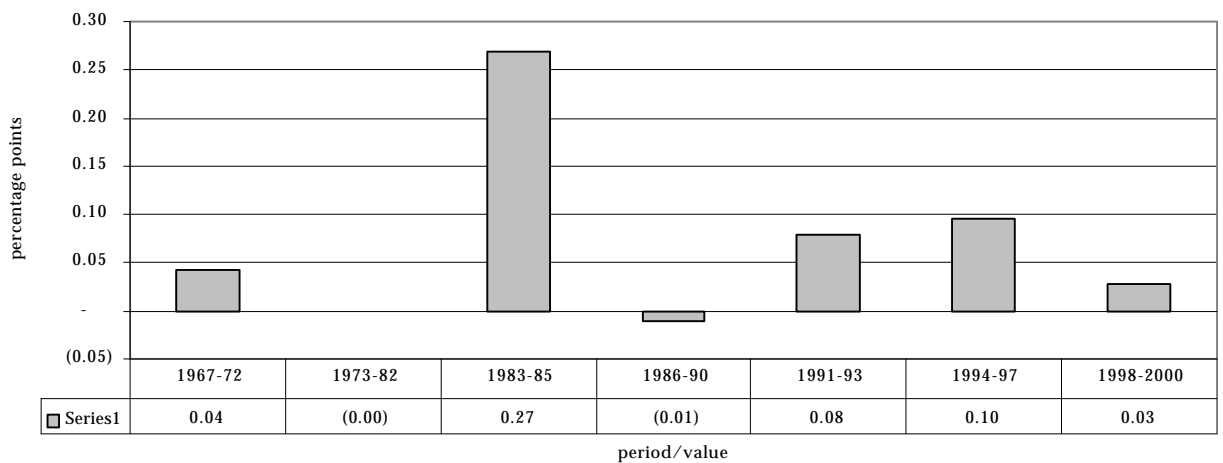
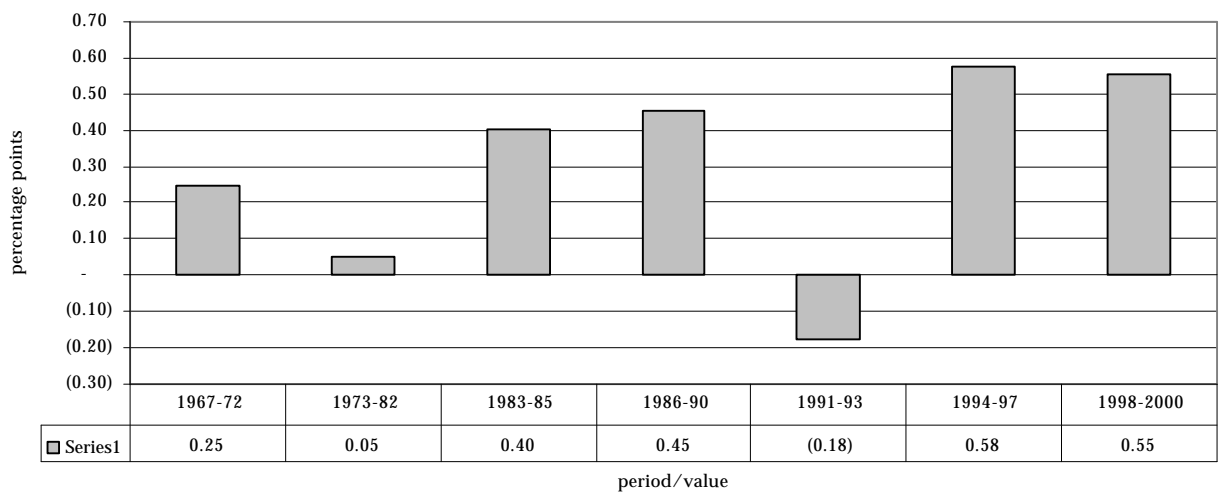


Figure 8: Contribution of Sectoral Labor Movement to TFP Growth



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APPENDIX

Appendix: Data (Philippines)

Caesar B. Cororaton

The paper attempts to estimate and analyze TFP in the Philippine as far back as possible to get a good historical perspective of its changes. Towards this end, assembling the database for analysis requires information dating as far back as early 1946.

1. Output

Output is indicated by the gross domestic product (GDP) at factor cost. In particular, this is computed as

$$\text{GDP at factor cost} = \text{Nominal GDP} - \text{indirect taxes} + \text{subsidies.}$$

This is expressed in 1985 prices using the implicit price deflator of GDP of the National Income Accounts (NIA). The latest base year for the price deflator is 1985. Nominal GDP, indirect taxes and subsidies were all sourced from the official NIA.

2. Labor Input

Labor input is indicated by employment data from the Department of Labor and Employment (DOLE)⁶. It is broken down into two employment categories, namely by major sectors and by skills. The sectoral breakdown includes agriculture, industry and service sector employment. On the other hand, skilled labor is defined in an ad hoc way, which includes employed people with at least high school graduate diploma.

Employment data by major sector is available from 1956 to 2000, except for 1979. For this particular year, the overall employment data which is available was broken down into sectoral employment using interpolated employment share derived as the average of the 1978 and 1980 employment share for agriculture and industry employment. Service sector employment was derived as a residual.

Data on employment by highest grade completed is available for 1976 to 2000, except for 1979. For this lacking year, data is interpolated using the average share in 1978 and 1980.

⁶The employment data was supplied directly by the staff of the National Statistics Office as part of the ongoing work on institutionalizing TFP estimation under an inter-agency technical working group on productivity indicators and monitoring system.

However, data are available for 1965 and 1961 on employment by highest grade completed. Employment series in this category was interpolated until 1961 using geometric growth formula on the shares of unskilled labor, which is defined as those without education up to third year high school. Data for skilled labor were derived residually for those years with unavailable data.

3. Investment

There is no available official capital stock series. Capital stock series is therefore a calculated one.

Investment is indicated by the gross capital formation (GCF) of the NIA, which is available officially starting 1946. Aside from GCF, four of its components were utilized in the estimation. These are investment in durable equipment; construction; breeding stocks and orchard development; and changes in stocks. Investment on breeding stocks and orchard development refers to expenditures on animals, as a form of capital formation, which are used as producing units on livestock and poultry and raised as breeding stocks, draught animals, dairy animals, and layers, less the disposal of those animals. Transfer costs incurred in the purchase of these animals are also included as part of fixed capital formation on animals. Expenditures on orchard development cover the outlays and expenditures on the cultivation of plantations and the planting of permanent crops until these become productive.

For purposes in the present research last two categories of investment were lumped under the heading of others. Data series on investment are expressed in 1985 prices using the implicit price deflator, which is available for each of the components of GCF.

4. Initial Capital Stock

Apart from the overall total initial capital stock, three more types of capital stock, as well as their respective initial capital stock, were estimated: machinery and equipment, structure, and others. The first two were estimated using historical data on investment, while the last one was derived residually.

Historical data on investment in durable equipment was used to estimate the initial capital for machinery and equipment, while historical data on construction was utilized to estimate initial capital stock for structure.

The procedure⁷ for estimating the overall initial capital stock is shown in Table A1. If a depreciation rate of 5 percent is assumed⁸, then the average life span of capital is 20 years (i.e. $1/0.05 = 20$ years). If the 5 percent depreciation rate is indeed true, then one is sure that the amount invested in 1946 would have zero value in 1966. Thus, the value of investment in 1946 of P14,377 million in 1985 prices will be zero in 1966 as shown in the table. Similarly, the investment in 1947 of P25,371 million will have a remaining value of P1,269 million in 1966, while for 1948 investment will have a remaining value of P3,103 million in 1966. If one continues this process until 1966, then one arrives at the value of the overall capital stock in 1966, which is P449,935 million in 1985 prices.

Similar procedure was used to estimate initial capital stock for structure. A 5 percent depreciation rate was assumed on investment in construction. This yielded the value of P212,068 million in 1985 prices of initial capital stock for structure in 1966.

However, using a similar procedure a 6 percent depreciation rate was assumed on investment in durable equipment to arrive at the initial capital stock for machinery and equipment. This generated an estimate of P90,684 million in 1985 prices in 1963 for the initial capital stock of machinery and equipment. To be consistent with the first two, the value for 1966 was considered in the analysis. The initial capital stock for others was derived residually.

5. Capital Stock

The series on capital stock was derived using the commonly used perpetual capital inventory method. That is,

$$K_t = K_{t-1}(1-\delta) + I_t$$

where K_t is capital stock in year t , K_{t-1} is the capital stock in the previous year, δ depreciation rate, and I_t is investment. The method was applied to derive the capital stock series for the overall total, structure, machinery and equipment. To be consistent with the estimation of the initial capital stock, the depreciation for the overall total is 5

⁷This procedure is different from the one developed in de Silva (2001). In the present procedure an assumed depreciation was used to calculate the initial stock stock, while in de Silva (2001) the initial capital stock was calculated as the simple sum of real investment from 1946 to 1960.

⁸Other studies have also applied 5% (see Austria and Martin, 1992).

percent, for the structure is 5 percent, and for machinery and equipment is 6 percent.

6. Factor Shares

The share of labor was computed using data on labor compensation and a derived labor income from household operating surplus. The former is readily available officially, while the latter was derived using the following assumption:

Labor income from household operating surplus = (total household operating surplus) x (labor compensation/GDP at factor cost)

Total labor income was calculated as the sum of labor compensation plus the derived labor income from household operating surplus. The share of capital is 1 minus the total share of labor income.

7. Price of Capital

The analysis that allows for differences in marginal productivity of the different types of capital input requires their respective capital prices. However, there are no official records on these prices. Proxy indicators were therefore devised utilizing information on interest rates, depreciation rates, and price deflators. In particular, the following relationship was used to come up with proxy indicators for capital prices:

Rental price of capital type 1 = interest rate + depreciation rate of capital type - rate of change of the price of capital type 1.

The price of capital was indicated by the implicit price deflator of structure, machinery and total gross capital formation, respectively. Because of wide annual fluctuations in the implicit price indices, a 5-year moving average was computed on each of them.

The share of capital type 1 was computed as

$$S_{K1} = (\text{rental price of capital 1}) * K_1 / [(\text{rental price of capital 1}) * K_1 + (\text{rental price of capital 2}) * K_2 + (\text{rental price of capital 3}) * K_3]$$

The shares of capital for the other types were similarly.

8. Price of Labor

There are two categories of labor that are needed in order to conduct analysis on the effects on TFP of (a) industry shift (which requires sectoral employment and their respective wage rates), and (b) quality of labor (skilled and unskilled and their respective wages). However, there are no official records on wage rates in the Philippines, except for information on legislated wage rates. Legislated wage rates are available for the National Capital Region (NCR) and regions outside NCR, as well as for agricultural plantation and non-plantation. Thus, proxy indicators were devised. These are:

i. On Wages By Major Sectoral. Breakdown of total compensation in the NIA into major sectors are available from 1980 to 1998. Thus, together with the sectoral breakdown of employment, sectoral wages were derived as the ratio of sectoral compensation and employment in agriculture, industry and services.

The remaining problem is how to extend sectoral compensation series beyond 1980. Information on sectoral compensation from the 1974, 1969, and 1961 input-output table were utilized to interpolate the missing years. In particular, sectoral shares of compensation were interpolated using geometric growth formula. These computed shares were then applied to the total compensation to derive the sectoral compensation for the missing years.

As of this writing breakdown of sectoral compensation in 1999 and 2000 are not yet available. For purposes here data for these years were derived using the past two-year average share of sectoral compensation and then applied to the available total compensation.

ii. On Wages by Skills. The assumption used in computing for wages by skill category is that the available legislated wages apply only to unskilled workers - those who have not completed high school. The legislated daily wage was converted into yearly rate using 240 working days (that is, 5 days a week x 4 weeks a month x 12 months). The problem arose when this computed yearly wage was multiplied with the number of employed unskilled workers because the product exceeded the overall compensation. In an ad hoc way, the resulting product was adjusted by multiplying a factor of 0.5 to capture the fact that not all unskilled workers are working the entire 240 days in a one year.

Table A1: Estimation of Initial Capital Stock

	GCF	1946	1947	1948	1949	1950	1951	...	1964	1965	1966
1946	14,377	14,377	13,658	12,939	12,220	11,502	10,783	...	1,438	719	0
1947	25,371		25,371	24,102	22,834	21,565	20,297	...	3,806	2,537	1,269
1948	31,030			31,030	29,479	27,927	26,376	...	6,206	4,655	3,103
1949	23,286				23,286	22,122	20,957	...	5,822	4,657	3,493
1950	22,197					22,197	21,087	...	6,659	5,549	4,439
1951	22,553						22,553	...	7,894	6,766	5,638
...
1964	56,589								56,589	53,760	50,930
1965	60,145									60,145	57,138
1966	60,184										60,184
	$K_0 = K_{66}$										449,935