Total Factor Productivity Growth in the Philippines: 1960–2000

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Average total factor productivity growth (TFPG) for the Philippine economy is negative, indicating that it has not been the source of growth in the Philippines. However, TFPG estimates showed an increasing trend in the 1990s when major economic reforms were implemented. The educational level of the labor force has improved consistently since the 1960s. However, based on the decomposition analysis the paper finds that its contribution to TFPG has declined.

I. INTRODUCTION

Recent growth literature highlights the importance of total factor productivity growth (TFPG) in the growth process of countries. While the literature does not downplay the critical role of factor accumulation in growth, it emphasizes that "there [are] something else besides factor accumulation that [play] prominent role in explaining differences in economic performance across countries" (Easterly and Levine 2001, 178). In fact, "major empirical regularities of economic growth emphasize the role of something else besides factor accumulation."

The common procedure used in quantifying these "residual" items is either through the use of the growth accounting approach or through econometric estimation of an aggregate production function. This approach, however, triggers an interesting debate in the literature. Felipe and McCombie (2004) question the very idea of whether a theory of total factor productivity (TFP) is really needed in order to explain the large differences in per capita income across countries. According to them "…the concepts of total factor productivity and aggregate production function serve more to obfuscate than to illuminate the important problem of 'why growth rates differ'." In another paper, Felipe and McCombie (2003) argue that the use of the production function to estimate TFP and to interpret this as rate of technical progress is problematic because production function estimation usually utilizes data in value terms (mostly sourced from national income accounts) and not in physical quantities. National income data that relates value added with the sum of wage bills, and overall profits, resemble a production function. If this is used to estimate an aggregate production function

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it will generate coefficients that are factor shares. They argue that "…the Solow residual is, by definition, a weighted average of the growth rates of the wage and profits rates, the latter being calculated from the national accounts. These conclusions are true always by virtue of the accounting identity, and hold for all economic units, regardless of the state of competition."

It is not the purpose of this paper to address these issues and to engage in the debate. The main objective of the paper is to update existing TFPG estimates for the Philippine economy and to examine the trend through time because these are used in policy discussions that assess the long-term growth performance of the economy. Also, the paper attempts to examine historically the contribution of the "quality" of factor inputs to TFPG, particularly labor.

Various researches have generated TFPG estimates for the Philippine economy. Using growth accounting, Cororaton and Caparas (1999) provided TFPG estimates that cover the period 1980–1996 for the whole economy as well as for major sectors. Cororaton and Cuenca (2001) updated these to 1980–1998. In both estimates the results are mixed at the sectoral level. The TFPG values of some sectors are positive, while others are negative. Negative TFPG is particularly evident in nontradable service sectors like real estate. Silva (2001) applied growth accounting to estimate TFPG over a longer period, from 1971 to 1998. The paper finds that, "from 1990 to 1997, the average TFPG is –0.8 percent, only a slight improvement from the average rate estimated for the 1980s." On the whole the paper implies that "the movements of TFPG indicate that it did not drive the growth of real output during the past 25 years."

Using a macrodynamic model with output and inflation interaction, Austria and Martin (1992) showed that TFPG from 1967 to 1997 declined by –0.47 percent. Likewise, Lim (1998), using a Cobb-Douglas production function showed negative TFPG for industry and services.

The TFPG estimates generated by Cororaton and Abdula (1997) for the whole manufacturing sector are slightly positive. However, within specific manufacturing subsectors, Cororaton et al. (1995) observed that the number of subsectors with negative TFPG increased in the period from 1956 to 1992.

Thus, based on these estimates the general trend is that TFPG is negative, which means that it has not contributed to Philippine growth.

II. THE PHILIPPINE ECONOMY

A. Growth Performance

The Philippine economy has been moving in a "roller coaster" fashion in the last 35 years. Growth was highest during the 1973–1982 period, averaging 5.5 percent per year (Table 1). This was the peak period of the Marcos administration. However, growth could not be sustained as dissatisfaction among

Filipinos in the military rule mounted. This led to a political uprising in the following period, 1983–1985. Because of weak economic fundamentals characterized by rising short-term debt and increasing fiscal imbalance, the political crisis triggered an economic crisis. The economy contracted by –4.1 percent per year during this period.

The Marcos administration was forced out of power in early 1986. When the Aquino government took over, the economy recovered in the succeeding period, 1986–1990, with growth was averaging 4.5 percent per annum. However, toward the end of the Aquino administration, political tug-of-war led to a series of military coup attempts and created political uncertainties and instability. This, together with the series of natural calamities and an energy crisis, brought the economy to a halt in the period 1991–1993. The economy contracted by –0.1 percent per year during the period.

Table 1. **The Philippine Economy**

				Gross Value Added Shares (%)				
		Ratio			Industry			
Period[1]	GDP Growth (%)	Export/ GDP	Import/ GDP	Agri-culture	Total	Manu-facturing	Nonmanu-facturing	Services
1967–72	4.8	13.6	17.4	29.3	31.7	24.7	7.0	39.0
1973–82	5.5	16.0	22.8	27.9	36.8	25.6	11.1	35.3
1983–85	-4.1	15.4	20.4	23.9	37.4	24.7	12.7	38.7
1986–90	4.5	17.4	23.0	23.1	34.7	25.0	9.7	42.2
1991–93	-0.1	19.5	30.2	21.5	33.2	24.4	8.8	45.4
1994–97	4.9	24.5	39.3	20.7	32.2	22.8	9.4	47.0
1998–00	3.5	45.8	43.2	17.2	30.9	21.9	9.0	52.0

	Employment Shares (%)				
		Industry			
Period[1]	Agri-culture	Total	Manu-facturing	Non-Manu-facturing	Services
1967–72	55.1	15.5		15.5	29.4
1973–82	52.5	14.7		14.7	32.7
1983–85	50.0	14.6	9.9	4.6	35.5
1986–90	46.9	15.0	10.0	5.0	38.0
1991–93	45.3	15.9	10.4	5.4	38.9
1994–97	43.0	16.2	10.1	6.1	40.7
1998–00	38.4	16.3	9.8	6.5	45.3

[1]These subperiods are major turning points in Philippine growth: 1967–72 pre-Martial Law years; 1973–82 Martial Law period; 1983–85 crisis period; 1986–90 recovery; 1991–90 another crisis period; 1994–97 recovery; and 1998–2000 Asian financial crisis period.

Sources: National Income Accounts (National Statistical Coordination Board), *Philippine Statistical Yearbook* (National Statistical Coordination Board), and *Selected Philippine Economic Indicators* (Bangko Sentral Ng Pilipinas).

The leadership of the Ramos administration revived the economy with growth averaging 4.9 percent per year from 1994 to 1997. However, the 1997 Asian financial crisis, the El Nino effects on agriculture production in 1998, and the political scandals that brought havoc to the subsequent Estrada administration in 2000 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 have been a cycle of boom and bust for the country. Economic growth could not be sustained. Political as well as weak economic fundamentals were believed to be the major forces causing such dismal performance.

B. Policy Reforms

Major economic policy shifts occurred when the Aquino government took over in 1986. Structural reforms such as trade liberalization, foreign exchange liberalization, investment reforms, banking reforms, and privatization were implemented. Implementation of the reforms intensified in the 1990s and continues to be pursued at present.

These reforms created a relatively dynamic foreign trade sector as indicated by increasing export and import ratios. From 13.6 percent, export-to-GDP ratio in 1967–1972 increased to 45.8 percent in 1998–2000. Similarly, the import-to-GDP ratio increased from 17.4 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 semiconductors in the world market. To date, more than 60 percent of the country's exports consist of semiconductors, which comprise a highly raw-material-intensive and import-dependent sector.

Yet in spite of reforms and the dramatic rise in foreign trade, signs of structural weakness prevail in the local economy. The share of industry and manufacturing stagnated in the last 35 years. Initially, the share of industry increased from 31.7 percent in 1967–1972 to 37.4 percent in 1983–1985. After that it continued to decline to 30.9 percent in 1998–2000. A similar declining share 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 structure of employment follows closely the structure of output. Industry employs 15 percent of the labor force, while manufacturing 10 percent. These shares have not improved over the years.

In terms of output and employment generation in the midst of policy reforms, the contrasting performance of the foreign trade sector on one hand, and the industrial and manufacturing sector on the other, indicates the absence of trickle-down effects. Considering the fact that these policy reforms have been pursued for quite some time, the lack of concrete trickle-down effects may imply a high degree of duality existing between the local and the foreign trade sectors.

This is an interesting issue to examine in depth, but is beyond the scope of the present paper.

III. METHODOLOGY

This section discusses the approach used in the estimation and decomposition of TFPG.

A. TFPG Measurement

The measurement of TFPG is based on the following translog growth accounting formula

$$TFPG_t = \left(\ln Q_t - \ln Q_{t-1}\right) - \omega_L \times (\ln L_t - \ln L_{t-1}) - \omega_K \times (\ln K_t - \ln K_{t-1}) \quad (1)$$

where $\omega_L = ½ \times \left(\omega_{L_t} + \omega_{L_{t+1}}\right)$ and $\omega_K = ½ \times \left(\omega_{K_t} + \omega_{K_{t+1}}\right)$ are the average factor shares of labor and capital respectively, ln is the natural logarithm operator, *Q* output, *L* employment, and *K* capital input. Direct application of (1) to Philippine data yields the unadjusted TFPG. These estimates are usually sensitive to business fluctuations. To net out these effects the following procedures were used: (i) estimate a Cobb-Douglas production function;[1] (ii) compute the "theoretical" value of output using the estimated production function; (iii) take the ratio of the actual output to the theoretical value of output and use this an indicator of capacity utilization rate; and (iv) take the rate of change of the estimated capacity utilization and subtract it from the unadjusted TFPG to get the adjusted TFPG.

B. Decomposition of TFPG

The first decomposition analysis separates the sources of output growth into the aggregate growth of factor inputs (aggregate labor and capital), TFPG,

[1]The estimated equation is:

lgdpl = 0.869 + 0.627*lkstockl – 0.011*trend – 0.139*d85_87
(t=4.709) (t=13.228) (t= – 8.757) (t= – 6.530)
– 0.059*d92_93 + 0.114*d2000
(t= – 2.302) (t=3.090)

R2 = 0.889, R2bar = 0.870, DW = 1.361, F=46.487, OLS, sample: 1966-2000, lgdpl is natural logarithm of $\left(\text{GDP}/\text{Labor}\right)$, and lkstockl of $\left(\text{Capital Stock}/\text{Labor}\right)$. Other variables in the equation are dummy variables, incorporated to capture the effects of turbulent years. Note that the coefficient of the trend variable (–0.011) indicates declining average TFPG over the period of estimation.

and the business fluctuation effects. The next decomposition analysis focuses on the effects of differentiated factor inputs on TFPG. The decomposition method starts from an aggregate production function

$$Q=A\times f\left(L,K\right) \tag{2}$$

where Q is output, L is simple aggregation of labor (aggregate of all possible kinds of labor skills), K is simple aggregation of capital (aggregate of all types of capital), and A is a scale parameter. The basic assumption in the production function with aggregated factor inputs is that, in the case of labor, the marginal productivity of all types of labor is uniform. Similarly, in the case of capital, the marginal productivity of all types of capital is the same. In most cases, this is not true. Different types of factor inputs may not have uniform marginal productivities. This implies that the corresponding total factor productivity estimate based on (2) (referred to as TFP_A) may not be true as well. "True" TFP may be derived if factor inputs are disaggregated into their various types, i.e.,

$$Q=B\times f\left(l_1,l_2,l_3,...,k_1,k_2,k_3...\right) \tag{3}$$

where Q is the same output as in (3), l_1 is labor type 1, l_2 is labor type 2, etc.; and k_1 is capital type 1, k_2 is capital type 2, etc. The parameter B may give an indication of the "true" TFP (or TFP_B). It may be possible to devise a way of decomposing the effects of factor quality from TFPG if TFP_B is subtracted from TFP_A. To do so it may be necessary to convert factor inputs of various types into efficiency units (Oguchi 2001). In discrete and growth form, (3) may be rewritten as

$$Q_g^t=TFP_g^{t^{**}}+\omega_K K_g^{t^{**}}+\omega_L L_g^{t^{**}} \tag{4}$$

where:

$$\omega_L L_g^{t^{**}}=\tfrac{1}{2}\left(\omega_{l1}^t+\omega_{l1}^{t-1}\right)\times\left(\ln l_1^t-\ln l_1^{t-1}\right)+\tfrac{1}{2}\left(\omega_{l2}^t+\omega_{l2}^{t-1}\right)\times\left(\ln l_2^t-\ln l_2^{t-1}\right)+$$
$$...+\tfrac{1}{2}\left(\omega_{ln}^t+\omega_{ln}^{t-1}\right)\times\left(\ln l_n^t-\ln l_n^{t-1}\right)$$

$$\omega_K K_g^{t^{**}}=\tfrac{1}{2}\left(\omega_{k1}^t+\omega_{k1}^{t-1}\right)\times\left(\ln k_1^t-\ln k_1^{t-1}\right)+\tfrac{1}{2}\left(\omega_{k2}^t+\omega_{k2}^{t-1}\right)\times\left(\ln k_2^t-\ln k_2^{t-1}\right)+$$
$$...+\tfrac{1}{2}\left(\omega_{kn}^t+\omega_{kn}^{t-1}\right)\times\left(\ln k_n^t-\ln k_n^{t-1}\right)$$

l_1, l_2,…l_n and k_1,k_2,…k_n are various types of labor and capital, while ω_s are the corresponding weights. For two types of labor, $\omega_L L_g^{t^{**}}$ may be written as

$$\omega_L L_g^{t**} = \left(\frac{w \times (l_1 + l_2)}{Q} \right) \times \left(\frac{w_1}{w} \right) \times \left(\frac{\partial l_1 + \left(\frac{w_2}{w_1} \right) \times \partial l_2}{l_1 + l_2} \right) \theta \quad (5)$$

or

$$\omega_L L_g^{t**} = \frac{w \times (l_1 + l_2)}{Q} \times \left(\frac{\frac{w_1}{w} \times \partial l_1 + \frac{w_2}{w} \partial l_2}{l_1 + l_2} \right)$$

where $w = \frac{w_1 \times l_1 + w_2 \times l_2}{l_1 + l_2}$ is the average wage of labor, w_1, and w_2 are wages of l_1 and l_2, respectively. Also, $\frac{\partial l_1 + \frac{w_2}{w_1} \partial l_2}{l_1 + l_2}$ is the growth rate of labor in efficiency units. The numerator of the last ratio is the efficiency-weighted increase in labor. After substituting equation (5), equation (4) can be subtracted from (2) to calculate the effects of labor qualities on TFPG. This method is applied to examine the effects of two labor types (skilled and unskilled) on TFPG. In the analysis, labor skill is defined in terms of the level of education of workers. In particular, skilled labor consists of workers who are at least high school graduate, while unskilled are those with zero education and up to third year high school. The indicator of wages of the two labor types is discussed in the Appendix.

A similar approach is used to analyze the decomposition of TFPG into the effects of labor movements. In particular, labor is disaggregated into agricultural labor (l_a), industrial labor (l_i), and service labor (l_s). The indicator of wages in these categories of labor is also discussed in the Appendix.

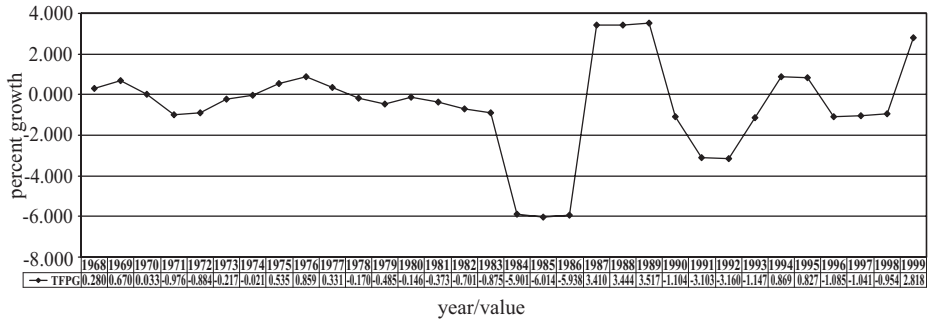
Lastly, the same framework is employed to calculate the effects of three types of capital on TFPG. Capital is broken down into durable equipment (k_1), structure (k_2) and other capital (k_3).

IV. DISCUSSION

The Appendix describes in detail the data requirement of the various analyses as well as sources of information. There are no official data series on capital stock. Thus, a method was devised to estimate capital stock that utilizes official data on gross domestic formation (GDF) stretching as far back as 1946. Labor data used is employment by headcount. Output data is GDP at factor cost. Factor prices are either constructed out of existing official available information or proxied by some appropriate variables.

The estimates of business fluctuation-adjusted annual TFPG[2] are presented in Figure 1 from 1968 to 1999. In the last 35 years, TFPG values fall mostly below zero. Also, even if business fluctuation effects are netted out and moving averages are computed on the original estimates, TFPG values are still fluctuating and erratic starting from 1983. It may be difficult to see a trend. However, if one starts from the drop in the 1991–1992 period and moves toward 2000, one sees that although some of the numbers are still negative, there is an upward trend. Incidentally, this is the period of economic reforms. However, the paper does not go in depth to test whether the economic reforms pursued during the period indeed had positive effects on TFPG. This may be an interesting issue to pursue.

Figure 1. **Three-year Moving Average of Business-Fluctuation-Adjusted TFPG**



The average contribution of TFPG to the growth of output is negative in five out of seven subperiods, the same subperiods as in Table 1[3] (see Table 2). The lowest values are in 1983–1985 and 1991–1993, the periods of economic crisis. TFPG is positive in 1986–1990 and 1998–2000. Although on the average the estimates are negative, there seems to be a positive trend in TFPG in the last three subperiods. In particular, from–2.47 percentage points in 1991–93, it improves to –0.11 in 1994–1997. TFPG registers a positive value of +0.93 in 1998–2000. As noted earlier, this is the period of economic reforms.

[2]These are 3-year moving averages of the estimates to smooth out the yearly fluctuations.

[3]Note that output growth is defined as growth in real GDP at factor cost. See Appendix for discussion of how GDP at factor cost is defined.

Table 2. **Decomposition of Output Growth (percent)**

Period	Growth in GDP[1]	Growth in Capital	Growth in Labor	Growth in TFP	Business Fluctuations
1967–72	4.83	3.07	1.06	–0.18	0.88
1973–82	5.17	3.33	1.93	–0.04	–0.05
1983–85	–2.76	1.38	1.46	–4.26	–1.34
1986–90	3.37	1.18	0.94	0.67	0.58
1991–93	0.62	1.73	1.28	–2.47	0.08
1994–97	4.32	2.22	1.31	–0.11	0.90
1998–00	3.13	1.71	0.08	0.93	0.41

[1]Real GDP at factor cost (see Appendix for definition of factor cost).

Table 3 presents the share of skilled and unskilled labor to the total labor force. In 1967–1972, unskilled labor comprises 80.9 percent of the total. The share drops consistently since then. In 1998–2000, the share is down to 54.5 percent. Thus, in terms of educational level there is an improvement in the quality of labor.

What is the impact of this change on TFPG? Table 3 presents the decomposition analysis of the effects of labor quality on TFPG. Column (1) is the average unadjusted TFPG, while column (2) is the labor quality-adjusted TFPG. Subtracting (2) from (1) gives an indication of the effects of labor quality on TFPG as discussed in the previous section. A positive difference implies a positive contribution. From the results one can observe that the contribution of labor quality on TFPG declines from a 2.11 percent difference in 1967–1972 to 0.46 in 1983–1985. Although there is a marginal increase to 0.64 in the next period, it declines to its lowest value at 0.16 in 1999–1993. The contribution recovers slightly in the succeeding periods. Overall, however, the contribution of labor quality to TFGP declines over time.

Table 3. **Effects of Labor Quality on TFPG**

				Labor Quality Analysis		
	Types of Labor, % Share[a]			Average of Unadjusted TFPG (%)[b]	Labor Quality Adjusted TFPG (%)[c]	
Period	Total	Unskilled	Skilled	(1)	(2)	Difference (1) – (2)
1967–72	100	80.9	19.1	-0.23	-2.34	2.11
1973–82	100	72.2	27.8	0.21	-0.89	1.10
1983–85	100	68.6	31.4	-7.11	-7.57	0.46
1986–90	100	64.3	35.7	2.30	1.66	0.64
1991–93	100	61.0	39.0	-3.21	-3.38	0.16
1994–97	100	58.3	41.7	1.14	0.71	0.44
1998–00	100	54.5	45.5	1.96	1.44	0.52

[a]Source: *Labor Force Survey* (various years). Unskilled means zero education up to 3rd year high school.
[b]Not adjusted for business fluctuations.
[c]Computed using equations (4) and (5).

These results raise a number of interesting hypotheses that the paper did not go into: (i) whether the quality of labor can be adequately captured by the level of education of the labor force; (ii) whether the present educational system in the Philippines produces the necessary labor skills that can improve productivity, or whether the marginal efficiency of the entire educational system has deteriorated over time; and (iii) whether the large numbers of Filipinos migrating and working abroad has resulted in a brain drain. The first may be addressed by using an alterative indicator that can capture labor quality appropriately. The second may be due to the fact that while the Philippines is one of the countries in Southeast Asia that has been producing one of the highest numbers of college graduates in the region, it has produced one of the lowest numbers of graduates that specialize in science and technology, and in engineering (Cororaton 1999). The third may be due to the low employment absorptive capacity of industry and manufacturing because of declining shares as noted above. If this is case then the excess supply of graduates (or those with higher educational attainment) will find their way to the international labor market. These are interesting hypotheses that may be pursued further.

Similar analysis was applied to examine the effects of sectoral labor movement on TFPG. Table 4 shows significant movement of labor from agriculture to the services sector. From 55.5 percent in 1967–1972, agricultural share drops to 38.4 percent in 1998–2000. Correspondingly, the share of service sector employment improves from 28.9 to 45.3 percent over the same period. There is a very small change in the employment share of industry.

What is the impact of these sectoral labor movements on TFPG? The effect is generally positive and increasing. This is shown in the difference between columns (1) and (2). There is, however, one negative value in 1991–1993. The positive and generally increasing effects on TFPG may be due to the gain in efficiency resulting from the movement of excess and redundant labor in agriculture to the services sector. The supply of arable land is limited while the population growth in the rural sector is high relative to the urban sector. Through time this creates an excess supply of labor in agriculture. A movement of agricultural labor to the other sectors of the economy will bring efficiency gains.

Table 4. **Effects of Sectoral Labor Movement on TFPG**

					Labor Movement Analysis		
	Employment Share, %[a]				Average of Unadjusted TFPG (%)[b]	Labor Sector Adjusted TFPG (%)[c]	Difference
Period	Total	Agriculture	Industry	Service	(1)	(2)	(1) – (2)
1967–72	100	55.1	15.5	29.4	–0.23	–0.48	0.25
1973–82	100	52.5	14.7	32.7	0.21	0.16	0.05
1983–85	100	50.0	14.6	35.5	–7.11	–7.51	0.40
1986–90	100	46.9	15.0	38.0	2.30	1.85	0.45
1991–93	100	45.3	15.0	38.9	–3.21	–3.04	–0.18
1994–97	100	43.0	16.2	40.7	1.14	0.57	0.58
1998–00	100	38.4	16.3	45.3	1.96	1.40	0.55

[a]Source: *Labor Force Survey* (various years).
[b]Not adjusted for business fluctuations.
[c]Computed using Equations (4) and (5).

The share of capital structure has not changed much over the years as shown in Table 5. However, the share of capital equipment has improved from 30.2 percent in 1967–1972 to 39.5 percent in 1998–2000. As indicated in the difference between columns (1) and (2), the effects on TFPG are very small and the trend over time is not clear.

Table 5. **Effects of Capital Type on TFPG**

					Capital Type Analysis		
	Type of Capital, % Share[a]				Average of Unadjusted TFPG (%)[b]	Capital Type Adjusted TFPG (%)[c]	Difference
Period	Total	Structure	Durable Equipment	Others	(1)	(2)	(1) – (2)
1967–72	100	45.5	30.2	24.2	-0.23	-0.27	0.04
1973–82	100	43.8	32.4	23.8	0.21	0.21	0.00
1983–85	100	49.3	33.2	17.5	-7.11	-7.38	0.27
1986–90	100	49.8	33.7	16.5	2.30	2.31	-0.01
1991–93	100	48.1	35.9	15.9	-3.21	-3.29	0.08
1994–97	100	46.5	38.4	15.1	1.14	1.05	0.10
1998–00	100	46.7	39.5	13.8	1.96	1.93	0.03

[a]Source: National Income Accounts (various issues).
[b]Not adjusted for business fluctuations.
[c]Computed using Equations (4) and (5).

V. CONCLUSION

On the average TFPG is negative. This means that in general TFPG has not been the source of growth in the Philippines. However, if one looks closely at the estimates in the 1990s, one can observe an upward trend. It is interesting to note

that this was a period of economic reforms. Whether these reforms affected TFPG positively is an interesting issue that needs to be pursued further.

The decomposition analysis shows that while the quality of labor in terms of educational level has improved since the 1960s, its contribution to TFPG has declined through time. This is also an interesting puzzle that needs to be investigated further. There could be a host of possible factors behind this, which could include: (i) failure of the educational system to produce the necessary skills to improve productivity, (ii) declining efficiency of higher education, and (iii) negative effects of brain drain.

APPENDIX

Output

The indicator of output is the gross domestic product (GDP) at factor cost. This is computed as: *GDP at factor cost = Nominal GDP – indirect taxes + 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 are all sourced from the official NIA.

Labor Input

The indicator of labor input is employment data from the Department of Labor and Employment (DOLE).[4] Two employment categories are used: major sectors and skills. Sectoral employment is broken down into agriculture, industry, and service sector. Skilled labor is defined as those who are at least high school graduate, while unskilled are those with zero education up to third year high school.

Employment data by major sector is available from 1956 to 2000, except 1979. The following method was used to supply the missing sectoral employment data for 1979. The available employment data was disaggregated into sectoral employment using the interpolated employment share derived as the average of the 1978 and 1980 employment share for agriculture and industry employment. Service sector employment is derived as a residual. Data on employment by highest grade completed is available from 1976 to 2000, except 1979. For this year, data is interpolated using the average share in 1978 and 1980.

[4]The employment data is supplied directly by the staff of the National Statistics Office as part of the ongoing work on institutionalizing TFP estimation under an interagency 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 is interpolated until 1961 using a geometric growth formula on the shares of unskilled labor, defined earlier. Data for skilled labor is derived residually for those years with unavailable data.

Investment

There is no available official capital stock series and is therefore derived. The indicator of investment is the gross capital formation (GCF) of the NIA, which became officially available beginning in 1946. Aside from GCF, four of its components were utilized in the estimation: investment in durable equipment, construction, breeding stocks and orchard development, and changes in stocks.[5] The last two categories 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 GCF components.

Initial Capital Stock

Apart from the overall total initial capital stock, three 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 procedure[6] used in estimating the overall initial capital stock is shown in the Appendix table. If a depreciation rate of 5 percent is assumed,[7] 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 gone to zero value in 1966. Thus, the value of investment in 1946 of

[5]"Investment on breeding stocks and orchard development" refers to expenditures on animals—as a form of capital formation—that 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.

[6]This 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, while in de Silva (2001) the initial capital stock was calculated as the simple sum of real investment from 1946 to 1960.

[7]Other studies have also applied 5% (see Austria and Martin 1992).

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.

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

However, using a similar procedure a depreciation rate of 6 percent 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 1963 in 1985 prices 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 is derived residually.

Capital Stock

The series on capital stock is derived using the commonly used capital inventory method. That is, $K_t = K_{t-1} \times (1-\delta) + I_t$ where K_t is capital stock in year t, K_{t-1} is the capital stock in the previous year, δ is 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 was 5 percent, for structure 5 percent, and for machinery and equipment 6 percent.

Appendix Table. **Estimation of Initial Capital Stock**

	GDF	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**…**	**1964**	**1965**	**1966**
1946	14,377	14,377	13,658	12,939	12,200	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**

GDF means gross domestic formation.
Source of basic data: National Income Accounts (National Statistical Coordination Board, various years).

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 is derived using the following assumption:

$$\text{Labor income from household operating surplus} = \left(\text{total household operating surplus}\right) \times \left(\frac{\text{labor compensation}}{\text{GDP at factor cost}}\right)$$

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.

Price of Capital

The analysis in this paper requires data on capital prices, which unfortunately is unavailable. 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 - of change of the price of capital type 1

The indicators of the price of capital are the implicit price deflators of the respective capital types. 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 *i*, SK_i was computed as

$$SK_i = \left(\frac{RENTP_i \times K_i}{\sum_{j=1}^{3} RENTP_j \times K_j}\right)$$

where $RENTP_i$ is rental price of capital *i* and *K* is capital

Price of Labor

There are no official records on wage rates in the Philippines, except for the 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 nonplantation. Given what is available, proxy indicators were devised.

1. Wages by Major Sectors

The NIA has a sectoral breakdown of total compensation from 1980 to 1998. Together with the available sectoral breakdown of employment, sectoral wages were derived as the ratio of sectoral compensation and employment in agriculture, industry, and services.

There is no available information on the sectoral breakdown of total compensation earlier than 1980. To extend the series information on sectoral compensation from 1961, 1969, and 1974 input–output tables were used to interpolate (using geometric growth formula) values for the missing years. As of this writing, the breakdown of sectoral compensation in 1999 and 2000 are not yet available. Thus, the data for these years were derived using the past 2-year average share of sectoral compensation and then applied to the available total compensation to get the shares.

2. Wages by Skills

The wages for unskilled workers were assumed to be the legislated wages, which are available. There is no available wage information for skilled workers. To derive a proxy indicator, the legislated daily wage was converted into yearly rate using 240 working days (i.e., 5 days/ week times 4 weeks/ month times 12 months). The problem arises when this computed yearly wage is multiplied with the number of employed unskilled workers because the product exceeds 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 1 year.

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