TFP as Asian Economies' Source of Economic Growth: Past Evidences, Measurement Controversies and Recent Findings

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Abstract

Owing to Enke's remark, Young's findings, and Krugman's consequential Soviet resemblance, studies on the Asian economies sources of growth and its potentials have not only become more lively and interesting but also puzzling. In fact, the studies had triggered numerous works devoted to investigate and analyze the actual contributory factors to growth process in Asia, particularly South-east Asian (ASEAN) and East Asian economies. In the present paper, it is shown that the sources of Asian economic growth in the past two decades or so were not homogeneous. While in some countries the source was input-driven, in some others it was productivity-driven. Specifically, in the case of ASEAN countries, with Vietnam being the only exception, all other countries' source of growth was predominantly input-driven. However, when the observation was extended to include East Asian and few West Asian countries the results were in stark contrast to Young's and Krugman's findings. Thus, we conclude that the growth of Asian economies was not fundamentally dominated by factor accumulation. As for the growth accounting method, as adopted by the previous and present studies to measure the sources of a country or a group of countries' economic growth and its attributes, it is still the work horse of empirical growth analysis. For all its flaws, be it real or imagined, as discussed in the measurement issues, many researchers have used it to gain valuable insights into the process of economic growth. Not only thousands of research papers have been published but also the residual (TFP) has consistently become a closely watched government statistics. Indeed, this proves nothing but an evergreen and sustainable forty-year Solow vintage work.

1. Introduction

It was in 1963 when Enke, the then World Bank's chief economist, wrote that Asia as a whole has the worst prospects among developing countries. He ranked them last in development potential, after Latin America, sub-Saharan, and the Middle East. In fact, he predicted in 1967 that Africa's economic future was brighter with seven of them had the potential to reach or surpass a 7-percent growth rate (Easterly, 1995). Instead, in 1980s, Hong Kong, Taiwan, Singapore, South Korea, and to a larger extent, Malaysia emerged as the most promising candidates to join the so-called Newly Industrializing countries club. The subsequent years, i.e., 1990s onwards, had witnessed several more Asian countries at the threshold of joining the "club" of which Thailand, Indonesia, and the Philippines were the talented ones.

Then came 1994, Krugman, a prominent US economist, who argued based on Young's (1992, 1994) findings that "[The] newly industrializing countries of Asia, like the Soviet Union of the 1950s, have achieved rapid growth in large part through an astonishing mobilization of resources. Once one accounts for the role of rapidly growing inputs in these countries' growth, one finds little left to explain. Asian growth, like that of the Soviet Union in its high-growth era, seems to be driven by extraordinary growth in inputs like labor and capital rather than by gains in efficiency" (Krugman, 1994, p.70). Obviously, his findings also serve to deflate the idea that East Asia poses a fundamental economic challenge to the United States. To put it differently, if the investment is subject to diminishing returns, the region's astronomical growth rates are destined to fall back to earth, which nothing to worry about, especially by the US.

Owing to Enke's remark, Young's findings, and Krugman's consequential Soviet resemblance, studies on the Asian economies sources of growth and its potentials have not only become more lively and interesting but also puzzling. While the former had triggered numerous works devoted to investigate and analyze the actual contributory factors to growth process in Asia, particularly South-east Asian (ASEAN) and East Asian economies, the latter, due to the post-Young-Krugman's studies, have shown that the future of Asian economies was not so gloomy. In general, studies conducted after 1995 have produced mixed results[1]. Some of them like Sonobe and Otsuka (2001), Hayami and Ogasawara (1999), and Singh and Trieu (1997, 1999) attributed the high economic performance of some of Asian countries to several factors ranging from capital deepening, borrowed technology, to technological change (Han et al., 2004). Hulten and Srinivasan (1999), and Hulten (2000), on the other hand, based on their empirical findings have concluded that the Young's and Krugman's findings, "[Do] not take into account the induced capital accumulation effect. The role played by total factor productivity (TFP) growth ….. is actually larger ……….. Exactly how much larger is hard to say, because the induced-accumulation effect depends on several factors, such as the bias in technical change and the elasticity of substitution between capital and labor

[1] See Collins and Bosworth (1996, Table 4) for the details of sources of growth by regions.

(p.36)*"*.[2] In fact, contrary to Young's and Krugman's findings, studies conducted to investigate individual Asian countries' sources of economic growth found support for the view that TFP growth in these countries was much stronger than their research results suggest.[3]

On the same subject, the World Bank has specifically attributed the East Asia high growth to improvements in efficiency or TFP that is associated with policy reform, openness to trade, and technological innovation (IMF, 1998). Collins and Bosworth (1996), despite quite in agreement to both Young's and Krugman's conclusions, have argued that there is some evidence that the East Asian economies were evolving toward a greater emphasis on TFP gains, and the future can be sustained. This was then supported by Crafts (1999) of the London School Economics (LSE), who showed that at least in the case of few leading East Asian economies "[The] opportunity for further rapid catch-up growth has not been completely eroded" (p.153). All of these findings tend to suggest that TFP still remains crucial as Asian economies' source of sustainable long-term economic growth for many years to come. Having said this, the question now is, what was the factor that had influenced the Asian economic growth performance after the 1997 financial crisis? Was it input-driven or productivity-driven? To the best of our knowledge, this question has not been addressed by any of the researchers mentioned above. Second, what happens, in terms of the sources of economic growth, to countries like Nepal, India and Iran, among others, which were not reported in the previous studies? Next, was the methodology used to measure TFP growth by the past researchers appropriate and reliable? This question is very pertinent because it has been frequently argued that the conflicting views, findings and conclusions of the above-surveyed works could have also been the results of different methodologies or measurements employed

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[2] When Hulten and Srinivasan (1999) made the correction using a different method of estimation called Harrodian correction, they found that the contribution of TFP has significantly changed. While with conventional (Hicksian) TFP accounts for approximately one-third of output growth in Hong Kong, South Korea, and Taiwan over the 1966-90/91 period, with Harrodian TFP the figure rises to nearly 50 percent for the same period. In another study of TFP of individual East Asian economies, Felipe (1999) had found a mixed result between the sources of growth originating from TFP and other factors of production.

[3] Examples are: Wong Fot-Chyi (1995) conducted a study for the case of Singapore; and, Tinakorn and Sussangkarn (1994) for Thailand. Both studies have estimated strong TFP growth for Singapore and Thailand. Fatimah et al (2003) measured Malaysia's sources of growth and found that the economy and its manufacturing sector was primarily input-driven.

by the researchers to quantify the Asian economies' growth and its attributes. In other words, measurement or methodological issues are at the heart of the differences of those works' findings, which, in turn, gave rise to different growth estimates of the Asian economies' TFP growth. Each question and issue that is raised here will be addressed and incorporated into the analysis of the paper.

The schematic details of the paper are as follows. In Section 2, the focus and emphasis will be to discuss the previous empirical studies conducted to measure the sources of Asian countries economic growth. The discussion will show that the different results obtained for the two sources, viz., from inputs accumulation and productivity, of Asian countries economic growth by various studies stemmed from the difference in the methodologies or measurements used. This clearly provides a reason for the previous findings to be verified further. Section 3 of the paper will be devoted to address the issue. In Section 4, using the recently Asian Productivity Organization (APO, 2004) published data and disaggregating them into three regions[4], the paper will demonstrate the peculiarity of each region, in so far as the sources of economic growth are concerned. Making this distinction in a cross-region analysis symbolizes the main contribution of the paper. There is a concluding remark in Section 5.

2. Past Evidences

The admirable performance of a number of Asian economies has been the premise for a large and diverged literature, much of which looks into reasons for the persistently high growth, and draws lessons for other countries that would like to follow suit. The growth experienced by those countries not only dramatically changed people's lives, but also raised issues such as what had been the contributing factors, and whether the experience was replicable. In fact, it has become a stylized fact that the growth rates of these countries have continued, even in recent years, at rates that exceeded by far the normal historical and geographical experience of other regions in other parts of the world. During 1980-95, for example, four ASEAN economies (Malaysia, Indonesia, Thailand, and Singapore), more than doubled their real income per person, compared with an increase

[4] They are: East Asian countries or economies; South-east Asian (ASEAN) countries or economies; and, West Asian countries or economies.

of only 20% in the United States and other industrial countries and even less than that in many other regions of the World (Sarel, 1997).

While some assessments of the sources of growth literature have questioned the approach and its theoretical basis, it remains true that empirical studies have been numerous and influential. Notwithstanding many differences in data and analytical methodologies, most of the studies have the tendency to share one common feature in analyzing the relative role of input accumulation and TFP change; they relied heavily on a growth accounting approach.

Surprisingly, the growth accounting approach[5] employed by the studies came out with markedly different results. For example, using the approach and taking the case of four East Asian countries; Singapore, Taiwan, Hong Kong and South Korea, Young (1995) argued that the East Asian source of economic growth was not very different from that of Latin America. However, Singh and Trieu (1999) showed that this conclusion might be flawed, since it was based on comparing results from different measurements. Other growth accounting exercises for individual East Asian countries have been found to give mixed results (Felipe, 1999). Han et al (2004) have deviated somehow in their approach. They have utilized frontier approach to measure the sources of a diverse of countries economic growth. Specifically, an allowance was given for the possibility that an economy might be producing output not using the inputs efficiently, or output is produced inside the best practice frontier. For sake of comparison, these and other studies' TFP results, which may be viewed as the pre-1997 empirical evidences, are shown in Table 1.

[5] A more detailed discussion on the approach and the measurement issues is available in Section 3 of the paper.

Table 1: Estimates of a Selected Asian Economies TFP Growth

(% a year)

Period	Young 1966-90	Collins and Bosworth 1960-94	Sarel 1978-96	Han et al. 1970-90*	Crafts 1960-84
India	-	-	-	-0.01	-
China	-	2.6	-	-	-1.4
Indonesia	1.2	0.8	1.2	-	0.8
Korea	1.7	1.5	-	0.03	1.5
Malaysia	1.1	0.9	2.0	-0.03	0.9
Philippines	-	-0.4	-0.8	0.01	-0.4
Singapore	0.2	1.5	2.2	0.00	1.5
Taiwan	2.6	2.0	-	-0.02	2.0
Thailand	1.5	1.8	2.0	-0.01	1.8
Japan	-	-	-	-0.06	3.6

Source: Crafts (1999, Tables 3 and 9), and, Han et al (2004, Tables A2-A5).

* Simple average. The TFP growth has been decomposed into technical efficiency change (TEC) and technological progress (TP).

As evident from the table, Collins and Bosworth (1996) obtained a TFP growth estimate of 2.6% for China during 1960-94, while Crafts (1997), despite utilizing the same approach, obtained a TFP growth of -1.4% for 1960-84. Further investigation has shown that the unique results obtained by the respective study can be attributed to the way in which the sources of economic/output growth of a country are decomposed. Traditionally (i.e., owing to Solow), the sources of output growth are decomposed into two components; a component that is accounted for by increases in the factors of production (capital and labor), and, a component that is not accounted by increases in factors of production, which is the residual after calculating the first component. The latter component actually represents the contribution of TFP growth. As shown by Hulten (2000), by careful measurement and correct model specification one can rid the residual (p.17).

It seems from Hulten's (2000) comment, the problem actually originated from the way the sources of economic growth of a country are measured. Simply put, different measurements used will result in different findings, and hence different conclusions. There are at least four major measurement issues that have led researchers to give different pictures on the growth and its attributes of the Asian countries performance. They are discussed in the next section.

3. Measurement Controversies

To begin with, the underlying methodology employed by the previous studies to measure the relative contributions of factor accumulation and productivity to the growth of an economy and thereby determining whether the economy is input- or productivity-driven, was the growth accounting framework. The standard neo-classical production function is,

$$Q_t = A_t F\,(K_t, L_t) \qquad (1)$$

where Q, A, K, and L are output, technology, capital and labor, respectively.[6]

Differentiating (1) with respect to (hereinafter, w.r.t) time (t), we obtain,

$$\frac{\dot{Q}_t}{Q_t} = \frac{\partial Q}{\partial K}\,\frac{K_t}{Q_t}\,\frac{\dot{K}_t}{K_t} + \frac{\partial Q}{\partial L}\,\frac{L_t}{Q_t}\,\frac{\dot{L}_t}{L_t} + \frac{\dot{A}_t}{A_t} \qquad (2)$$

Equation (2) suggests that the growth of real output can be decomposed into the growth rates of capital and labor, both weighted by their output elasticities, and the growth rate of the Hicksian efficiency index. While the former rates represent movements along the production function, the latter rate is the shift in the function.

The output elasticities in (2) are not directly observable. However, if each input is paid the value of its marginal product, i.e., if

$$\frac{\partial Q}{\partial K} = \frac{r_t}{p_t}, \text{ and } \frac{\partial Q}{\partial L} = \frac{w_t}{p_t} \qquad (3)$$

where r, p and w are the price of capital, output and labor, respectively, then we get,

[6] Note that A_t should not only be attributed to technical change but to some other measurable and un-measurable variables (Hulten, 1986).

$$\frac{\dot{Q}_t}{Q_t} = \frac{r_t K_t}{p_t Q_t}\frac{\dot{K}_t}{K_t} + \frac{w_t L_t}{p_t Q_t}\frac{\dot{L}_t}{L_t} + \frac{\dot{A}_t}{A_t}$$

$$= S_t^K \frac{\dot{K}_t}{K_t} + S_t^L \frac{\dot{L}_t}{L_t} + \frac{\dot{A}_t}{A_t} \qquad (4)$$

where S_t^K and S_t^L are the shares of capital and labor in the total production or output, and the summation of both is equal to one. Equation (4), after rearranging, becomes

$$\mathcal{M}_t = \frac{\dot{Q}_t}{Q_t} - S_t^K \frac{\dot{K}_t}{K_t} - S_t^L \frac{\dot{L}_t}{L_t} = \frac{\dot{A}_t}{A_t} = \text{TFP} \qquad (5)$$

$\mathcal{M}_t$ = **TFP** is a residual, the growth rate of output not explained by the growth in inputs.

It is from (5) that the controversies or issues on the measurement of the sources of a country's economic growth originated. To reiterate, there are four issues, and each will be dealt with in the same order as when they were highlighted.

First, the terms S_t^K and S_t^L, which are intended to capture the elasticity of output w.r.t. growth of capital and labor, are valid only under perfect competition. In most cases, regardless whether the measurement of the sources is done for developed (where the markets for both capital and labor are said to be more competitive) or developing countries (where the markets for both capital and labor are said to be less competitive), the terms are merely approximated. Studies conducted on the Asian economies have chosen S_t^K and S_t^L on different grounds. Sarel, for example, derives weighted averages for each economy according to their output composition (Crafts, 1999, p.147). The estimated S_t^K was in the range of 0.28 to 0.35, which was much lower than Collins and Bosworth (1996) estimation, 0.35. It goes without saying that the higher (lower) of S_t^K will have influence on the lower (higher) value of S_t^L and $\mathbf{A_t}$, the residual or TFP.

Second, an issue that has put many researchers at variance concerns the treatment of improvements in the quality of labor (L), in particular through education. Whereas

Young (1995), and Collins and Bosworth (1996) adjust their raw labor force estimates on the basis of assumptions about rates of return to observed increases in schooling, Sarel (1999) prefers to make no adjustment, with the implication that any unmeasured improvement in labor force quality will show up in the residual, i.e., TFP growth. As implied by the results of both studies (see Table 1), the value of TFP growth of all selected Asian economies measured using Sarel method was higher than that of Collins and Bosworth.

Third, it has been argued that a more subtle reason to believe that the results of the studies on sources of the Asian economies economic growth were biased is because they rely on the nature of the production function that the technological change is Hicks-neutral. When Hulten and Srinivasan (1999) rectified it using a different method of estimation, called Harrodian correction, they found that the contribution of TFP has changed significantly. While with conventional (Hicksian) method the TFP accounts for approximately one-third of output growth in Hong Kong, South Korea, and Taiwan over the 1966-90/91 period, with Harrodian method the TFP figure magnifies to nearly 50 percent for the same period. In other words, employing a slightly different technique of measuring the sources will change the result significantly, i.e., the sources change from input-driven to productivity-driven.

Finally, the results of measurements of the sources of economic growth can also be biased because the production function is assumed to be subject to constant returns to scale. Collins and Bosworth (1996) were of the opinion that "[any] deviation of (the function) from constant returns to scale is allocated to the residual of total factor productivity (p.8)". Obviously, this will induce the estimate of TFP upwards (downwards) if the production function is bound by increasing returns to scale (decreasing returns to scale).

It is interesting to note that all these biases, according to Hulten (2000)[7] and others[8], do not in any way indicate the inferiority of the neo-classical technique, pioneered by Solow, of measuring the sources of economic growth of a country. The

[7] This is based on Hulten (2000) work.
[8] Sarel (1997), and Collins and Bosworth (1996), among others.

arguments pertaining to the measurement issues highlighted above are addressed accordingly below.

On the first issue that the terms S_t^K and S_t^L, which are intended to capture the elasticity of output w.r.t. growth of capital and labor, are valid only under perfect competition, Collins and Bosworth (1996) have resolved it when they employed fixed weights in aggregating the factor inputs, capital and labor. They found that there is surprisingly little evidence of major changes in factor shares over time. In fact, since the share of capital (S_t^K) in both developed and developing countries are not so difficult to obtain, the share of labor can be computed residually. That is to say, $S_t^L = 1 - S_t^K$. Furthermore, even though various methods have been employed by many researchers to measure the share of factor inputs of an economy, particularly the share of capital (S_t^K), like parametric estimates and fixed weights (Collins and Bosworth, 1996, p.17), national accounts and regression approaches (Sarel, 1997, p.14), and "new method" (Sarel, 1997), little evidence of major changes in factor shares over time. In fact, using the "new method", Sarel (1997) found the level of development (measured by the average stock of capital per person) did not significantly affect the share of capital in each economic activity (p.16).

On the second issue of the treatment of improvements in the quality of labor and its relationship with the sources of economic growth, it has always been the case that it is confined to the number or years of schooling of the labor force. This is not to rule out the fact that over years the quality of labor force is also influenced by the institutional and policy changes. However, unfortunately the latter change could not be directly quantified. The case at hand is the change of education policy from social sciences-based to natural or physical sciences-based, and then to ICT-based. Even though undoubtedly such changes will significantly affect the quality of labor nurtured at a particular point of time when the development process is being undertaken, they are difficult, if not impossible, to be measured quantitatively. Since an effective method to quantify the quality of labor has not yet been found we are left with little choice but to adopt the existing method, i.e., the measurement has to be based on number of labor force schooling years.

A third issue concerns the implied nature of the technical change. The Hicksian-neutral of technical change of the production function (5) is valid if innovation improves the marginal productivity of all inputs equally. In this case, the production function shifts by the same proportion at all combinations of labor and capital. This is, however, a strong assumption, if violated, may lead to biases. As shown by Hulten (2000), a more general formulation allows costless improvements in technology to augment the marginal productivity of each factor input separately:

$$Q_t = F\,(a_t K_t, b_t L_t) \qquad (1')$$

This is the "factor-augmentation" formulation of technology or better known as the Solow-augmented model. It replaces the Hicksian A_t with two augmentation parameters, a_t and b_t. If all the other assumptions of the Solow derivation are retained, a little algebra shows that the residual can be expressed as[9]

$$\mathcal{M}_t = S_t^K \frac{\dot{a}_t}{a_t} + S_t^L \frac{\dot{b}_t}{b_t} \qquad (5')$$

The residual is now the share-weighted average of the rates of factor augmentation, but it still measures changes in total factor productivity. Indeed, when the rates of factor augmentation are equal, and the sum of the shares is constant, it effectively brings us back to the previous Hicksian case (equation 4).

On the final issue, which is presumably caused by the close link between the GDP accounting identity and the production function, the problem is resolved as follows. If the production function happens to exhibit constant returns to scale and the inputs are paid the value of their marginal products, as in (3), the value of output equals the sum of the input values. This product exhaustion follows from Euler's theorem, and it implies that the value shares, S_t^K and S_t^L , sum to one.[10]

[9] For a detailed exposition of this, see Hulten (2000).

[10] However, there is nothing in the sequence of (1) – (5), i.e., leading from the production function to the residual, that requires constant returns (Hulten, 1973). Constant returns are actually required for another purpose: to estimate the return to capital as a residual, as shown by Jorgensen and Griliches (1967). If an

In a nutshell, what the preceding discussion tends to highlight is that the growth accounting method, despite being put under unceasing criticisms since its inception, is still robust and reliable, and thus valid to be used to measure the sources of economic growth of any country. Perhaps, it was for this reason that until recently the same method is utilized by the Asian Productivity Organization (APO) to measure the Asian countries sources of economic growth. To recapitulate, the empirical results of the present study are obtained from APO (2004) publication, which uses the growth accounting method to measure the sources of Asian countries economic growth.

4. Recent Findings

To be precise, the sources of Asian economic growth are estimated using equation (5), and the sample period by period together with the estimated results of the output, input and TFP for 1980-84, 1985-89, 1990-94, 1995-99, and 1980-2000 of the twelve selected Asian countries are shown in Table 2.[11]

As can be seen from the table, with Iran (1985-89) being the only exception, the output growth was positive in all economies during the periods analyzed, and that the estimated contribution of input accumulation to growth was also positive. The TFP growth, however, showed some variations between the economies. While in the case of Japan, the one and only one Asian developed economy, the TFP contributed not only positively but very significantly (i.e., 68.46% per year throughout 1980-2000) to growth, other developing economies including South Korea and Singapore the contribution of TFP was not only far less than that of the Japanese but also negative in some periods. It is, however, quite surprising but interesting to note here that in the seemingly least developed economies like Nepal, India and Vietnam the contribution of TFP to growth was relatively high compared to more developed ones like Malaysia, Thailand and Indonesia. The latter countries are known to have achieved a high level of technology. In the case of India (second huge economy after China), for instance, the contribution of TFP for 1995-99 was 71.21%, which was far higher than the contribution of inputs,

independent measure of the return to capital is used in constructing the share-weights, the residual can be derived without the assumption of constant returns.

[11] The author of this paper has the privilege to have access to the results published by APO by virtue of being a resource person to the Malaysian National Productivity Corporation's (NPC) Macroeconomic Unit, and NPC is one of the APO members.

28.79%. In a huge economy like China, the share of TFP in output growth was about one-fourth that of inputs.

Putting this and other studies results side by side will reveal a number of interesting facts. First, the present study results pertaining to sources of Asian economies growth are closer to reality, simply because it takes into account the impact the of the 1998 financial crisis on the Asian economies, especially ASEAN countries. Specifically, throughout the two-decade periods (1980-2000), the contribution of TFP to growth in these countries was relatively higher, despite the crises of 1980s and 1990s came in the middle. Second, in countries that were "overlooked" by the previous studies the TFP seemed to have been the major contributing factor to their economic growth. India, Vietnam, and Nepal with TFP growth per year of 2.08%, 3.27%, and 1.11%, respectively, were considered high, implying that they were in the process of catching-up with the more developed countries.

Table 2: Sources of Economic Growth, Selected Asian Countries: 1980-2000

		GDP growth rate (%)	Inputs growth rate (%)	TFP growth rate (%)
(1)	**INDIA**			
	1980-84	**3.53**	**2.95** (83.57)	**0.58** (16.43)
	1985-89	**5.33**	**2.70** (50.66)	**2.63** (49.34)
	1990-94	**4.78**	**2.77** (57.95)	**2.01** (42.05)
	1995-99	**6.53**	**1.88** (28.79)	**2.90** (71.21)
	1980-2000	**5.10**	**3.02** (59.22)	**2.08** (40.78)
(2)	**INDONESIA**			
	1980-84	**6.88**	**7.20** (106.65)	**-0.32** (-4.65)
	1985-89	**6.04**	**6.51** (107.78)	**-0.47** (-7.78)
	1990-94	**7.35**	**6.53** (88.84)	**0.82** (11.16)
	1995-99	**1.44**	**5.11** (354.86)	**-3.67** (-254.86)
	1980-2000	**5.40**	**6.20** (114.82)	**-0.80** (-14.82)
(3)	**IRAN**			
	1980-84	**1.78**	**4.19** (235.39)	**-2.41** (-135.39)
	1985-89	**-1.18**	**-0.07** (-5.98)	**-1.25** (105.98)
	1990-94	**6.83**	**2.43** (35.59)	**4.40** (64.41)
	1995-99	**3.11**	**1.96** (63.02)	**1.15** (36.98)
	1980-2000	**2.63**	**2.16** (82.13)	**0.47** (17.87)
(4)	**JAPAN**			
	1980-84	**4.22**	**1.04** (24.64)	**3.18** (75.34)
	1985-89	**4.64**	**1.82** (39.22)	**2.82** (60.78)
	1990-94	**1.02**	**0.42** (41.18)	**0.60** (58.82)
	1995-99	**0.87**	**0.12** (13.80)	**0.75** (86.22)
	1980-2000	**2.60**	**0.82** (31.54)	**1.78** (68.46)

(5)	**ROK**			
	1980-84	**6.51**	**5.76** (88.48)	**0.75** (11.52)
	1985-89	**9.39**	**6.61** (70.40)	**2.75** (29.60)
	1990-94	**7.77**	**6.04** (77.73)	**1.73** (22.27)
	1995-99	**5.18**	**3.11** (60.04)	**2.07** (39.96)
	1980-2000	**7.22**	**5.40** (74.79)	**1.82** (25.21)
(6)	**MALAYSIA**			
	1980-84	**6.87**	**6.13** (89.23)	**0.74** (10.77)
	1985-89	**4.20**	**4.00** (95.24)	**0.20** (4.76)
	1990-94	**9.31**	**5.95** (63.91)	**3.36** (36.09)
	1995-99	**5.12**	**4.80** (93.75)	**0.32** (6.25)
	1980-2000	**6.48**	**5.19** (80.10)	**1.29** (19.90)
(7)	**NEPAL**			
	1980-84	**4.69**	**4.12** (87.85)	**0.57** (12.15)
	1985-89	**5.48**	**4.24** (77.37)	**1.24** (22.63)
	1990-94	**5.43**	**3.16** (58.19)	**2.27** (41.81)
	1995-99	**4.25**	**4.11** (96.71)	**0.14** (3.29)
	1980-2000	**5.04**	**3.93** (77.98)	**1.11** (22.02)
(8)	**PHILIPHINES**			
	1980-84	**1.87**	**4.21** (225.13)	**-2.34** (-125.13)
	1985-89	**2.30**	**1.81** (78.70)	**0.49** (21.30)
	1990-94	**1.28**	**2.96** (231.25)	**-1.68** (-131.25)
	1995-99	**3.96**	**2.93** (73.99)	**1.03** (26.01)
	1980-2000	**2.51**	**2.88** (114.74)	**-0.37** (-14.74)
(9)	**SINGAPORE**			
	1980-84	**7.91**	**8.20** (103.67)	**-0.29** (-3.67)
	1985-89	**6.03**	**4.74** (78.61)	**1.25** (21.39)
	1990-94	**7.74**	**5.41** (69.90)	**2.33** (30.10)
	1995-99	**6.70**	**7.11** (106.12)	**-0.41** (-6.12)
	1980-2000	**7.12**	**6.34** (89.05)	**0.78** (10.95)
(10)	**ROC**			
	1980-84	**7.47**	**7.24** (96.92)	**0.23** (3.08)
	1985-89	**9.08**	**6.19** (68.17)	**2.89** (31.83)
	1990-94	**6.95**	**4.18** (60.14)	**2.77** (39.86)
	1995-99	**5.87**	**4.34** (73.93)	**1.53** (26.07)
	1980-2000	**7.34**	**5.49** (74.80)	**1.85** (25.20)
(11)	**THAILAND**			
	1980-84	**5.30**	**4.93** (93.02)	**0.37** (6.98)
	1985-89	**8.60**	**4.94** (57.44)	**3.66** (42.56)
	1990-94	**8.64**	**6.50** (75.23)	**2.14** (24.77)
	1995-99	**1.18**	**3.34** (283.05)	**-2.16** (-183.05)
	1980-2000	**5.93**	**4.93** (83.14)	**1.00** (16.86)
(12)	**VIETNAM**			
	1980-84	**DNA**	**DNA**	**DNA**
	1985-89	**3.61**	**1.59** (44.04)	**2.02** (55.96)
	1990-94	**6.80**	**2.68** (39.41)	**4.12** (60.59)
	1995-99	**7.66**	**4.44** (57.96)	**3.22** (42.04)
	1980-2000	**6.36**	**3.09** (48.58)	**3.27** (51.42)

Source: Asian Productivity Organization (APO, 2004) and self computations.
DNA = Data Not available.
Figures in the parentheses are the contribution of factor inputs and productivity in percentage terms to the respective countries' economic growth.

Next, we perform a disaggregating analysis where the twelve countries are disaggregated into three sub-samples: East Asian consisting of ROK, ROC, and Japan; South-east Asian (ASEAN) comprising of Malaysia, Singapore, Thailand, Vietnam, the Philippines and Indonesia; and, West Asian made-up of Nepal, Iran and India.

These sub-samples provide an interesting experiment for a study on the different sources of economic growth in Asian countries. Table 3 shows the empirical estimates of the sources of economic growth for the respective sub-samples.

The evidence provided in this paper suggests that the sources of economic growth in a group of Asian countries differ from one another. From the table, it can be seen that the TFP growth rate registered by the ASEAN countries during the 1980-2000 (i.e., 1.00%) was the lowest followed by West Asian countries with a TFP growth rate of 1.22%, and East Asian countries with 1.62%. This tends to suggest that the West Asian countries' or the late-comers, during the entire period, had the ability to efficiently make use of the technology and management know-how acquired from the advanced industrial countries. Indeed, the case for convergence appears to be true.

From the same table, what is also equally interesting is the fact that the 1998 financial crisis-affected countries, especially among the ASEAN, were less able to manage the crisis as compared with another sub-sample countries, East Asian countries. This is evident from the TFP growth rate registered by the former countries as a whole was -0.28% throughout the 1995-99 period, which was far low than that registered by its "counterparts". Thus, in general, the first sub-sample countries did not stand out in terms of levels or improvements in technical efficiency compared to another group of countries.

Concluding this section, based on these results it can safely be said that our finding is not totally in line with that of Young and Krugman, though the methodology used is the same.

Table 3: East Asian, South-east Asian (ASEAN) and West Asian Economies: GDP Growth Rate, Input Growth Rate and TFP Growth Rate (Simple Average)

East Asian

(ROK, ROC, and Japan)

Period	GDP growth rate (%)	Inputs growth rate (%)	TFP growth rate (%)
1980-84	6.07	4.68	1.37
1985-89	7.70	4.87	2.82
1990-94	5.25	3.55	1.50
1995-99	5.31	2.52	1.45
1980-2000	5.72	**3.90** (68.18)	**1.82** (31.82)

South-east Asian (ASEAN)

(Malaysia, Singapore, Thailand, Vietnam, the Philippines and Indonesia)

Period	GDP growth rate (%)	Inputs growth rate (%)	TFP growth rate (%)
1980-84	5.77	6.13	-0.37
1985-89	5.13	3.93	1.19
1990-94	6.85	5.01	1.85
1995-99	4.34	4.62	-0.28
1980-2000	5.63	**4.77** (84.72)	**1.00** (15.28)

West Asian

(Nepal, Iran and India)

Period	GDP growth rate (%)	Inputs growth rate (%)	TFP growth rate (%)
1980-84	3.33	3.75	-0.33
1985-89	3.21	2.29	0.87
1990-94	5.68	2.79	2.89
1995-99	4.63	2.65	1.40
1980-2000	4.26	**3.04** (71.36)	**1.22** (28.63)

Source: Asian Productivity Organization (APO, 2004), and self computations.
Figures in the parentheses are the contribution of factor inputs and productivity, in percentage terms, to the respective countries economic growth.

5. Concluding remark

In this study, it is shown that the sources of Asian economic growth in past two decades or so were not homogeneous. While in some countries the source was input-driven, in some others it was productivity-driven. Specifically, in the case of ASEAN countries, with Vietnam being the only exception, all other countries' source of growth was predominantly input-driven. Obviously, the finding provides little support to Young's and Krugman's, because when the observation was extended to include Vietnam and few West Asian countries the results were in stark contrast to theirs. Thus, we henceforth conclude that the growth of Asian economies was not fundamentally dominated by factor accumulation.

As far as the growth accounting method, which was adopted by the previous and present studies to measure the sources of a country or a group of countries' economic growth and its attributes, is concerned, as aptly put by Hulten (2000), it is still the work horse of empirical growth analysis. For all its flaws, be it real or imagined, as discussed in the measurement issues, many researchers have used it to gain valuable insights into the process of economic growth. Not only thousands of research papers have been published but also the residual (TFP) has consistently become a closely watched government statistics. Indeed, this proves nothing but an evergreen and sustainable forty-year Solow vintage work. Bravo Solow!

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