# AN ASSESSMENT OF TOTAL FACTOR PRODUCTIVITY [1]

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**Abstract**

*The high performing **East Asian development model** sparked controversies in the academia: its success was ascribed alternatively to nation-states, markets, and sociocultural factors. This paper undertakes a comparative assessment of the last two generations of submodels, i.e. ASEAN-4 and China, by quantifying and interpreting their **total factor productivity** (TFP) using the Solow Model. Results show that capital accumulation was their major growth driver before the beginning of the millennium. Subsequently growth is led by **technical change** in ASEAN-32, and capital inputs respectively in late industrialising economies, i.e., China and the Philippines. The main differences between the two submodels consist in levels in growth rates and technical progress contributions, which are strongly sped up in China by transition and integration in global production networks. For ASEAN-4 average null or negligible TFP values in the 1990s point to structural vulnerabilities that surface during the Asian financial crisis. ASEAN-3's recovery is led by technical change though.*

**Key words:** East Asian development model, intermediate states, economic growth, total factor productivity, tehnical change

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The sustainability of the **East Asian development model**, which became emblematic through fast and shared growth, is questioned by the 1997-1998 financial crisis3. The hallmarks of this development model are state activism, reflected in a toolkit of peculiar economic policies4, and shared sociocultural traits. According to

1. Referring to the ASEAN-4 and China. The ASEAN-4 group is made up of four South-East Asian economies, i.e. Thailand, Malaysia, Indonesia, and the Philippines. Alongside Singapore, these countries founded the ASEAN (Association of South-East Asian Nations) regional trading arrangement in 1967, initially purporting to contain communism. Next ASEAN targeted trade liberalisation among member states, but its economic benefits fell short of expectations.

2. ASEAN-3 groups together ASEAN-4 except the Philippines, deemed a less evolved economy.

3. The most affected countries were the ASEAN-4 group and South Korea.

4. Export-oriented development strategies, active industrial policies, concerns for economic macrostability, education and social cohesion policies.

the start of export-oriented industrialisation, four generations of submodels stand out: Japan, the new industrialised economies1 (NIE), ASEAN-4, and China. The last two differentiate themselves from the first through their endowment in natural resources, their higher dependence on the world economy, and less efficient institutions2.

This paper undertakes a comparative analysis of the last two submodels from the angle of a major driver of economic growth, i.e. **total factor productivity** (TFP), which will be quantified and interpreted using the Solow Model. The timeframe runs from the inception of export-oriented industrialisation to the start of the ongoing financial crisis. The first section presents the neoclassical model of growth quantification, the second one applies it to five countries over the period 1971/1981-2006, and interprets their growth rate dynamics, and TFP respectively. The last section concludes on the applications' outcomes.

The neoclassical model for quantifying economic growth [12], [2], [9] is used departing from the following assumptions: (i) there is perfect competition on the goods and production factors markets; (ii) there are just two production factors, i.e. physical capital and labour; (iii) production factors are paid their marginal contributions; (iv) production factors are perfect substitutes. A Cobb Douglas type production function is used:

$$Y_t = A_t K_t^{\beta} L_t^{\alpha} \quad (1)$$

Y represents production, A measures the efficiency of utilising production factors (or total factor productivity, TFP), L - labour, K - physical capital. **The production function** has constant returns to scale, so $\alpha+\beta=1$, where $\alpha$ stands for labour elasticity, $\beta$ - for capital elasticity. For simplification the two elasticities are deemed eqal.

The aggregate economy can be described through relations (2) to (4):

A production function: $Y_t = A_t L_t^{\alpha} K_t^{\beta}$ (2) where $\alpha+\beta = 1$;

A capital stock whose dynamics is captured through:

$K_t = I_{t-1} + K_{t-1}(1-\delta)$ (3) where $\delta$ is the rate of capital depreciation (deemed the same for the whole national economy);

TFP is obtained by deriving the production function function of time:

$$g_t = \frac{\dot{Y}_t}{Y_t} - \alpha\frac{\dot{L}_t}{L_t} - (1-\alpha)\frac{\dot{K}_t}{K_t}$$

TFP dynamics were computed for ASEAN-4 and China. Time horizon: 1971-2006 for Thailand and the Philippines, and 1977/1981-2006 for Indonesia/Malaysia and China respectively. Yearly data were used for gross domestic product (GDP), gross fixed capital formation3 (GFCF), and labour4 (L). The GDP and GFCF data

1. The new industrialised economies (NIE) are Japan, South Korea, Hong Kong, and Singapore.

2. S. the difference between developmental states and intermediate states [3]. Japan and the NIE, which built an institutional scaffolding conducive to development, fall into the former category whilst ASEAN-4 and China vye toward the latter through the inefficiency of their institutional arrangements [4].

3.Data series source: the United Nations Statistics Division.

4 The employed series was sourced from the LABORSTA database of the International Labour Organisation (ILO).

series were denominated in millions of US dollars at 1990 constant prices. In order to compute the capital stock equation (3) was used. To apply the equation it was necessary to determine the initial capital stock, and the rate of capital depreciation. The initial stock of capital was determined by using the information that the capital to output ratio was about 1.2 in the first decade under analysis. The depreciation rate was deemed normal, i.e. 10%.

Over the first three intervals, economic growth was underpinned by capital inputs in contrast with the last perioad, when the share of this factor was null (Thailand) or low (Malaysia and Indonesia), and the recovery was led by tehnical change. On average Thailand outstrips the rest of ASEAN-4 through its TFP levels1. The shift from a near-primary orientation to manufacturing industries2 is captured through high capital growth rates in the 1980s to be consolidated in the 1990s through the pursuit of investment by local companies and transnational corporations (TNC). As the share of capital-intensive industries increases labour contribution decreases accordingly except for Malaysia where it stays constant. The first waves of foreign direct investments (FDI) generate an export boom in the late 1980s, which secures hard currency, and obscures the salience of some major issues such as efficiency and industrial deepening. In the 1990s negligible TFP values suggest the existence of structural problems that would „explode" during the Asian financial crisis (AFC).

**Factors' contribution to economic growth in Thailand, various periods (1971-2006)**

**Table 1**

| Period | Average GDP growth rate | L contribution | K contribution | TFP Dynamics |
|---|---|---|---|---|
| 1971-1980 | 6.8 | 1.3 | 5.2 | 0.3 |
| 1981-1990 | 7.9 | 2.1 | 3.8 | 2.0 |
| 1991-2000 | 4.6 | 0.4 | 4.5 | -0.2 |
| 2001-2006 | 5.0 | 0.7 | 0.0 | 4.3 |

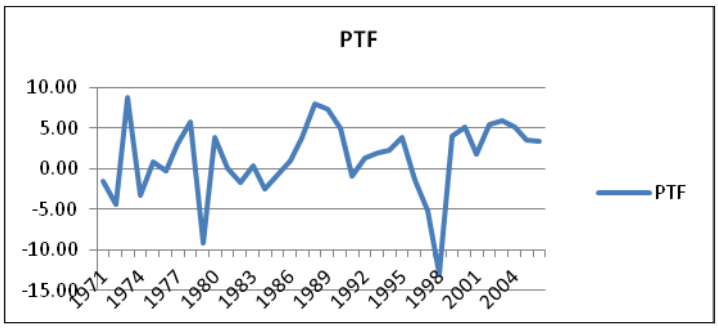
In the 1970s economic growth is due primarily to capital contribution. TFP impact is negligible: the investment boom did not positively impact upon local companies' technological levels. Over the next interval significant improvements in technological progress (superior to the other ASEAN-4), and labour contribution occur against the backdrop of a wave of export-oriented FDI. In the 1990s TFP values reflect a string of structural issues. This decade's rather modest growth rates are due primarily to capital contribution thanks to further investments by both foreign

1. Of all ASEAN-4 Thailand comes closest to NIE's performance, hence the label „the fifth Asian tiger".

2. This structural change of ASEAN-4 economies was precipitated by dwindling prices for primary products in the late 1970s.

businesses, and local conglomerates. The rising share of capital-intensive industries decreases the impact of labour. Over the last interval growth is led by TFP1, and the share of capital is null.

**TFP Dynamics in Thailand, various years (1971-2006)**




TFP lows occur during the oil shocks, the slowdown of the American economy2 of 1991-1992, and the AFC. The most spectacular upward trends coincide with the investment boom of the mid 1980s, and associated exports as well as with the recovery from the regional contagion.

**Factors' contribution to economic growth in Malaysia, various periods (1981-2006)**

**Table 2**

| Period | Average GDP growth rate | L contribution | K contribution | TFP Dynamics |
|---|---|---|---|---|
| 1981-1990 | 5.9 | 1.7 | 4.1 | 0.1 |
| 1991-2000 | 7.2 | 1.7 | 5.0 | 0.5 |
| 2001-2006 | 5.3 | 1.1 | 1.4 | 2.9 |

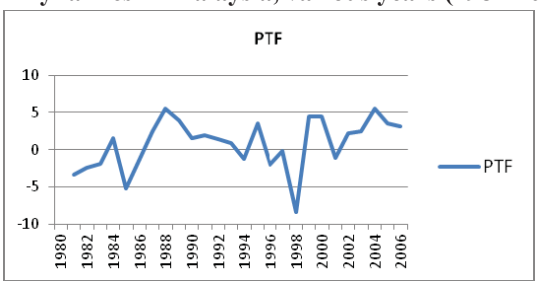
Capital inputs drive growth in the first two decades under investigation as high local and foreign investments fuel export-oriented manufacturing industries. Labour contribution stayed constant, whilst low TFP levels suggest an inferior efficiency in factor use, as well as imminent structural problems that would surface during the AFC. The last period exhibits substantial average growth rates given the predicaments of recovery, and the dotcom crash that impaired performance in major export markets (i.e. the Triad). This time parameter contributions are reversed: economic growth is led by technical progress3, and capital contribution drops significantly.

1. The new Thai administration breaks away from neoliberal policies recommended by the IMF during the AFC. It foregrounds social objectives, and boosting the economy's competitiveness [5].

2. The US is one of ASEAN-4's major export markets [4].

3 This is in keeping with the novel orientation in Malaysia's latest development plan (2001-2010) toward education and technology-intensive industries.

**TFP Dynamics in Malaysia, various years (1981-2006)**




Fuelled primarily by FDI, TFP rises sharply from the mid-1980s, and reaches a first climax towards the end of the decade, which coincides with an export boom. This trend is seriously perturbed by China's emergence as a major investment destination [4]. Two downward portions of TFP are noteworthy: the former occurs during the Asian crisis, and is more pronounced, whereas the latter is mostly due to the 2000-2002 global recession.

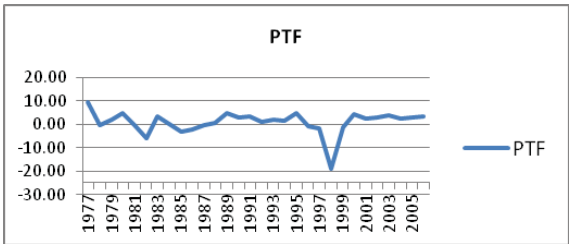
**Factors' contribution to economic growth in Indonesia, various periods (1977-2006)**

**Table 3**

| Period | Average GDP growth rate | L contribution | K contribution | TFP Dynamics |
|---|---|---|---|---|
| 1977-1990 | 6.8 | 1.3 | 4.5 | 1.1 |
| 1991-2000 | 4.4 | 0.9 | 4.2 | -0.6 |
| 2001-2006 | 4.9 | 0.5 | 1.2 | 3.1 |

Substantial growth rates over the first decade under analysis mellow down over the next two intervals. Between the late 1970s and the late 1980s there is a shift from a near-primary sector orientation to basic, and labour-intensive industries respectively [5]. Despite this industrial diversification, TFP is a minor contribution to growth because of investments' low spillover effects. In the 1990s labour contribution comes close to the prior interval, whilst TFP has slipped into negative territory hinting at structural drawbacks, which are primarily related to crony capitalism and its attendant inefficiencies [4], [5], [10]. A slight recovery ensues after the AFC. Economic growth is led by technical progress. The contribution of capital inputs decreases sharply along with labour inputs.

**TFP Dynamics in Indonesia, various years (1977-2006)**



Paradoxically, TFP dynamics hits two lows in the late 1970s, and in the early 1980s respectively: high export revenues from oil and gas do not counterbalance the inefficiency of the conglomerates led by local tycoons [5]. If compared to the other East Asian economies, Indonesia records the sharpest drop in TFP during the 1990s, and is hit the hardest by the AFC [8]. At the outset of the millenium higher TFP levels point to an improvement in input use.

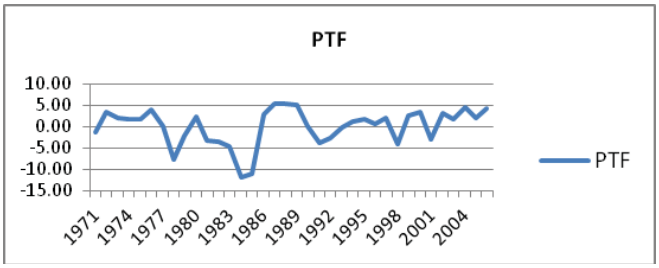
**Factors' contribution to economic growth in the Philippines, various periods (1971-2006)**

**Table 4**

| Period | Average GDP growth rate | L contribution | K contribution | TFP Dynamics |
|---|---|---|---|---|
| 1971-1980 | 5.9 | 2.2 | 3.4 | 0.4 |
| 1977-1990 | 1.8 | 1.9 | 3.7 | -1.5 |
| 1991-2000 | 3.0 | 2.1 | 4.0 | 0.0 |
| 2001-2006 | 4.8 | 1.8 | 4.2 | 2.3 |

Between 1971 and 2006 the Phillipino economy exhibited inferior growth rates relative to the other group members1: high labour inputs, low physical capital levels, and negligible TPF (except for the 1980s when it declines abruptly) are noteworthy. The reasons behind this lag are inefficient macroeconomic management, and delayed start of both industrialisation and institution building which lowered FDI volume, and its positive spillovers. In the 1970s the average growth rate is reasonably high, and is underpinned primarily by exports of primary products. In exchange the mid-1980s recession contracts the economy by over 10%. The recovery proves difficult despite the next two post-Marcos administrations' reforms. However, in the early 1990s first-generation institutional reforms coupled with economic reforms attract FDI, and thus spark economic growth, and industrial diversification. This promising start is perturbed by the AFC. In the early 2000s the recovery of growth rates is due to capital inputs and TFP.

**TFP Dynamics in the Phillipines, various years (1971-2006)**




1. This development gap prompted the exclusion of the Philippines from the HPAE gang ("High Performing Asian Economies") in some analyses.

TFP exhibits three major lows in line with the major recessions of the late 1970s, mid-1980s, and late 1990s. The upward trend1 in the early 1990s is abruptly interrupted by the AFC. Still, at the outset of the millenium TFP grows significantly due to ongoing structural reforms, and rising FDI inflows.

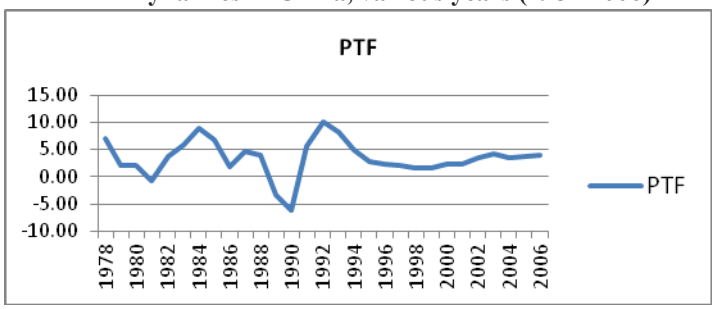
**Factors' contribution to economic growth in China, various periods (1981-2006)**

**Table 5**

| Period | Average GDP growth rate | L contribution | K contribution | TFP Dynamics |
|---|---|---|---|---|
| 1981-1990 | 9.3 | 1.9 | 4.5 | 2.8 |
| 1991-2000 | 10.5 | 0.6 | 5.7 | 4.2 |
| 2001-2006 | 9.5 | 0.5 | 5.7 | 3.4 |

Economic growth rates surpass by far ASEAN-4 levels although the reform of its economic system, and integration in global production networks occurred later, and proceeded gradually[2]. Throughout the period under analysis capital inputs outstrip the other growth sources, whilst labour inputs decrease, which is in keeping with China's evolution towards capital- and technology-intensive industries[3]. In the 1980s the physical capital stock increases dramatically due to government investment in state-owned enterprises (SOE), and FDI enncouragement in several capitalistic enclaves. Substantial TFP levels reflect FDI spillover effects, and profit incentives for local businesses. In the 1990s export-oriented FDI soars, and capital and TFP contributions rise with the „take-off" in processing trade4: China turns into the global industrial workshop thus competing with ASEAN-4. In the early to mid-2000s capital inputs stay constant: foreign companies tend to consolidate their investments, whilst local businesses go global as competition in the home market grows fierce. TFP and labour contributions are slightly lower relative to the prior decade.

**TFP Dynamics in China, various years (1981-2006)**




1. This marks the successful launching of an economic reform package under the Ramos administration.

2. Economic reform gradualism is grounded in an experimental approach, and the concern for safeguarding the political statu quo.

3. This resonates with the foreign investors' orientation, especially those based in the OECD.

4. TNC subsidiaries import parts and components from neighbouring Asian countries, assemble them in China, and export the (semi-)finished products to Triad markets.

TFP records a descending trend during the post-Mao economic adjustment (between the late 1970s and the early 1980s). Another downward portion is triggered by the fall of communism, and the corresponding drop in China's traditional export markets. The most significant upward trends surface after the end of first-generation reforms in the 1980s, and during the 1990s investment boom.

## Conclusions

In ASEAN-3's case growth decomposition by source shows that capital inputs are paramount between 1971/1981-2000, whilst technical change comes to the fore from 2001. In China and the Philippines, which started industrialisation later, capital accumulation sustains growth throughout. For ASEAN-4 negligible or null average TFP values in the 1990s suggest the existence of structural problems foreshadowing the AFC. Technical change leads recovery except for the Philippino economy, the least evolved group member. Ostensibly higher TFP levels in China capture improvements in production factor use that are inherent to transition, and booming industrialisation, both magnified by the integration in global production networks.

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