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Aggregate and Sectoral Productivity Growth in Thailand and Indonesia [*]

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Abstract

Total factor productivity growth is studied in this paper for two countries, Thailand and Indonesia, from 1980 to 2006. The analysis is conducted at both the aggregate and sectoral levels. A feature of the analysis is the decomposition of aggregate total factor productivity growth into two components: productivity growth in individual sectors, and a resource reallocation effect: the movement of resources from low productivity to high productivity sectors. In both countries, virtually all factor productivity growth at the sectoral level derived from agriculture, but the reallocation of resources away from agriculture was a much larger source of aggregate productivity growth.

JEL classifications: O47; Q10; O30

Key words: total factor productivity growth; Thailand; Indonesia.

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1. Introduction

Understanding long-term growth requires distinguishing between increases in the quantities of factors of production employed and improvements in their productivity, an exercise often called growth accounting. The original contribution, Solow (1957), contended that 80 per cent of the long term increase in per capita output in the United States was due to productivity growth and only 20 per cent due to capital accumulation. An enormous literature has ensued. Growth accounting was widely popularized by Paul Krugman (1994), in one of the most famous articles ever written by an economist. Regarding the rapid growth of East Asia, Krugman argued that, in contrast with Solow's findings for the United States, the East Asian growth 'miracle' was due almost entirely to growth in factor inputs; productivity growth was negligible.

Krugman drew out two implications from these findings. First, there was nothing 'miraculous' about Asia's growth, since it derived almost entirely from 'perspiration' (increased factor inputs) coming primarily from greatly increased rates of investment and extension of basic education, rather than 'inspiration' (increased factor productivity). More specifically, the earlier claim by others that Asian productivity had increased because far-sighted industrial policies had generated massive efficiency gains was not credible because there was very little productivity growth to be explained. Second, Krugman claimed that large increases in investment shares over GDP and expansion of basic education were not sustainable indefinitely. A long-term slowdown of growth based on these sources could therefore be expected.

The quantitative basis for Krugman's argument was drawn mainly from earlier empirical work by Young (1994), which dealt with Singapore and Hong Kong. The present paper analyses the sources of growth in Thailand and Indonesia, two countries not covered by Krugman's discussion or by Young's empirical studies and which differ markedly from the

countries studied by Young in that both possess substantial, low-productivity agricultural sectors. In this respect, Thailand and Indonesia are more typical of developing Asian countries than city-based economies like Singapore and Hong Kong, the focus of Young's empirical work, which lack agricultural sectors almost entirely.

It is argued in this paper that generalizations about Asian productivity growth are hazardous when they are based on economies lacking significant agricultural sectors because they necessarily overlook two important points concerning the role of agriculture. The significance of these two points is demonstrated in this paper for the empirical cases of Thailand and Indonesia. First, productivity growth at the sectoral level occurred in their agricultural sectors almost exclusively. Second, quite separately from productivity growth in individual sectors, an even more important source of aggregate productivity growth derived from the movement of resources (mainly labour) out of low-productivity agriculture and into higher productivity non-agricultural sectors – the resource reallocation effect.

We begin with a theoretical decomposition of productivity growth into three components: growth of total factor use adjusted by average productivity; productivity growth in individual sectors; and productivity growth arising from factor reallocation among sectors. The next section illustrates these theoretical arguments with a simple two sector numerical example. The following section applies this framework to data for Thailand and Indonesia.

2. Aggregate and Sectoral Productivity Growth

The objective of this theoretical discussion is first the familiar one of decomposing aggregate output growth into a component due to growth in the use of factor inputs and another due to growth in aggregate total factor productivity. The second objective is to decompose further the aggregate productivity growth component just described into one component due to

growth in productivity in individual sectors and a second due to the reallocation of resources among sectors of differing total factor productivity.[1]

For simplicity, we shall adopt the conventional neo-classical assumptions of constant returns to scale, full employment of factors and disembodied technology at the sectoral level. Let output in sector *j* be given by

$$Y_j = F_j T_j, \tag{1}$$

where F_j is an index of factor use in sector *j* and T_j is an index of total factor productivity in that sector. For example, in the case of the familiar constant returns to scale Cobb-Douglas production function $Y_j = A_j K_j^{\alpha} L_j^{1-\alpha}$, with K_j and L_j denoting capital and labour use in sector *j*, respectively, and $0 \le \alpha \le 1$ denoting the coefficient on capital, $F_j = K_j^{\alpha} L_j^{1-\alpha}$ and $T_j = A_j$.

For simplicity, we will assume that commodity prices are constant[2] and units of measurement of output are chosen such that these commodity prices are all unity. Aggregate output in the economy is given by

$$Y = FT, \tag{2}$$

where F and T are indexes of aggregate factor use and total factor productivity, respectively. Aggregate output is simply the sum of output in the various sectors, $Y = \sum_j Y_j$,

[1] This distinction was apparently first identified empirically by Jorgenson (1988) in the context of US productivity growth.

[2] For example, the economy may be a small trading economy in which both commodity prices are determined exogenously by international prices.

and aggregate factor use is similarly the sum of factor use at the sectoral level, $F = \sum_j F_j$. Aggregate total factor productivity is then defined as $T = Y/F$.[3]

We shall now use lower case Roman letters to denote proportional changes in variables denoted by upper case letters. At the aggregate level, $y = dY/Y = f + t$, and at the sectoral level, $y_j = dY_j/Y_j = f_j + t_j$. The growth of aggregate output is given by

$$y = \sum_j S_j y_j = \sum_j S_j (f_j + t_j) = \sum_j S_j f_j + \sum_j S_j t_j, \tag{3}$$

where $S_j = Y_j/Y$ is the share of total output deriving from sector *j*, $f_j = dF_j/F_j$ is the growth rate of factor use in sector *j* and $t_j = dT_j/T_j$ is the growth rate of productivity in sector *j*. Equation (3) states that the aggregate growth rate can be decomposed into two components, each of which an output-weighted summation of sector-level variables: one due to the growth of factor inputs at the sectoral level ($\sum_j S_j f_j$) and the other due to the growth of total factor productivity (TFPG) in each sector ($\sum_j S_j t_j$).

When TFPG is measured at the sectoral level and then aggregated, the second right hand side term in equation (3) is what is measured. But TFPG measured at the economy-wide level includes more than this. It also includes a component that is buried within the first term. By substituting the identity $T_j = T + T_j - T$ into this first term it can be further decomposed as,

$$\begin{aligned} \sum_j S_j f_j = \sum_j (F_j T_j / FT) f_j &= \sum_j [F_j (T + T_j - T)/Y] f_j . \\ &= T \sum_j dF_j / Y + \sum_j dF_j (T_j - T)/Y , \end{aligned} \tag{4}$$

[3] It should be noted that $T = Y/F = (\sum_j F_j T_j)/(\sum_j F_j)$, and that in general $T \neq \sum_j T_j$.

noting that $F_j f_j = dF_j$.

We can now interpret the two terms on the right hand side of equation (4). Taking the first of these, the growth of total factor use in the economy is given by

$$f = dF/F = \sum_j dF_j/F = T\sum_j dF_j/Y, \tag{5}$$

which corresponds to the first right hand side component of (4). It represents the sum of factor use in individual sectors adjusted by the aggregate level of total factor productivity, T.[4]

Now consider the second term in equation (4). Suppose that *total* factor employment in the economy remains constant. Factor employment at the sectoral level can then change only from the reallocation of factor use among sectors. Then $f = 0$ and from (4)

$$\sum_j S_j f_j = \sum_j F_j f_j (T_j - T)/Y = \sum_j dF_j (T_j - T)/Y. \tag{6}$$

This second term thus corresponds to the growth of output arising from the *reallocation* of factors among sectors of varying total factor productivity.

Now, combining equations (3) and (5),

$$t = y - f = \sum_j S_j t_j + \sum_j F_j f_j (T_j - T)/Y = \sum_j S_j t_j + \sum_j dF_j (T_j - T)/Y. \tag{7}$$

That is, in summary,

[Aggregate TFPG] = [growth of aggregate output]

[4] It is important to note that, in general, $f \neq \sum_j S_j f_j$.

- [growth of total factor use adjusted by aggregate factor productivity]

= [weighted sum of TFP growth within individual sectors]

+ [productivity growth from factor reallocation among sectors]. (8)

The last component of this expression, referred to here as *the resource reallocation effect*, is commonly overlooked. It can be non-zero when the levels of total factor productivity differ among sectors differ (the $T_j - T$ terms are non-zero) and when there is a change in the allocation of factors among these sectors (the dF_j terms are non-zero). The relevance of this result is that total factor productivity growth at the aggregate level, defined as the difference between the growth rate of total output and the growth rate of total factor inputs, $t = y - f$, is not just the weighted sum of total factor productivity growth in the various sectors, $\sum_j S_j t_j$. It also includes the efficiency effect of resource movement among sectors of differing levels of total factor productivity. When factors move from sectors of lower to higher productivity, this component is positive, contributing to aggregate growth.

This result applies at any level of aggregation, provided the number of sectors is at least two. Moreover, the same issue arises within sectors. Because sectoral output is always an aggregate of various sub-sectors (themselves ultimately aggregates of firm-level data), this distinction between TFP growth at an aggregate level and productivity growth at a disaggregated level is always present.

3. A Numerical Illustration

Not all readers are convinced by purely theoretical arguments and a numerical illustration can be helpful. In the present context, a hypothetical numerical example can confirm that the

resource reallocation effect, described above, exists and that it can be quantitatively significant. Consider an economy with two sectors, agriculture and industry, where output prices are constant, as above, normalized at unity by choice of units of measurement. Let both sectors have Cobb-Douglas production functions with constant returns to scale and let each sector use a single mobile factor (labour) and a single sector-specific factor (land in agriculture and capital in industry).

The agricultural production function is $Y_1 = T_1 L_1^{1/2} \overline{H}^{1/2}$, where Y_1 is agricultural output, L_1 is its use of labour, $\overline{H}$ is its fixed supply of land and the level of total factor productivity in agriculture is T_1. The production function in industry is $Y_2 = T_2 L_2^{1/2} \overline{K}^{1/2}$, where terms are defined similarly and $\overline{K}$ is the fixed supply of capital. The economy-wide supply of labour is fixed and normalized at unity, as are the supplies of the industry-specific factors land and capital.

The initial position of the economy is summarized in the first column of Table 1: 70% of the labour is in agriculture, 30% in industry and the level of total factor productivity in agriculture is 1, whereas in industry it is 2. It is important that this position is not an equilibrium in that the value of the marginal product of labour in agriculture is well below that in industry (last four rows of the table). In empirical studies of developing economies, this is a common finding. There is an incentive for labour to relocate from agriculture to industry, but the long-term persistence of an observed disparity in sectoral returns to labour, despite labour mobility, means that the process of labour relocation occurs slowly.

Now consider three changes to this initial position. We choose small changes for this illustration to minimize the conflict between the infinitesimal changes described in the calculus derived above and the discrete changes required for a fully described numerical example. In the first (Example 1) total factor productivity in agriculture increases to 1.01 (TFPG is 1%) but there is no productivity growth in industry. The employment shares remain unchanged at 70:30. When the economic statistician observes this change and calculates total

factor productivity at the economy-wide level ($t = y - f$) she obtains the result of 0.433 per cent, which is identical to the weighted sum of total factor productivity growth in the two sectors ($S_1 t_1 + S_2 t_2$). Because there is no factor movement, the factor reallocation effect is zero. It should be noted that in spite of the increased productivity in agriculture, the marginal product of labour still exceeds that in industry and the incentive for labour to move out of agriculture persists.

In Example 2 labour moves out of agriculture into industry and employment shares change to 69:31. There is no productivity growth in any sector. The weighted sum of total factor productivity growth in the two sectors ($S_1 t_1 + S_2 t_2$) is therefore zero. But aggregate factor productivity ($T = Y / F$) increases and this consists entirely of the factor reallocation effect. It arises because labour is moving to a more productive use. The economic statistician observes that at the aggregate economy-wide level total factor productivity has increased but factor productivity has not increased in any individual sector.

Example 3 is a combination of Examples 1 and 2. There is the same 1% productivity shock in agricultural production alone, but there is in addition a movement of labour out of agriculture, again leaving the employment shares 69:31. Output in agriculture declines, because of the exit of labour and despite the increased productivity, and output rises in industry because of the inflow of labour. The weighted sum of productivity growth in the two sectors, $S_1 t_1 + S_2 t_2$, is 0.433 per cent, but the increase in aggregate factor productivity is 0.836 per cent. The difference is the factor reallocation effect, 0.403 per cent, which is 48 per cent of aggregate TFPG.

The numerical examples thus confirm the analytical result given by equations (7) and (8) above: aggregate TFPG ($t = y - f$) is given by the weighted sum of TFP growth within individual sectors ($S_1 t_1 + S_2 t_2$) plus the resource reallocation effect – aggregate productivity growth from factor reallocation among sectors of varying levels of total factor productivity, ($[dF_1(T_1 - T) + dF_2(T_2 - T)]/Y$).

4. Productivity Growth in Thailand and Indonesia[5]

This section applies data on factor employment by sector in Thailand and Indonesia to study rates of total productivity growth by sector.[6] The data include:

- physical capital used by sector;
- employment of labour by educational category by sector;
- use of land in agriculture by extent of irrigation coverage; and
- cost shares for each of the above factors of production by sector.

The data set covers the years 1980 to 2006 and identifies the sectors agriculture, industry and services. In the case of Indonesia, the mining industry, including petroleum, is also identified separately, because of its special importance for Indonesia. The data set assembled for this purpose allows for improvement in the 'quality' of labour and land used by each sector. This is done, in the case of labour, by constructing a separate factor, human capital, equal to the aggregate value of labour inputs minus the value of its unskilled labour component. The unskilled labour component is calculated by taking the number of workers and multiplying this number by unskilled wage rates. Data on labour use by educational category are used for this purpose and the results are then aggregated. The higher growth rate of human capital that is observed for Thailand than for Indonesia reflects the higher level of

[5] Useful background studies on productivity and economic growth in these two countries are, for Thailand, Sussangkarn and Tinakorn (1998), Vines and Warr (2003) and Warr (2005) and for Indonesia Aswicahyono and Hill (2002), Fuglie (2004) and Jacob and Meikster (2005).

[6] Kind assistance with the raw data used in this analysis was provided by Pranee Tinakorn of Thailand Development Research Institute and Thammasat University, Bangkok, and from Kirida Bhaopichitr and David Robalino of the World Bank Office, Bangkok.

educational investment that occurred in Thailand.[7] For land, the 'quality adjusted' data set uses land price data for irrigated and non-irrigated land to form quality adjusted measures of the use of land in agriculture and therefore in the total economy.

The growth of output and the use of factors of production is summarized in Tables 2 and 3 for Thailand and Indonesia, respectively. In Tables 4 and 5 these data are then used to construct factor growth rates for each of the two countries over the following four sub-periods as well as the whole period of 1980 to 2006:

Pre-boom – 1980 to 1986

Boom – 1987 to 1996

Crisis – 1997 to 1998

Recovery – 1999 to 2006.

Standard growth accounting methods with time-varying cost shares were used to estimate rates of total factor productivity growth using the data summarized in Tables 2 to 5. The averages of these cost shares over the whole period are summarized in Table 6. The cost shares vary over time and were constructed from data on factor prices and input use by sector.[8] Finally, Tables 7 and 8 show the results of the calculations of total factor productivity.

The results for Thailand shown in Table 7 may be summarized as follows. First, over the two and a half decades 1980 to 2006, aggregate GDP grew at an average annual rate of 6 per cent, but measured TFG growth at the aggregate level accounted for only one tenth of

[7] The data on human capital for Thailand reflect some anomalies, such as the sudden drops in 1984 and 1986. Partly because of data errors of this kind, calculations of TGPG are more meaningful when presented over medium to long time periods, than on an annual basis.

[8] Tables 4 and 5 show that in both Thailand and Indonesia the growth rates of human capital in agriculture are comparable with other sectors. But in both countries, agriculture started with very low levels of human

that growth. Growth of factor inputs accounted for the other 90 per cent. Growth of the physical capital stock was the overwhelming component of this increased level of factor inputs.

Second, although output (value added) grew more slowly in agriculture (2.64 per cent) than in either industry (8.09 per cent) or services (5.53 per cent) it was the only major sector to record positive TFP growth. This TFP growth in agriculture contributed one twentieth of the overall growth of GDP. In agriculture, the growth of output of 2.64 per cent per year was achieved by factor input growth of 0.47 per and TFP growth of 2.17 per cent (Table 7). TFP growth therefore accounted for 82 per cent of the growth of value-added in agriculture.

Third, the *level* of factor productivity in agriculture remained significantly lower than elsewhere in the economy, despite its higher TFP *growth* over this period. The movement of factors of production out of agriculture, shown in Figures 1 and 2, thus further contributed to economic growth by raising the productivity of these factors. Indeed, this reallocation effect contributed 24 per cent of the growth of aggregate output that actually occurred. For example It was almost *five times* as important for overall growth as the growth in the productivity of the factors that remained within agriculture. TFP growth in agriculture thus contributed to economic growth by making it possible for factors to be reallocated to more productive uses without a contraction in agricultural output.

The story for Indonesia, summarized in Table 8, is qualitatively similar. Agriculture was the only sector to record positive TFP growth. This productivity increase accounted for 30 per cent of the actual growth of value-added in agricuture and for 3.5 per cent of overall economic growth. However, the reallocation effect, involving the movement of resources out of agriculture, as depicted in Figures 3 and 4, was more than four times as important for overall growth as this, contributing 16 per cent of the overall growth of GDP that occurred.

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capital. This is reflected in the cost shares. Table 6 shows that for both countries the average values of these cost shares in agriculture are much lower than for other sectors.

During the 'boom' period of 1987 to 1996 TFPG was significant for agriculture but the 'reallocation effect' was also significant. Part of the growth of agricultural productivity was reflected in increased output, part in the release of resources to the non-agricultural sectors where their level of productivity was higher.

The Asian financial crisis and the subsequent protracted recovery was dominated by a contraction of aggregate demand, rather than any supply-side issue. As Tables 7 and 8 show, measured productivity growth in agriculture in both Thailand and Indonesia was maintained during this period, but this says more about the limited contraction in demand that was experienced for agricultural products than any supply-side issue.

Growth accounting focuses on supply-side determinants of output. During the first two periods (1980 – 1986 and 1987 – 1996) output was primarily supply-constrained; aggregate demand was not the binding constraint on output and factors of production were more or less fully employed. However, the crisis and recovery periods from 1997 onwards were characterized by a deficiency of aggregate demand, reflected in unemployment and unused capacity. Although the data for this period are included in this paper, it is debatable whether a growth accounting framework, which focuses on the determinants of aggregate supply, is relevant for such periods.

Finally, Table 9 summarizes the overall contributions to economic growth over the pre-crisis period of 1980 to 1996, as well as the full time period covered by the data, 1980 to 2006. Two empirical findings stand out. First, in both countries agriculture was the only major sector to experience significant total factor productivity growth. Second, in both Thailand and Indonesia, the resource reallocation effect made a far larger contribution to overall aggregate factor productivity growth, and to overall economic growth, than total factor productivity growth in any individual sector, or in all sectors combined.

5. Conclusions

The analysis of this paper indicates that agriculture's contribution to economic growth in both Thailand and Indonesia included impressive rates of TFP growth. But its main contribution occurred through releasing resources which could be used more productively elsewhere, while still maintaining output, rather than through expansion of agricultural output. It is seriously wrong to characterize agriculture in these countries as 'stagnant', based merely on the fact that output growth is slower in agriculture than in other sectors. If agriculture had really been 'stagnant' economic growth would have been substantially lower because it would not have been possible to raise productivity significantly within agriculture or to release resources massively while still maintaining moderate growth of agricultural output.

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Appendix: Data Sources

Thailand:[9]
Real GDP by sector: data from National Accounts Division, National Economic and Social Development Board, Bangkok.
Capital stocks: data from Macroeconomic Analysis Division, National Economic and Social Development Board, Bangkok. Land use in non-agricultural sectors is treated as a component of the capital stock.
Employment by sector and educational category: data from Labour Force Survey of Thailand, National Statistical Office, Bangkok.
Wages by sector and educational category: data from Labour Force Survey of Thailand, National Statistical Office, Bangkok.
Land use in agriculture: data on irrigated and non-irrigated land use from the Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok.

Indonesia:[10]
Real GDP by sector: data from *Indikator Ekonomi*, Central Bureau of Statistics, Jakarta, various issues.
Capital stocks, constructed using inventory accumulation method, from 1969, using data from *Indikator Ekonomi*, various issues. Land use in non-agricultural sectors is treated as a component of the capital stock.

Labour force in various categories by sector: data employment levels from *Labour Force Situation in Indonesia*, Central Bureau of Statistics, Jakarta, various issues. Aggregated from published categories as follows: Raw labour = No schooling + Not yet completed primary school + primary school. Human capital = higher educational categories minus raw labour component.
Land use in agriculture: data on irrigated and non-irrigated land use from Ministry of Agriculture, Jakarta.

[9] Kind assistance with the raw data used in this analysis was provided by Pranee Tinakorn of Thailand Development Research Institute and Thammasat University, Bangkok, and from Kirida Bhaopichitr and David Robalino of the World Bank Office, Bangkok.

[10] Assistance with the raw data used and the subsequent statistical analysis was provided by Arief Ramayandi of the Australian National University.

Table 1 Numerical Illustration

	Initial value	Example 1	Example 2	Example 3
Level of variable				
L_1	0.70	0.70	0.69	0.69
L_2	0.30	0.30	0.31	0.31
$L = L_1 + L_2$	1	1	1	1
T_1	1.00	1.01	1.00	1.01
T_2	2	2	2	2
H	1	1	1	1
K	1	1	1	1
$Y_1 = T_1 L_1^{1/2} \overline{H}^{1/2}$	0.837	0.845	0.831	0.839
$Y_2 = T_2 L_2^{1/2} \overline{K}^{1/2}$	1.095	1.095	1.114	1.114
$Y = Y_1 + Y_2$	1.932	1.940	1.944	1.953
$F_1 = Y_1 / T_1$	0.837	0.837	0.831	0.831
$F_2 = Y_2 / T_2$	0.548	0.548	0.557	0.557
$F = F_1 + F_2$	1.384	1.384	1.387	1.387
$T = Y / F$	1.396	1.402	1.401	1.407
$S_1 = Y_1 / (Y_1 + Y_2)$	0.433	0.435	0.427	0.430
$S_2 = Y_2 / (Y_1 + Y_2)$	0.567	0.565	0.573	0.570
Percentage change from initial value				
$l_1 = 100 dL_1 / L_1$		0	-1.429	-1.429
$l_2 = 100 dL_2 / L_2$		0	3.333	3.333
$t_1 = 100 dT_1 / T_1$		1.000	0	1.000
$t_2 = 100 dT_2 / T_2$		0	0	0.000
$y_1 = 100 dY_1 / Y_1$		1.000	-0.717	0.276
$y_2 = 100 dY_2 / Y_2$		0.000	1.653	1.653
$y = dY / Y = S_1 y_1 + S_2 y_2$		0.433	0.627	1.057
$f_1 = 100 dF_1 / F_1$		0	-0.717	-0.717
$f_2 = 100 dF_2 / F_2$		0	1.653	1.653
$f = 100 dF / F$		0	0.221	0.221
$t = y - f$		0.433	0.406	0.836
$S_1 t_1 + S_2 t_2$		0.433	0.000	0.433
$[dF_1 (T_1 - T) + dF_2 (T_2 - T)] / Y$		0	0.406	0.403
Memo item: marginal productivity of factors				
$\partial Y_1 / \partial L_1$	0.598	0.604	0.602	0.608
$\partial Y_1 / \partial H$	0.418	0.423	0.415	0.419
$\partial Y_2 / \partial L_2$	1.826	1.826	1.796	1.796
$\partial Y_2 / \partial K$	0.548	0.548	0.557	0.557

Source: Author's calculations.

Table 2 Thailand: Growth of Output and Factor Supplies, 1980 to 2006 (1980 = 100)

Year	Real GDP	Raw labour	Human capital	Physical capital	Agricultural land
1980	100	100	100	100	100
1981	105.9	108.2	100.17	106.2	108.2
1982	111.6	110.2	121.32	112.2	110.2
1983	117.8	111.8	117.45	119.6	111.8
1984	124.6	115.4	53.94	127.5	115.4
1985	130.4	114.8	158.38	134.7	114.8
1986	137.6	118.5	44.24	141.8	118.5
1987	150.7	122.7	661.10	150.7	122.7
1988	170.7	130.8	787.00	162.7	130.8
1989	191.5	136.0	737.85	178.3	136.0
1990	212.9	137.0	947.34	200.0	137.0
1991	231.1	138.3	1419.23	224.9	138.3
1992	249.8	143.9	1924.73	251.8	143.9
1993	270.4	142.8	2267.78	281.3	142.8
1994	294.7	142.6	2383.25	314.6	142.6
1995	321.9	144.7	2549.28	350.3	144.7
1996	340.9	143.2	2687.29	389.5	143.2
1997	336.3	147.3	2973.03	417.9	147.3
1998	300.9	142.8	3152.76	428.7	142.8
1999	314.3	137.0	3091.01	437.7	137.0
2000	329.2	139.7	3323.67	447.4	139.7
2001	336.4	142.6	3571.19	455.2	142.6
2002	354.3	146.9	3864.10	463.6	146.9
2003	379.6	150.4	4157.69	474.0	150.4
2004	403.6	154.3	4475.94	487.2	154.3
2005	421.9	156.6	4754.81	502.9	156.6
2006	443.5	155.8	4942.42	519.4	155.8

Sources:
Real GDP by sector: data from National Accounts Division, National Economic and Social Development Board, Bangkok.
Capital stocks: data from Macroeconomic Analysis Division, National Economic and Social Development Board, Bangkok.
Employment by sector and educational category: data from Labour Force Survey of Thailand, National Statistical Office, Bangkok. Human capital = higher educational categories minus raw labour component.
Wages by sector and educational category: data from Labour Force Survey of Thailand, National Statistical Office, Bangkok.
Land use in agriculture: data on irrigated and non-irrigated land use from the Office of Agricultural Economics, Ministry of Agriculture and Cooperatives, Bangkok.

Table 3 Indonesia: Growth of Output and Factor Supplies, 1980 to 2006 (1980 = 100)

Year	Real GDP	Raw labour	Human capital	Physical capital	Agricultural land
1980	100	100	100	100	100
1981	107.5	107.3	110.2	98.5	101.3
1982	108.8	114.6	119.7	106.2	101.2
1983	113.1	119.6	134.7	112.2	101.2
1984	120.1	124.7	148.6	119.1	101.1
1985	131.1	129.8	161.4	119.3	99.2
1986	138.8	134.9	173.1	200.5	104.2
1987	146.1	141.4	203.6	220.3	108.3
1988	155.1	147.6	217.6	265.5	113.0
1989	167.0	149.7	207.5	326.6	114.4
1990	178.9	150.2	240.0	502.3	115.5
1991	191.1	151.3	233.7	580.3	117.0
1992	204.3	155.6	240.3	626.3	109.4
1993	217.8	157.0	267.2	666.8	109.4
1994	255.8	162.6	267.3	796.9	111.2
1995	276.8	159.2	288.0	984.4	111.1
1996	298.4	170.3	305.4	1134.2	111.6
1997	312.4	173.1	340.7	1321.5	112.3
1998	271.4	179.1	278.1	1332.5	112.6
1999	273.7	183.0	286.9	1289.5	112.6
2000	286.8	177.8	331.2	1311.1	112.6
2001	296.9	179.8	397.1	1285.8	112.6
2002	307.8	181.4	419.6	1204.3	112.6
2003	322.6	186.4	449.3	1362.7	112.6
2004	338.7	191.6	481.0	1541.9	112.6
2005	358.0	197.0	515.0	1744.6	112.6
2006	377.7	202.4	551.5	1974.0	112.6

Sources:
Real GDP by sector: data from *Indikator Ekonomi*, Central Bureau of Statistics, Jakarta, various issues.
Capital stocks, constructed using inventory accumulation method, from 1969, using data from *Indikator Ekonomi*, various issues.
Labour force in various categories by sector: data employment levels from *Labour Force Situation in Indonesia*, Central Bureau of Statistics, Jakarta, various issues. Aggregated from published categories as follows: Raw labour = No schooling + Not yet completed primary school + primary school. Human capital = higher educational categories minus raw labour component.
Land use in agriculture: data on irrigated and non-irrigated land use from Ministry of Agriculture, Jakarta.

Table 4 Thailand: Factor growth rates, 1980 to 2006 (per cent per year)

	Pre-boom 1980-1986	Boom 1987-1996	Crisis 1997-1998	Recovery 1999-2006	Whole period 1980-2006
All sectors:					
1. Labour	2.91	1.94	-0.10	1.12	1.75
2. Human capital	0.14	3.32	2.45	1.65	2.10
3. Physical capital	5.99	10.61	1.68	2.43	6.61
4. Agricultural land	1.91	0.51	0.60	-0.02	0.35
Agriculture:					
1. Labour	1.96	0.07	-2.20	-4.19	-0.40
2. Human capital	3.45	3.32	2.45	1.47	2.04
3. Physical capital	1.41	4.49	-4.33	-1.70	1.72
4. Agricultural land	1.91	0.51	0.60	0.59	0.92
Industry:					
1. Labour	3.55	7.89	3.24	2.79	5.36
2. Human capital	1.77	3.08	3.10	1.64	2.46
3. Physical capital	9.60	13.47	6.39	4.30	10.11
Services:					
1. Labour	6.22	3.82	1.81	7.83	5.02
2. Human capital	2.89	1.32	2.05	0.87	1.73
3. Physical capital	5.80	10.36	3.89	3.12	7.21

Source: Author's calculation from data in Table 1.

Table 5 Indonesia: Factor growth rates, 1980 to 2006 (per cent per year)

	Pre-boom 1980-1986	Boom period 1987-1996	Crisis 1997-1998	Recovery 1999-2006	Whole period 1980-2006
All sectors:					
1. Labour	3.22	2.39	2.54	1.47	2.78
2. Human capital	20.49	6.07	-3.40	9.90	7.07
3. Physical capital	14.50	19.54	8.67	6.57	13.15
4. Agricultural land	1.17	0.40	0.11	0.00	0.48
Agriculture:					
1. Labour	3.48	0.12	5.71	-0.63	1.50
2. Human capital	10.65	8.25	-5.19	17.55	9.43
3. Physical capital	3.29	19.08	4.13	-6.67	8.50
4. Agricultural land	1.17	0.40	0.11	0.00	0.48
Mining:					
1. Labour	10.18	6.05	2.45	3.96	6.63
2. Human capital	13.94	8.61	-8.46	8.97	8.81
3. Physical capital	5.23	9.59	-10.04	-5.04	4.01
Industry:					
1. Labour	6.00	6.88	0.64	2.18	5.25
2. Human capital	13.07	13.67	-8.37	12.39	11.35
3. Physical capital	16.67	19.33	10.27	-3.06	13.84
Services:					
1. Labour	4.99	4.04	0.58	0.84	3.47
2. Human capital	9.16	6.25	2.98	6.51	6.90
3. Physical capital	16.13	28.90	5.22	3.13	18.47

Source: Author's calculation from data in Table 2.

Table 6 Thailand and Indonesia: Average Cost Shares, 1980 to 2006 (per cent)

	Raw labour	Human capital	Physical capital	Agricultural land
Thailand				
All sectors	0.402	0.112	0.469	0.018
Agriculture	0.590	0.039	0.130	0.241
Industry	0.304	0.120	0.576	0.000
Services	0.310	0.092	0.598	0.000
Indonesia				
All sectors	0.610	0.095	0.234	0.061
Agriculture	0.594	0.029	0.060	0.318
Mining	0.315	0.280	0.365	0.000
Industry	0.290	0.199	0.511	0.000
Services	0.782	0.113	0.105	0.000

Table 7 Thailand: Total Factor Productivity Growth, 1980 to 2006 (per cent per year)

	Pre-boom 1980-1986	Boom 1987-1996	Crisis 1997-1998	Recovery 1999-2006	Whole period 1980-2006
All sectors:					
1. Output growth	5.46	9.50	-5.93	4.98	6.00
2. Factor growth	4.60	7.50	3.11	3.55	3.97
3. TFP growth	0.86	2.00	-9.03	1.43	2.03
Agriculture:					
1. Output growth	3.61	2.67	-0.33	2.58	3.11
2. Factor growth	3.83	0.15	-1.44	-2.84	1.19
3. TFP growth	-0.22	2.52	1.10	5.42	1.92
Industry:					
1. Output growth	6.72	12.77	-7.70	6.32	7.84
2. Factor growth	8.23	12.26	6.37	4.40	7.92
3. TFP growth	-1.50	0.51	-14.07	1.92	-0.08
Services:					
1. Output growth	5.43	9.01	-5.44	2.45	5.49
2. Factor growth	6.86	7.99	3.88	6.53	6.14
3. TFP growth	-1.43	1.03	-9.32	-4.08	-0.65
All sectors:					
1. Aggregate sectoral TFPG	-1.22	1.02	-10.28	-0.43	-0.07
2. Reallocation	2.08	0.99	1.25	1.86	2.10

Source: Author's calculations.

Table 8 Indonesia: Total Factor Productivity Growth, 1980 to 2006 (per cent per year)

	Pre-boom 1980-1986	Boom period 1987-1996	Crisis 1997-1998	Recovery 1999-2006	Whole period 1980-2006
All sectors:					
1. Output growth	6.07	8.00	-4.21	4.20	5.16
2. Factor growth	6.28	7.01	4.22	2.05	5.26
3. TFP growth	-0.22	0.99	-8.44	2.15	-0.10
Agriculture:					
1. Output growth	4.07	3.59	-0.16	2.90	3.00
2. Factor growth	3.05	1.85	2.89	1.96	2.10
3. TFP growth	1.02	1.74	-3.05	0.94	0.90
Mining:					
1. Output growth	1.11	3.93	-0.32	2.55	3.08
2. Factor growth	10.48	11.44	-2.23	1.90	7.10
3. TFP growth	-9.37	-7.52	1.91	0.65	-4.02
Industry:					
1. Output growth	11.56	12.44	-5.43	4.93	8.85
2. Factor growth	11.91	14.91	7.09	0.50	10.00
3. TFP growth	-0.34	-2.48	-12.52	4.43	-1.15
Services:					
1. Output growth	6.94	8.30	-5.44	4.18	5.89
2. Factor growth	6.62	7.30	2.90	4.30	6.03
3. TFP growth	0.31	0.99	-8.34	-0.12	-0.14
All sectors:					
1. Aggregate sectoral TFPG	-1.00	-0.72	-7.89	1.90	-0.85
2. Reallocation effect	0.78	1.71	-0.54	0.25	0.75

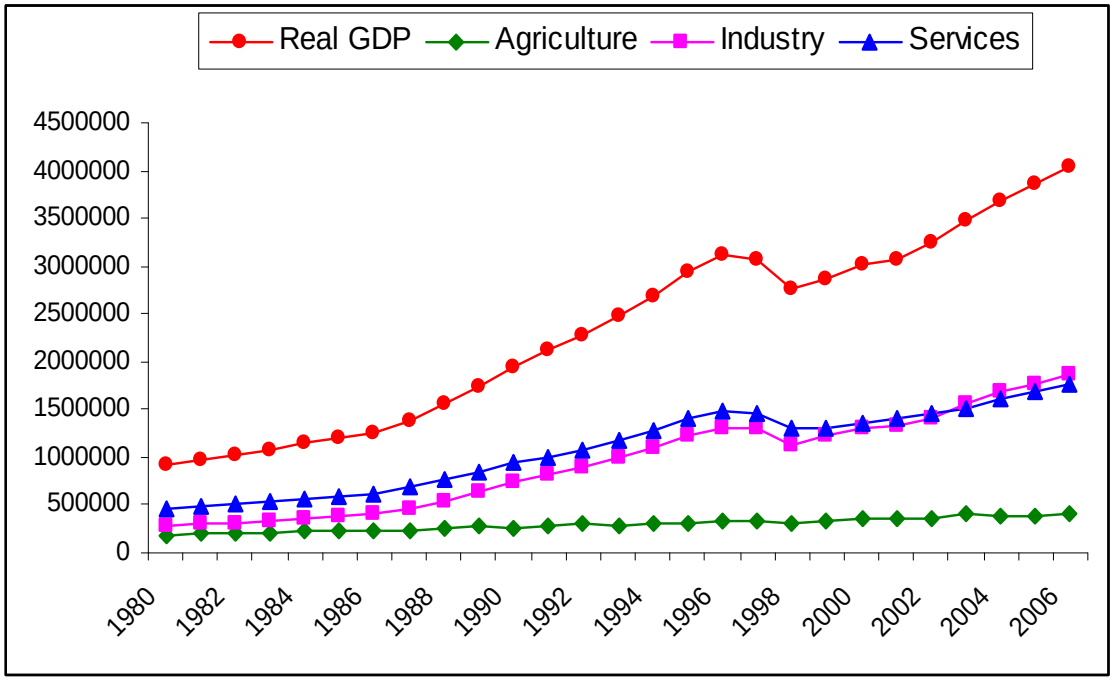
Source: Author's calculations.

Table 9 Thailand and Indonesia: Contributions to Economic Growth, 1980 - 2006 (per cent)

	Thailand		Indonesia	
	Pre-crisis period 1980-1996	Whole period 1980-2006	Pre-crisis period 1980-1996	Whole period 1980-2006
Aggregate factor growth	80.20	66.17	93.12	101.94
Aggregate TFP growth	19.80	33.83	6.88	-1.94
Sectoral TFP growth	2.50	-1.17	-10.60	-16.47
Agriculture TFP growth	2.90	4.48	4.61	2.85
Mining TFP growth	-	-	-13.64	-8.32
Industry TFP growth	-1.10	-0.52	-5.56	-10.00
Services TFP growth	0.70	-5.13	3.99	-1.00
Reallocation effect	17.30	35.00	17.48	14.53
Total	100	100	100	100

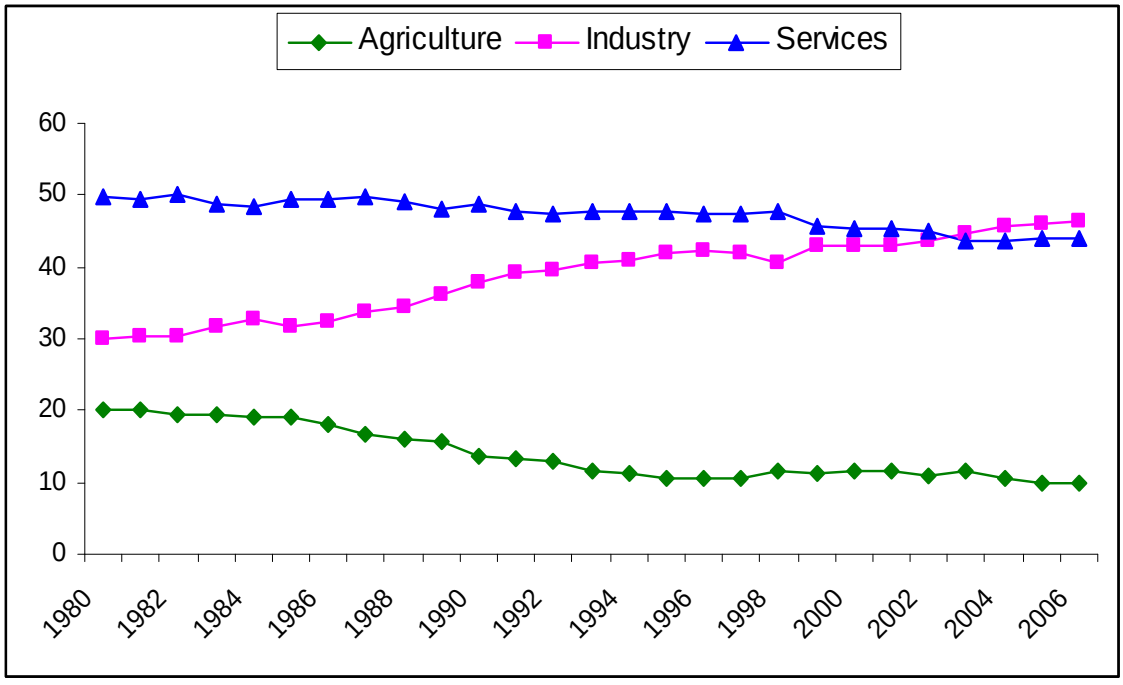
Source: Author's calculations.

Figure 1 Thailand: Real GDP and its Sectoral Components, 1980 to 2006



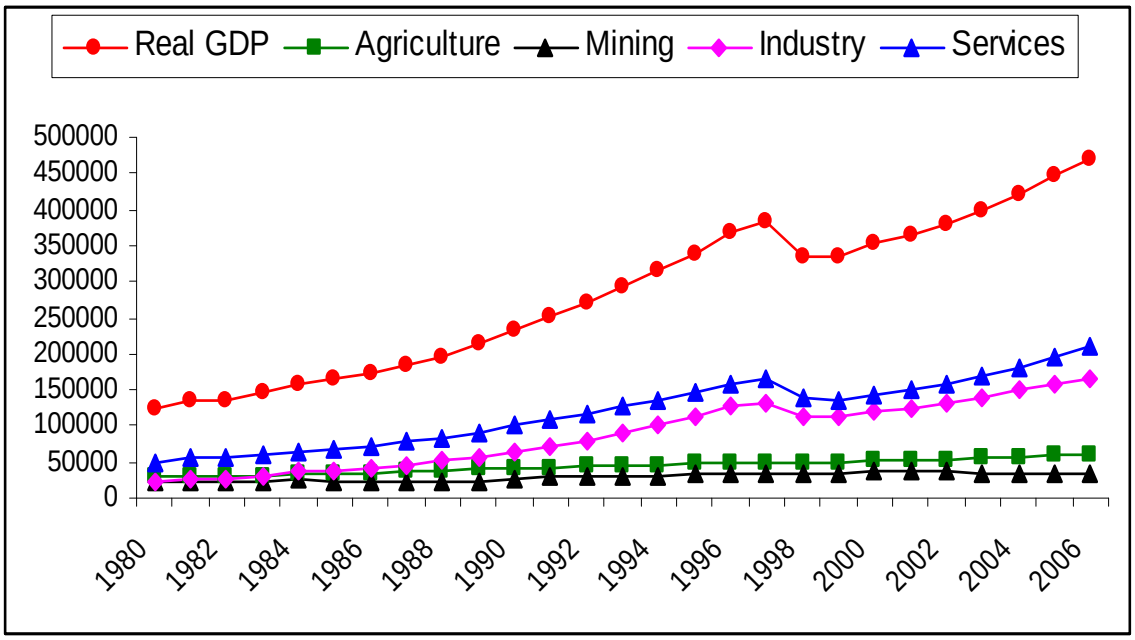
Source: National Economic and social Development Board, Bangkok.

Figure 2 Thailand: Sectoral Composition of GDP, 1980 to 2006



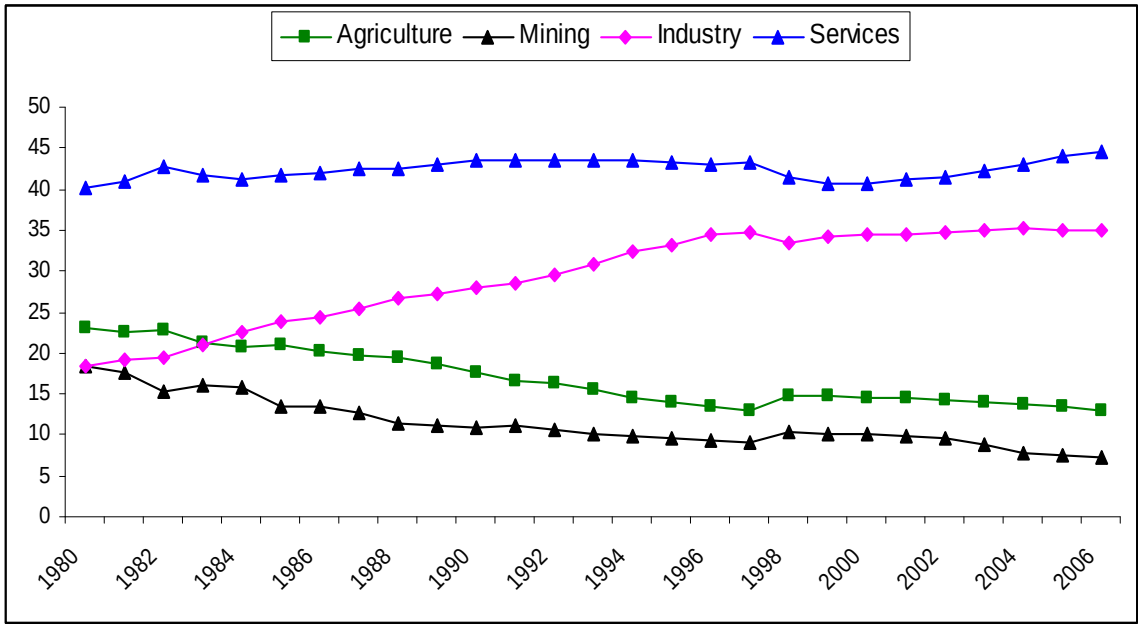
Source: National Economic and social Development Board, Bangkok.

Figure 3 Indonesia: Real GDP and its Sectoral Components, 1980 to 2006



Source: Indikator Ekonomi, Central Bureau of Statistics, Jakarta, various issues.

Figure 4 Indonesia: Sectoral Composition of GDP, 1980 to 2006



Source: Indikator Ekonomi, Central Bureau of Statistics, Jakarta, various issues.

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