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How Krugman forgot agriculture and misread the sources of Asia's growth*

Peter Warr

In his famous 1994 essay 'The Myth of Asia's Miracle', Paul Krugman argued that the growth of output per person in Asia was due almost entirely to increasing primary factor inputs per head of population – raising labour force participation and adding capital to labour. He called this 'perspiration', which he distinguished from 'inspiration' – productivity growth derived from technical change. According to Krugman's sources, the latter contributed very little. The article rightly discounted the 'miracle' rhetoric that had been applied to Asia's rapid economic growth over the preceding two decades, but it missed a key point. By focusing on the economic record of enclave, city-based economies like Singapore and Hong Kong, which lack traditional agriculture, Krugman overlooked the role of agriculture and the process of structural transformation. This is the mechanism through which workers relocate from low-productivity employment in agriculture to higher-productivity employment in industry and, more especially, services, raising overall labour productivity. The present paper demonstrates the importance of this matter, using data for Thailand and Indonesia. It shows that structural transformation contributed 47 per cent of long-term growth of labour productivity in Thailand and 28 per cent in Indonesia.

Keywords: Asia's miracle; structural transformation; productivity growth; agriculture; Thailand; Indonesia

JEL codes: O13; O47; O53

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1. Introduction

Paul Krugman is among the most creative members of the global community of economists and his 1994 *Foreign Affairs* article, 'The Myth of Asia's Miracle', is one of the most widely read and debated essays ever written by an economist. In this justly famous polemic, Krugman attacked the notion that the rapid economic growth occurring in much of Asia over the two decades from the mid-1970s to the mid-1990s was attributable to forces that defy conventional economic logic. He contended instead that the source was boringly conventional, but also unsustainable. His conceptual target is summarised in the title of an influential World Bank report of the previous year, *The East Asian Miracle*. According to Krugman, there was no miracle. He was right about that, but wrong about the true sources of Asia's growth.

The analytical basis for Krugman's argument was 'growth accounting', an approach to understanding the sources of economic growth that rests on the distinction between growth of output deriving from increases in the quantities of inputs employed and increases in the amount of output obtained per unit of these inputs – their productivity. The seminal contribution, from Robert Solow (1957), had related the growth of output per worker in the United States to the growth of the capital stock per worker. Solow estimated that only 12.5 per cent of the long-term increase in the former was due to increases in the latter. The

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remaining 87.5 per cent was an unexplained residual, which Solow identified as technical change.

According to Krugman, the empirical evidence assembled by earlier studies on East Asia revealed that, in contrast with Solow's findings for the United States, Asia's rapid per capita growth rate was due almost entirely to growth in the quantity of factor inputs employed per head of population, which he called 'perspiration'. The 'perspiration' had two components: increases in the size of the workforce per head of population – labour force participation – and increases in the quantities of capital inputs applied per worker. These capital inputs consisted of physical capital, in the form of machines, buildings and public infrastructure and also human capital, in the form of education and vocational training. When all these inputs were accounted for, the difference between the actual growth of output per worker and the growth attributable to increases in the quantity of inputs applied per worker – Solow's residual productivity growth, which Krugman called 'inspiration' – was negligible. It was nearly all perspiration.

Krugman drew three implications from these propositions. First, at a conceptual level, there was nothing 'miraculous' about Asia's economic growth, since it derived almost entirely from observable increases in the inputs employed. Second, Krugman debunked claims that Asian productivity had increased through far-sighted industrial policies and selective protectionism; there was very little productivity growth available to be explained by these stories. Third, and even more controversially, Krugman argued that large increases in investment shares of GDP and expansion of basic education were subject to diminishing returns. The growth they produced was not sustainable indefinitely. For example, literacy rates could be doubled from 40 to 80 per cent of the population but could not be doubled

again, no matter how much was invested in education.[1] A long-term slowdown of growth based on these sources alone should therefore be expected.

Krugman's argument about the sources of Asia's growth rested on generalisation from quantitative research by earlier authors. He cited studies on the sources of economic growth in selected parts of East Asia, especially Singapore and Hong Kong and to a lesser extent Korea and Taiwan.[2] Krugman's own discussion of these empirical findings emphasised especially what they revealed about economic growth in Singapore. In extrapolating from this to Asia's growth more broadly, Krugman's perspective was influenced by his focus on these particular economies. But the city-based trading economies of Singapore and Hong Kong were then and remain now highly atypical of Asia in one key structural feature. They lack the traditional, low-productivity agricultural sector that employs so much of Asia's population.

Krugman's discussion of Asia's growth rightly stressed the process of industrialisation, but his account did not mention agriculture. It thereby ignored the process of structural transformation characterising economic development in almost all of the rest of Asia, through which resources, especially labour, are gradually released from low-productivity agriculture and relocate to higher-productivity employment in industry and at least some services (Timmer 2014). In Singapore and Hong Kong, almost without agriculture and importing nearly all their food, that sector might reasonably be disregarded, as Krugman does. But what about other rapidly growing Asian economies?

[1] This is Krugman's argument, not mine. It is of course true that educational investments can raise the quality of education, but Krugman would presumably respond that diminishing returns applies there as well.

[2] These studies were Young (1992, 1994a and 1994b), and Lau and Kim (1993 and 1994).

The present paper analyses the sources of growth in Thailand and Indonesia, two prominent Asian countries not mentioned by Krugman, although both were booming at the time he wrote. Both contain large, low-productivity agricultural sectors together with higher-productivity industrial and services sectors.[3] In this respect, they are far more typical of developing Asia than Singapore or Hong Kong. We shall compare the economic experience of these two countries with Krugman's story.

Some analytical background is needed. It will be helpful to decompose the sources of productivity growth – expansion of aggregate output per worker – into three conceptual categories:

(a) growth of factor inputs (physical and human capital) relative to raw unskilled labour, within each major sector (agriculture, industry and services);

(b) growth of the productivity of these factors, through technical change, again within each sector; and

(c) growth of aggregate output per worker due to the reallocation of labour from lower-productivity sectors (mainly agriculture) to higher-productivity sectors (mainly industry and some services).[4]

[3] The data for Thailand and Indonesia, presented in Figures 5 and 6 below, confirm higher average labour productivity in both industry and services overall than in agriculture, in both countries. Despite this, there may be components of the services sector where labour productivity is no higher than in agriculture.

[4] The analytical basis for the distinction between (a) + (b) and (c) is derived in the Appendix. In growth accounting terms, the aggregate contributions to overall growth attributable to sources (a) and (b) in each year are each given by the sum of that source across sectors, each weighted by the (time variant) share of that sector in GDP. The contribution of source (c) is calculated in each year as a residual: aggregate productivity growth minus the growth attributable to sources (a) + (b).

At the level of each sector, the distinction between (a) and (b) above is identical to the Solow-Krugman distinction between the quantity of inputs applied per worker and the productivity of these inputs. The distinction rests on an identity. But in the Solow-Krugman growth accounting framework, a similar mathematical identity that applies to individual sectors is also assumed to apply to the aggregate economy. The possibility that changes in the sectoral composition of the economy may disrupt this identity at the aggregate level is therefore disregarded.

Of course, if sources (a) and (b) together explained all empirically observed productivity growth at the level of the whole economy, that would leave no scope for (c). But is that true? The present paper attempts to ascertain the importance or otherwise of source (c). It is important that source (c) is distinct from both source (a) – increased application of factor inputs per unit of labour – and from source (b) – technical change. In the present paper, sources (a) and (b) combined are called 'within-sector' productivity growth and source (c) is called 'between-sector' productivity growth.

As an intuitive aid to understanding the role of structural change in contributing to aggregate productivity growth, a hypothetical illustration may be helpful. Consider the case where the initial levels of productivity per worker differ among sectors but where productivity growth (sources (a) + (b)) is zero in every sector. Does this mean that aggregate productivity growth is also zero? Not if labour moves from sectors with low *levels* of average productivity to sectors of higher productivity (source (c)). For this relocation to happen without reducing average productivity in the sectors to which the labour moves, the relocated labour must become more productive.[5]

5 The above calculations are *ex post* descriptions of the data, derived from an identity—the definition of GDP. Equation (3) is an identity that the data must necessarily satisfy. This should be distinguished from *ex ante* prescriptions of the requirements for structural change that will raise aggregate GDP per worker. For that, the focus must be on structural change that moves labour from sectors of lower marginal product to sectors of higher marginal product.

How important is between-sector productivity growth? Does recognition of it matter for our understanding of the sources of Asia's growth? Section 2 reviews the data on structural change in Thailand and Indonesia, noting the difference between structural change measured in terms of output on the one hand and employment on the other. Section 3 focuses on the productivity of labour in both countries and its relationship to structural change. Section 4 concludes.

In this study, the Thai and Indonesian economies are each disaggregated into three sectors – agriculture, industry and services. Productivity in each sector is measured as real value-added per worker and productivity in aggregate is measured as the sum of real value-added in each sector (real GDP) divided by the aggregate workforce. The data cover the period 1981 to 2017.

As background, over this 36-year period, real GDP grew at average annual rates of 5.14 and 4.87 per cent per year in Thailand and Indonesia, respectively. The population grew at 1.05 and 1.63 per cent per year, leading to GDP growth per capita of 4.09 and 3.24 per cent per year. Labour force participation grew in both countries, at annual rates of 0.54 and 0.65 per cent per year, leading to real GDP growth per worker of 3.55 and 2.59 per cent per year.[6]

2. Structural transformation

Structural transformation will be defined simply to mean a reallocation of economic activity among sectors. It can be interpreted in terms of output or employment. When overall growth is positive, structural change will normally correspond to a reduction in agriculture's share of both output and employment, necessarily coinciding with an increase in the combined output and employment shares of industry and services. But the mix of industry and services in this

[6] For further background on the Thai and Indonesian economies, see Warr (2020) and Hill (2018).

structural change may vary greatly over time and the mix may be quite different for output and employment. In addition, the pattern of ST – both output and employment – may be very different during economic recessions (negative growth) and booms (unusually rapid growth) from the pattern seen under normal, long-term rates of (positive) growth. In what follows, the long-term pattern of structural change will be reviewed for both Thailand and Indonesia.

Output shares

Figure 1 shows the sectoral composition of Thailand's sectoral output (value-added) in agriculture, industry and services from 1981 to 2017. The first row of Table 1 summarises the annual rates of change of these shares. Over this 36-year interval, agriculture's share of GDP (agricultural value-added / GDP) declined from 20 % to 6 %, an annual rate of contraction of agriculture's GDP share of 0.39 percentage points. At the same time, the share of industry (including, but not exclusively manufacturing) rose from 30 to 34 %, while the share of services rose from 49 to 60 per cent. That is, of the decline in agriculture's share of output (14 % of GDP), one third was taken up by an increase in the share of industry (column [2] of Table 1) and the remaining two thirds by an increase in the share of services.

In the case of Indonesia (Figure 2 and second row of Table 1), agriculture's GDP share declined from 23 % in 1981 to 13 % in 2017, an annual rate of contraction of 0.28 percentage points. Industry's share remained unchanged at 43 %, while services' share rose from 33 to 45 % of GDP. That is, of the contraction in agriculture's GDP share, all was absorbed by an increase in services' share and industry's share barely changed.

Employment shares

These calculations are even more surprising when conducted in terms of employment shares. The data are shown in Figures 3 and 4 and summarised in columns [3] and [4] of Table 1. In

Thailand, agriculture's employment share contracted by a dramatic 37 percentage points – from 68 % of total employment in 1981 to 31 % in 2017 – an annual rate of contraction of agriculture's employment share of 1.02 %. At the same time, industry's employment share rose by 12 percentage points and services' share rose by 24 percentage points. Abstracting from temporary unemployment, for every 100 workers leaving agriculture, 34 found jobs in industry and 66 in services.

Performing the same calculations for Indonesia, agriculture's employment share contracted by 25 percentage points, from 55 % in 1981 to 30 % in 2017, an annual rate of contraction of 0.71 %, while industry's employment share rose by 8 percentage points and services share by 17 percentage points. Abstracting again from temporary unemployment, for every 100 workers leaving agriculture, 32 relocated to industry and 68 to services. The numbers for the two countries are remarkably similar. Structural transformation was a massive event in both. In output and employment terms, the relative size of agriculture contracted greatly, but the corresponding expansion was primarily in services, not industry.

3. Productivity and structural change

Economic development involves more than just raising output per worker, but it certainly requires it. In another of his rightly famous contributions of 1994, Krugman (1994b) wrote memorably that in economic terms

> "Productivity isn't everything, but in the long run it is almost everything. A country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker."

Figures 5 and 6 summarise labour productivity (average value-added per worker at constant prices) in Thailand and Indonesia, respectively, in agriculture, industry and services, and in aggregate.

As these charts show, in both countries the level of labour productivity in agriculture in 1981 was low, relative to other sectors. Over time, the gap between agricultural and non-agricultural labour productivity narrowed somewhat but remained large. In Thailand, in 1981 the level of labour productivity in agriculture was only 10.3 per cent of its average level in industry and 12.7 per cent of its level in services. In 2017 these proportions were 12.6 and 25.4 per cent, respectively. In Indonesia, the story was qualitatively similar. In 1981 labour productivity in agriculture was 13.2 per cent of its average level in industry and 39.5 per cent of its level in services. In 2017 these proportions were 23.7 and 47.5 per cent, respectively.

Table 2 summarises the key features of labour productivity growth in Thailand and Indonesia. In both countries, the average growth rate of labour productivity within agriculture (column [2]) exceeded that of both industry and services. This finding contrasts with the fact that the average growth rate of total output from agriculture was lower than that from industry or services, as revealed by the decline in agriculture's share of GDP. The difference occurs because in the calculation of sectoral labour productivity – sectoral output per worker employed – both the numerator and denominator change over time, and not just the numerator. Agriculture shed labour dramatically at the same time as its real output increased moderately. Output grew more rapidly in industry and services, but they absorbed additional labour in the process.

The mathematical relationship between productivity growth and structural change is derived fully in the Appendix, along with the residual method of calculation used to estimate this relationship using discrete (annual) data. Figures 7 and 8 present the annual decomposition implied by this analysis, using a three-year moving average to smooth annual fluctuations, and Table 3 summarises the decomposition for the full period, 1981 to 2017,

including the Asian Financial Crisis period (1997-1999) as well as for the pre-crisis (1981 to 1996) and the post-crisis (2000-2017) periods.[7]

Although productivity growth within agriculture (column [2] in Table 3) was more rapid than in industry or services (columns [3] and [4]), agriculture's declining share of GDP meant that agriculture's within-sector productivity growth contributed only a moderate proportion of economy-wide within-sector productivity growth (column [5]). In Thailand, this proportion was 12 per cent and in Indonesia it was 22 per cent. Relative to total growth of labour productivity (column [1]), productivity growth within agriculture itself (column [2]) contributed only 6 per cent of total productivity growth in Thailand and 16 per cent in Indonesia. Productivity growth within industry and within services made larger contributions to overall productivity growth in both countries, but services was the largest in both cases.

Table 3 reveals two key points about the percentage contribution of structural change to aggregate productivity growth. First, it was large. Looking at the entire period of 1981 to 2017, in Thailand it was 47 per cent and in Indonesia 28 per cent. In both countries, structural transformation was a crucial component of the long-term increase in overall labour productivity. Second, this percentage contribution has declined, along with the declining economic importance of agriculture. In both countries, over the period following the Asian Financial Crisis (2000 to 2017), the estimated percentage contribution of structural change to aggregate productivity growth was substantially less than its pre-crisis (1981 to 1997) value.

[7] The growth accounting framework implicitly assumes that output is supply-constrained. When deficiency of aggregate demand constrains output, as in both Thailand and Indonesia during the 1997 to 1999 Asian Financial Crisis period, this assumption is invalid and supply-side growth accounting is potentially misleading. For this reason, Table 3 decomposes productivity growth for the full 1981 to 2017 period but also separately for the pre-crisis 1981 to 1996 and post-crisis 2000 to 2017 periods.

Figures 7 and 8 reveal two further significant points. First, during the booming mid-1990s, structural change was an especially important contributor to aggregate productivity growth. Second, this contribution ceased during the Asian Financial Crisis (1997-1999). Millions of workers who had relocated from agriculture to urban employment in manufacturing, construction and services during the boom lost their jobs during this period of contraction and were compelled to undertake low-productivity employment in farming and petty trading. This was reverse-structural transformation. A similar phenomenon apparently occurred in response to the COVID-19 pandemic during the year 2020.

The above observations suggest that faster overall labour productivity growth coincides with a higher percentage contribution from structural change. Figure 9 relates annual data on these variables for both countries, seemingly confirming a positive relationship for both countries. A simple linear regression was run separately for each country with the annual percentage contribution of structural change to labour productivity growth as the dependent variable and the annual rate of overall labour productivity growth as the independent variable. The results are shown in Table 4. The relationship was positive and significant at the 99 per cent confidence level for each country. The data indicate that the proportional contribution of structural change is largest when overall productivity growth is most rapid.

Finally, it should be noted that the estimated share of productivity growth attributed to structural change will increase as the degree of disaggregation increases. Structural change occurs within agriculture, industry and services themselves and it is distinct from factor growth or technical change. For example, if labour moves within agriculture from low-productivity rice production to higher productivity vegetables, or from low-productivity personal services to higher productivity banking services, the measured contribution of structural change will increase in each case. If industries are disaggregated to, say, 20 sectors,

the estimated proportional contribution of structural change will generally be higher than (not less than) that estimated with three sectors. If industries are disaggregated to 40, the estimated proportional contribution will be higher again. The above results show that in economies containing substantial traditional agricultural sectors, like most of Asia, the contribution of structural change is large, even within a framework that recognises just three sectors.

4. Conclusions

Paul Krugman's celebrated essay of 1994 argued that the growth of labour productivity in Asia was due almost entirely to increasing labour force participation and adding capital to labour, as distinct from technical change. The article rightly discounted the 'miracle' rhetoric that had recently been applied to Asia's rapid economic growth over the preceding two decades. Krugman's own account of Asia's growth rested on the distinction between 'perspiration' and 'inspiration'. But the analysis missed a key point. By focusing on enclave, city-based economies like Singapore and Hong Kong, atypical of Asia because of the absence of traditional agriculture, Krugman overlooked the role of agriculture and the process of structural transformation.[8] This is the process through which workers relocate from agriculture to industry and, more especially, services, raising overall labour productivity.

The process of labour 'relocation' corresponds to neither of Krugman's categories 'perspiration' and 'inspiration', but it contributed significantly to long-term growth of labour

[8] In the development economics literature, the role of the agricultural sector in the process of structural transformation and the importance of the latter in overall economic development, have been well-documented. Seminal examples are the classic presentation by Johnston and Mellor (1964), World Bank (2008) and Timmer (2014). In the context of the Philippines, these important issues are discussed in Ravago and Balisacan (2016, pp. 5 to 9).

productivity in both Thailand and Indonesia. Between 1981 and 2017 that contribution was 47 per cent in Thailand and 28 per cent in Indonesia. Krugman's analysis aside, overlooking the importance of agriculture in the development process is common. But this is a mistake, based on the view that this sector is static or backward. Understanding the key role of structural transformation changes the way we view the development process. It draws attention to the capacity of agriculture to contribute to overall output while *reducing* its claim on scarce productive resources, making them available for productive use elsewhere.

These issues matter. The policies that encourage (a) labour force participation and accumulation of capital relative to labour and (b) technical change in specific industries are not necessarily the same as those that facilitate (c) structural change. Recognition of the central developmental role of structural change directs attention to policies that can contribute to labour-saving technical change in agriculture and which facilitate the mobility of labour between sectors. These include not only productive investments in agriculture itself, but also in the public infrastructure required to improve the lives of people migrating from rural to urban areas, together with the education needed to aid their transition into non-agricultural employment.

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Appendix A: Labour productivity and structural change

Continuous time derivation

By definition, real gross domestic product is given by $GDP = \sum_{j=1}^{J} V^j$, where V^j denotes real value-added in sector *j*. Aggregate labour productivity can be written

$$Z = GDP/L = \sum_{j=1}^{J} V^j /L = \sum_{j=1}^{J} S^{Lj} Z^j, \quad (1)$$

where $L=\sum_{j=1}^{J} L^j$, is total employment, L^j is employment in sector *j*, $S^{Lj} = L^j/L$ is the share of sector *j* in total employment and $Z^j = V^j/L^j$ is the productivity of labour in sector *j*.

The change in total labour productivity – GDP per worker – is obtained by differentiating equation (1):

$$dZ = \sum_{j=1}^{J} S^{Lj} dZ^j + \sum_{j=1}^{J} Z^j dS^{Lj}. \quad (2)$$

Equation (2) is intuitively helpful. It states that the total change in aggregate labour productivity is given by the sum of two terms: the sum across sectors of changes in labour productivity within individual sectors, each weighted by its share in total employment, and the sum across sectors of the changes in employment shares, each weighted by its level of labour productivity. The first of these terms becomes the basis for within-sector sources of productivity growth and the second becomes the basis for between-sector sources.

Using the notation $\hat{X} = dX/X$ for the proportional change of a variable X, it is readily confirmed from (2) that the proportional change in the aggregate productivity of labour is

$$\hat{Z} = \sum_{j=1}^{J} S^{Vj} \hat{Z}^j + \sum_{j=1}^{J} S^{Vj} \hat{S}^{Lj}, \quad (3)$$

where $S^{Vj} = V^j/GDP$ is the GDP-share of sector *j*.

Equation (3) states that the proportional change – growth rate – of aggregate labour productivity is equal to the sum across sectors of two terms: (i) the GDP-share-weighted proportional change in the sector's labour productivity ($\hat{Z}^j$), and (ii) the GDP-share-weighted proportional change in the employment share of that sector ($\hat{S}^{Lj}$). The contribution of

structural change to aggregate productivity growth is therefore given by the difference between the proportional change of aggregate labour productivity ($\hat{Z}$) and the sectoral GDP-share weighted sum of the proportional change of labour productivity in each sector:

$$\sum_{j=1}^{J} S^{Vj}\hat{S}^{Lj} = \hat{Z} - \sum_{j=1}^{J} S^{Vj}\hat{Z}^{j}. \quad (4)$$

Discrete time application

For empirical application using discrete (annual) data, the method of calculation is as follows. Real GDP in year *t* is given by $GDP_t = \sum_j V_t^j$, where V_t^j is real value-added in sector *j* at time *t*. Real GDP per worker = $GDP_t/L_t = Z_t$. Its annual growth rate, $\widehat{Z_t}$, is calculated by

$$\widehat{Z_t} = 100(Z_t - Z_{t-1})/\, Z_t. \quad (5)$$

Sectoral real value-added per worker in sector *j* is given by

$$Z_t^j = V_t^j / L_t^j, \quad (6)$$

where L_t^j is employment in sector *j* at time *t*.

The growth rate of GDP can now be divided into two components. The first component corresponds to categories (a) and (b) combined, in the introductory section of the text, and the first right hand term in equation (3). Using discrete period data, the GDP-share weighted growth of real sectoral value-added in all sectors at time *t* is approximated by

$$\sum_j [(S_t^j + S_{t-1}^j)/2]\, \hat{Z}_t^j, \quad (7)$$

where $S_t^j = V_t^j / GDP_t$ is the share of sector *j* in GDP. Equation (7) makes allowance for the fact that when discrete (annual) data area being used, S_t^j and S_{t-1}^j will normally differ and equation (7) takes their linear mid-point. The estimated contribution of structural change corresponds to category (c). It takes account of the movement of resources between sectors and is calculated as a residual from

$$\hat{Z} - \sum_j [(S_t^j + S_{t-1}^j)/2]\, \hat{Z}_t^j. \quad (8)$$

Table 1. Agriculture's contraction and industrialisation component, 1981 to 2017

Country	Output shares		Employment shares	
	Mean annual change of agriculture's % GDP share	Industry expansion as % agriculture's contraction	Mean annual change of agriculture's % employment share	Industry expansion as (%) agriculture's contraction
	[1]	[2]	[3]	[4]
Thailand	-0.39	33	-1.02	34
Indonesia	-0.28	0	-0.71	32

Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Table 2. Labour productivity growth by sector, 1981 to 2017

Country	Mean annual growth of real GDP per worker	Mean annual growth of sectoral real VA per worker		
		Agriculture	Industry	Services
	[1]	[2]	[3]	[4]
Thailand	3.55	2.57	1.82	1.98
Indonesia	2.59	2.78	1.22	2.29

Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Table 3. Contribution of structural change to aggregate productivity growth, 1981 to 2017

Country	Mean annual growth of real GDP per worker	Mean annual growth of GDP-share weighted sectoral real VA per worker			Contribution to productivity growth	
					Within sectors	Between sectors
	[1]	Agriculture [2]	Industry [3]	Services [4]	[5] = [2] + [3] + [4]	[6] = [1] – [5]
Thailand						
1981 to 2017: per cent per year	3.55	0.22	0.64	1.02	1.89	1.66
(1981 to 2017: percent contribution)	(100)	(6)	(18)	(29)	(53)	(47)
1981-1996: per cent per year	4.39	0.11	0.72	1.31	2.14	2.25
(1981 to 1996: percent contribution)	(100)	(3)	(16)	(30)	(49)	(51)
2000 to 2017: per cent per year	3.13	0.34	0.89	0.87	2.10	1.03
(2000 to 2017: percent contribution)	(100)	(11)	(28)	(28)	(67)	(33)

Table 3. (continued) Contribution of structural change to aggregate productivity growth, 1981 to 2017

Country	Mean annual growth of real GDP per worker	Mean annual growth of GDP-share weighted sectoral real VA per worker			Contribution to productivity growth	
					Within sectors	Between sectors
	[1]	Agriculture [2]	Industry [3]	Services [4]	[5] = [2] + [3] + [4]	[6] = [1] – [5]
Indonesia						
1981 to 2017: per cent per year	2.59	0.41	0.58	0.89	1.88	0.72
(1981 to 2017: percent contribution)	(100)	(16)	(22)	(34)	(72)	(28)
1981-1996: per cent per year	2.70	0.29	0.65	0.71	1.65	1.05
(1981 to 1996: percent contribution)	(100)	(11)	(24)	(26)	(61)	(39)
2000 to 2017: per cent per year	3.63	0.67	0.72	1.58	2.97	0.65
(2000 to 2017: percent contribution)	(100)	(18)	(20)	(44)	(82)	(18)

Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Table 4. Structural change and the rate of productivity growth: Regression results - Thailand and Indonesia, 1981 to 2017

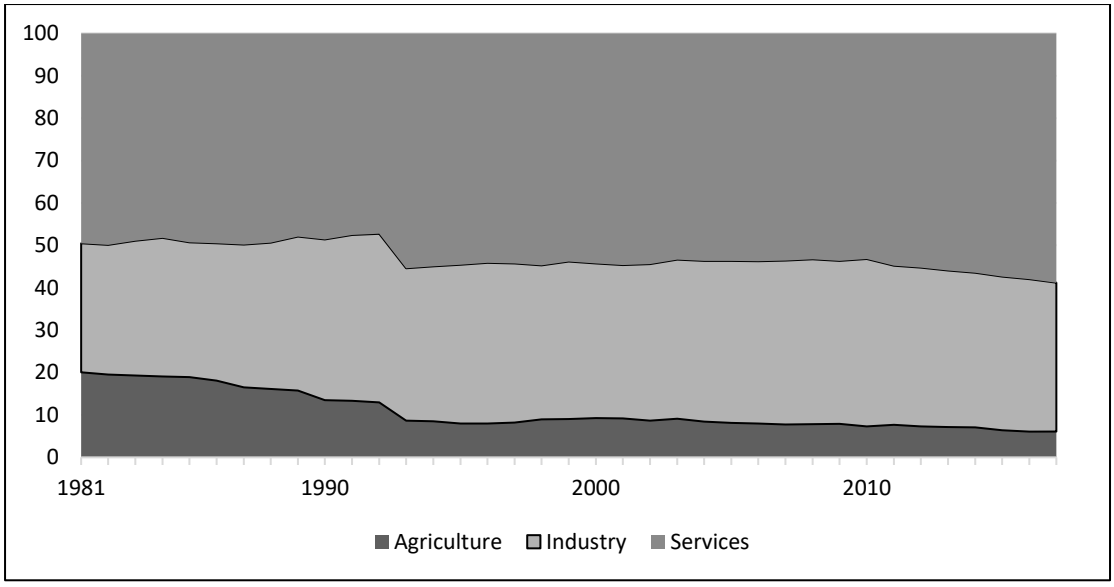
Country	Thailand		Indonesia	
Coefficient name	*a*	*b*	*a*	*b*
Coefficient value	-0.29	0.62	-0.19	0.79
Standard error	0.77	0.16	0.58	0.13
t-statistic	-0.38	4.01	-0.33	6.16
p-value	0.695	0.000	0.526	0.000
R^2	0.32		0.52	
$\overline{R^2}$	0.30		0.51	
$F(0, 35)$	16.10		39.94	
Years	1981-2017		1981-2017	
Observations	37		37	

Note: The above estimates relate to the regression equation $C_t^k = a^k + b^k \widehat{Z_t^k} + u_t^k$, where C_t^k is the percentage contribution of structural change to labour productivity growth in country *k* in year *t*, $\widehat{Z_t^k}$ is the growth rate of labour productivity in country *k* in year *t* and u_t^k is an error term. The coefficient a^k is an intercept term and b^k is the slope coefficient of interest.

Source: Author's calculations, using data from World Bank, *World Development Indicators.*

Figure 1. GDP shares by sector, Thailand, 1981 to 2017

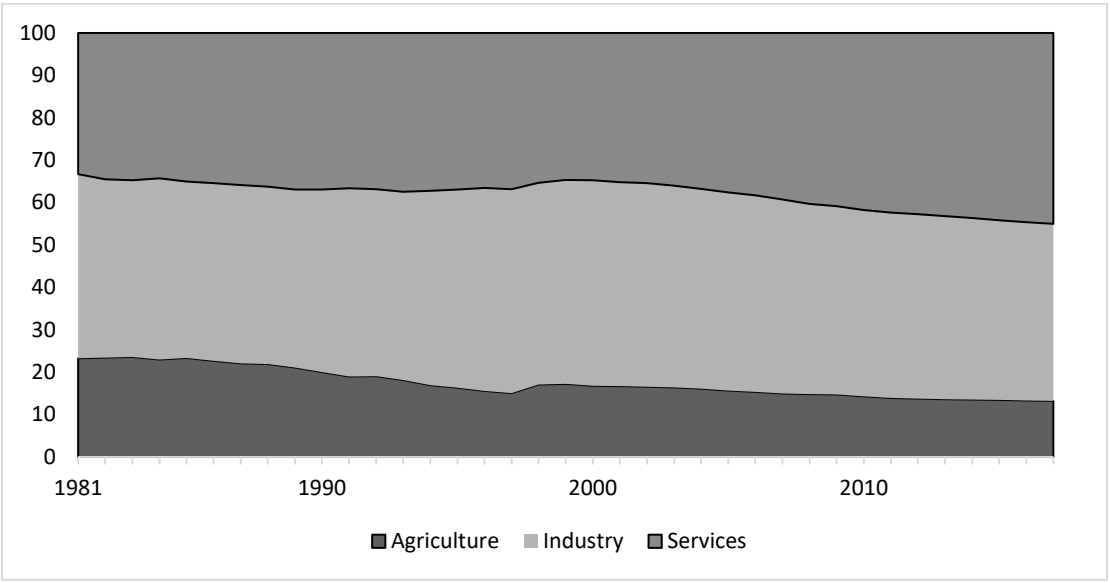
(Per cent of GDP)



Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Figure 2. GDP shares by sector, Indonesia, 1981 to 2017

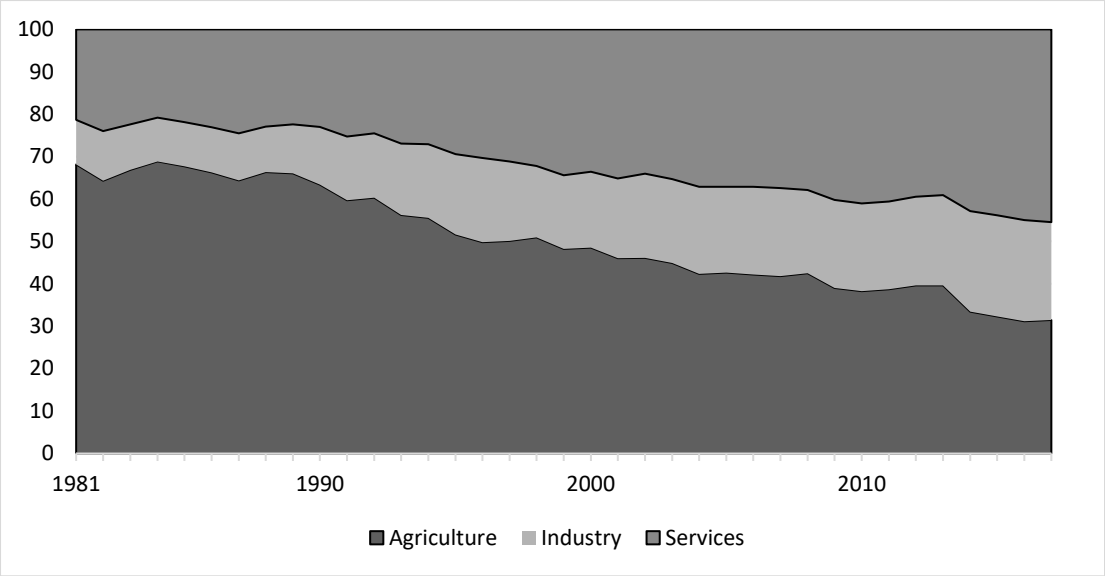
(Per cent of GDP)



Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Figure 3. Employment shares by sector, Thailand, 1981 to 2017

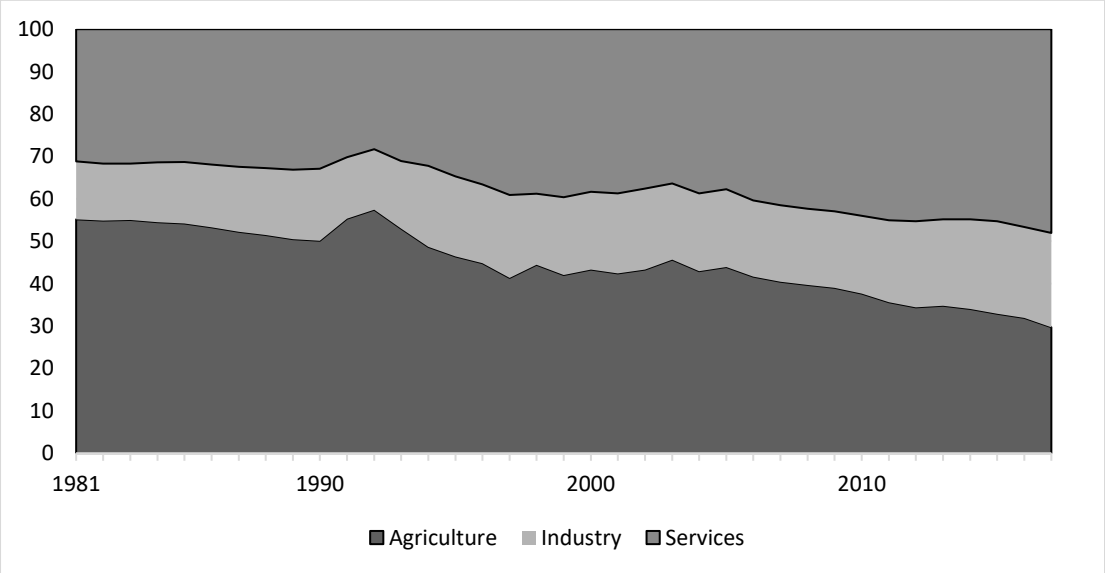
(Per cent of total employment)



Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

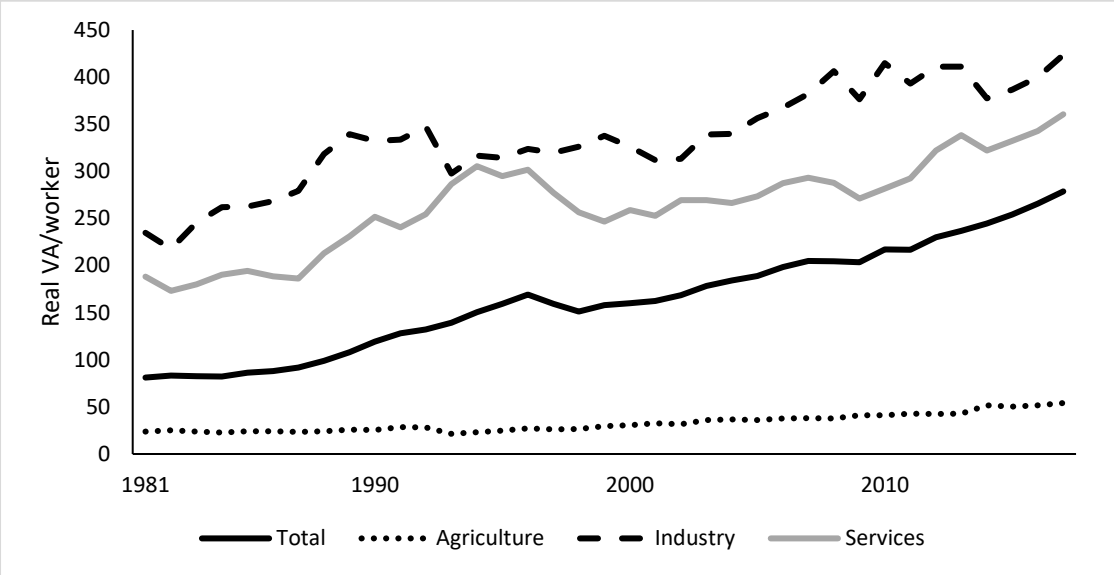
Figure 4. Employment shares by sector, Indonesia, 1981 to 2017

(Per cent of total employment)



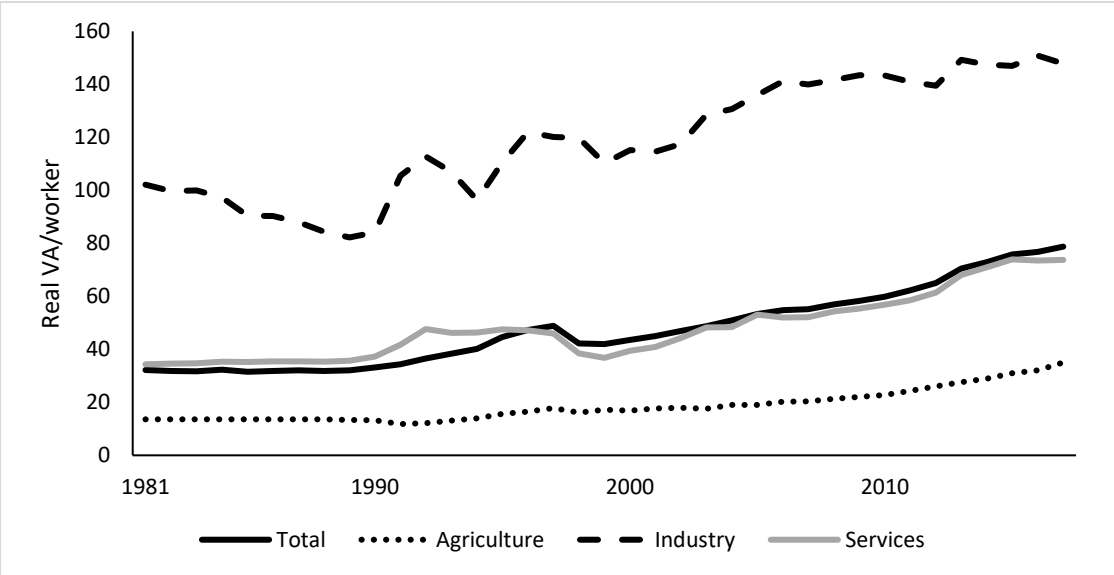
Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Figure 5. Labour productivity by sector, Thailand, 1981 - 2017



Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

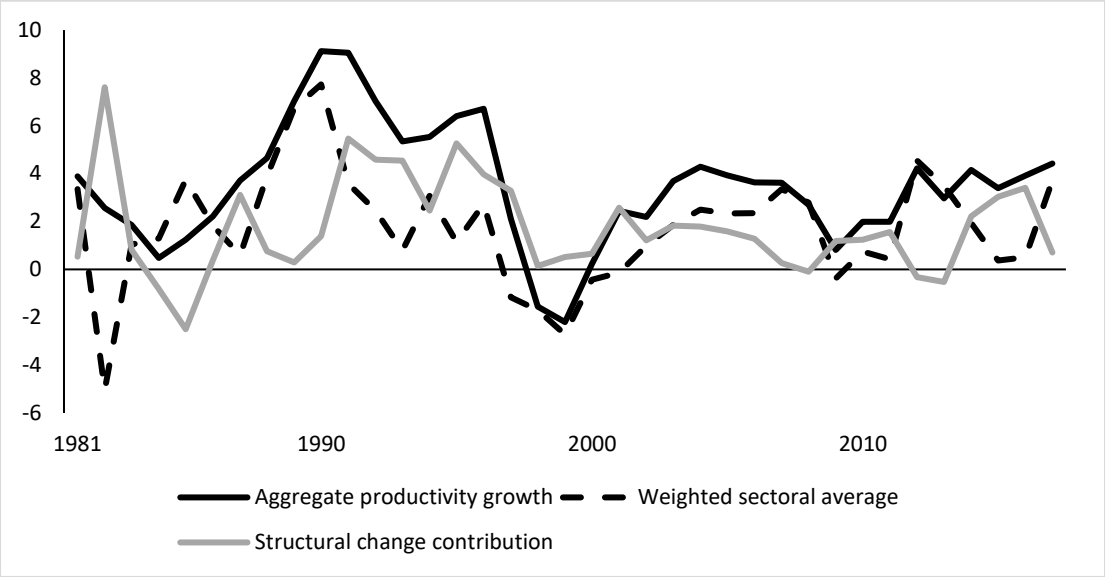
Figure 6. Labour productivity by sector, Indonesia, 1981 – 2017



Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

Figure 7. Productivity growth and structural change, Thailand, 1981 - 2017

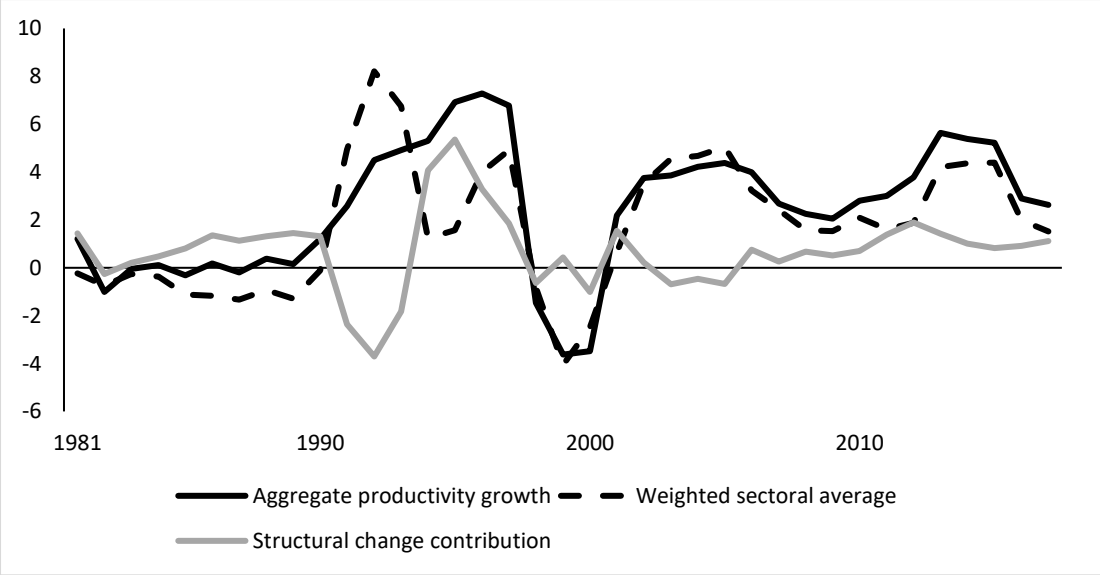
(Percent change per year, three-year moving average)



Source: Author's calculations, using data from World Bank, *World Development Indicators.* <https://databank.worldbank.org/source/world-development-indicators>

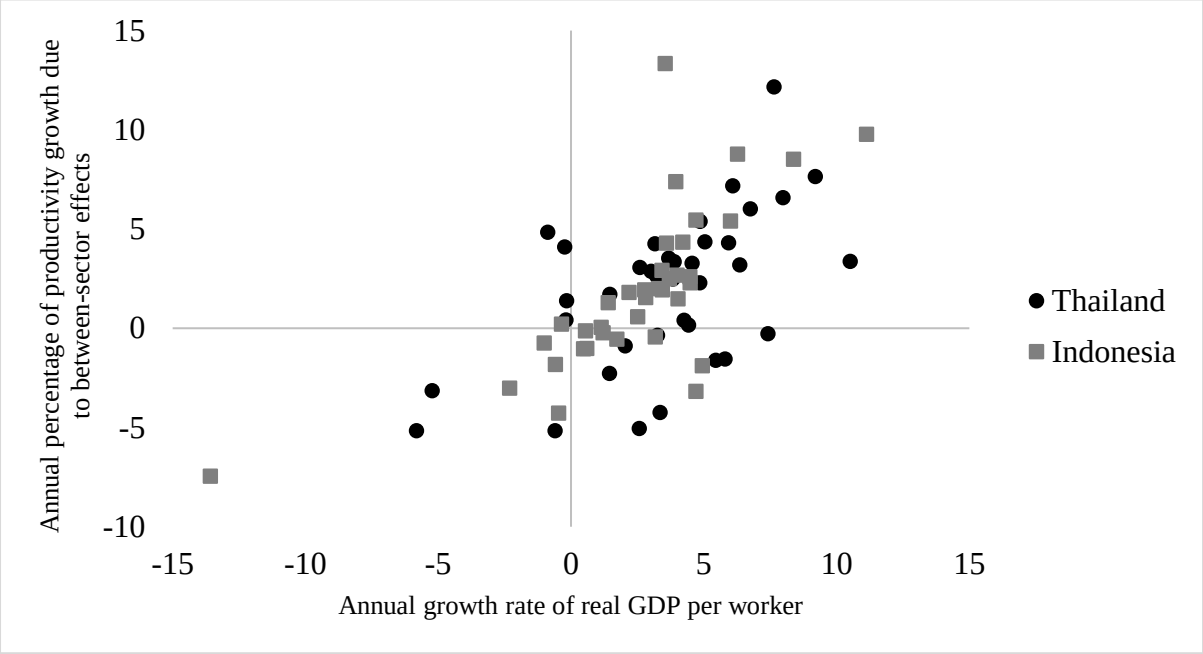
Figure 8. Productivity growth and structural change, Indonesia, 1981 - 2017

(Percent change per year, three-year moving average)



Source: Author's calculations, using data from World Bank, *World Development Indicators.* https://databank.worldbank.org/source/world-development-indicators

Figure 9. Productivity growth and the percentage contribution from structural change, Thailand and Indonesia, 1981 to 2017



Note: THA means Thailand and IDN means Indonesia.

Source: Author's calculations, using data from World Bank, *World Development Indicators.* https://databank.worldbank.org/source/world-development-indicators