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Factor Accumulation and Total Factor Productivity Growth: ASEAN Economies

(Pengumpulan Faktor dan Jumlah Faktor Pertumbuhan Produktiviti: Ekonomi ASEAN)

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ABSTRACT

This study examines the contribution of factor accumulation on Total Factor Productivity (TFP) growth in the eight ASEAN countries with specific reference to short-term and long-term estimation effect. Using Mean Group (MG) estimator on data between 1990 and 2018, this study found a significant relationship between capital accumulation and TFP growth. Our analysis suggests that the positive growth on TFP in most ASEAN countries was due to the short-run effect of capital accumulation. This study also found that the ASEAN economies have a relatively lower rate of capital utilization that adversely affects TFP growth in the long run. The contribution of TFP to output growth is paramount for the sustainability of long-term economic growth. Thus, ASEAN countries need to accelerate capital accumulation and technology adoption in the short-term and utilize idle capital in the long-term.

Keywords: Factor accumulation; TFP; Mean Group Estimator; ASEAN

ABSTRAK

Kajian ini bertujuan untuk mengkaji sumbangan pengumpulan faktor keatas pertumbuhan Produktiviti Faktor Keseluruhan (TFP) di lapan negara ASEAN dengan merujuk secara khusus kesan terhadap jangka pendek dan jangka panjang. Dengan menggunakan anggaran Mean Group (MG) ke atas data antara 1990 and 2018, selaras dengan beberapa hasil kajian yang lalu, kajian ini mendapati hubungan yang signifikan hanya diantara pengumpulan modal dan pertumbuhan TFP. Butiran unik analisis kami menujukkan bahawa pertumbuhan positif TFP di kebayakkan negara ASEAN adalah disebabkan oleh kesan jangka pendek pengumpulan dana. Walau bagaimanapun, kajian ini juga mendapati bahawa ekonomi ASEAN mengalami kadar penggunaan modal yang lebih rendah yang mempengaruhi pertumbuhan TFP dalam jangka panjang. Sumbangan TFP terhadap pertumbuhan keluaran adalah amat penting bagi kelestarian pertumbuhan ekonomi jangka panjang. Oleh itu, penting bagi negara-negara ASEAN untuk mempercepatkan pengumpulan modal dan penggunaan teknologi dalam jangka pendek dan menggunakan secara optimum modal terbiar dalam jangka panjang.

Kata kunci: Pengumpulan faktor pengeluaran; TFP; Mean Group Estimator; ASEAN

INTRODUCTION

The economic growth of some countries is faster than others despite there were no drastic differences in initial stock of capital or labour. This has been one of the primary concerns of economists around the world in recent decades and led to studying the underlying growth models of economic development. A considerable number of studies have reported that the accumulation of factors of production can only explain economic growth partially. A substantial part of contributing factors often remains dormant within the production development and technological processes known collectively as Total Factor Productivity (TFP). The TFP growth not only significantly contributes to the economic growth of many countries, but also explains the gap in productivity levels and income differences (Kim & Park 2018). TFP growth addresses contributing causes of economic growth by extensive measurements on related elements, such as the efficient distribution of resources, development of technological spill-over, human capital accumulation, population, currency, and research and development (R&D) as well as firm's accessibility to finance (Kim & Park 2018; Sulaiman & Rashid 2013). Numerous studies that were devoted to addressing these developments cited the role of TFP growth in the economic growth differences across countries.

This study, which is aimed at assessing the primary force of productivity, uses TFP with specific reference to inputs of the factor of production such as capital and labour between 1990 and 2018. The aggregate allocation

of these variables within and between firms and industry potentially determine the level of productivity. Although it has been often reported that there are changes in factor accumulation and TFP on economic growth, the role of former to the later remains largely unexplained, especially in the context of ASEAN countries.

Traditionally, the accumulation of physical capital as the factor of production has been considered to be one of the main contributing factors of economic growth since the time of classical economists. However, recently the interest to study the contribution of technological change and human capital accumulation regarding TFP growth has increased tremendously. The accumulation of human capital by obtaining new abilities requires integration into the existing framework of knowledge with the use of physical capital. The more capital workers have, the more productive they become. The more human capital diffusion there is, the greater knowledge accumulation occurs. In contrast, the more physical capital diffusion exists, the less there remains of it for future use. Collectively, higher human capital diffusion on physical capital escalates knowledge accumulation at the cost of physical capital, which was one of the contributing factors to the TFP growth.

Furthermore, the accumulation of human capital at a certain level of threshold would lead to further accumulation of human capital that tends to increase the human capital aggregate in a country. A continued accumulation of human capital, therefore, implicitly affects TFP growth in a country before impacting labour productivity over the long run. However, until recently, much uncertainty has remained about the long-run relationship between TFP growth and accumulation of factors of production across countries. Therefore, this study investigates the contribution of factor accumulation, with specific reference to estimation of short-term and long-term effect of labour quality and capital input on the TFP growth in eight ASEAN countries namely Cambodia, Myanmar, Vietnam, Philippines, Malaysia, Singapore Indonesia and Thailand. These countries are believed to successfully able to utilize the technological knowledge productively.

Figure 1 below shows the potential relationship between capital accumulation and TFP growth in eight ASEAN countries from 1990 to 2018. Despite the increasing trend in capital accumulation growth of more than 10% in Cambodia (Figure 1a) and Myanmar (Figure 1b) between 1990 and 2018, TFP growth reflects a downward trend at the given constant and a lower contribution of labour input. The TFP growth trend in these countries appears to diverge from capital input growth. Much emphasis was given to attracting FDI, especially in the period after accession into WTO, Cambodia in 2004 and Myanmar in 1995. These countries do not seem to give equal importance to improving labour quality that is vital in technological absorption and production efficiency, which is the key element to TFP growth (Seng 2010). Similarly, in the case of Vietnam (Figure 1c), the identical performance of capital input to Cambodia and Myanmar seems not to influence its TFP much during the period of observation. In contrast, TFP growth in the Philippines (Figure 1d) appears responsive to the growth of capital accumulation despite less than 10% growth compared to the former three countries. One of the principal reasons for the significant improvement in the TFP in the Philippines lies in the contribution of FDI (Cororaton, 2002) and export (Austria 1998) despite poor performance in TFP fundamentals (Qian et al. 2018). Capital accumulation growth in the rest of ASEAN countries, namely Malaysia (Figure 1e), Singapore (Figure 1f), Indonesia (Figure 1g) and Thailand (Figure 1h) all dropped sharply after the 1998 Asian financial crisis. TFP growth trend in these countries appears to be invariant to the fluctuations in factor accumulation. TFP resistance to the variation in factor accumulation, especially in Malaysia and Singapore, is possibly due to the high human capital regime in these countries (Yuhong, Nor & Sarmidi 2017).

LITERATURE REVIEW

The early theoretical contributions of TFP on growth have been evident since (Abramovitz 1956) and (Solow 1957) argued that economic growth is often associated with TFP growth compared to only a small contribution of factor accumulation. According to Abramovitz (1956), approximately 90% of economic growth in the United States of America was due to TFP growth and only 10% due to factor accumulation. In contrast Solow (1957) recorded 88% in support of TFP and 12% in the later, respectively. It is important to note that at this point, their investigation merely interested in investigating the association between TFP and physical capital accumulation and inadvertently ignored human capital as part of factor accumulation. Nonetheless, until Mayer (2001), the production function did not distinctly consider human capital as one of the inputs in the production. Mayer showed a measure of TFP changes across countries by refining the measure of technology transfer (Coe & Snower 1997) and combines it with human capital. Correspondingly, Miller and Upadhyay (2002) also argued that human capital is a measurement variable in the production function together with labour and physical capital (Mankiw, Phelps & Romer 1995; Mankiw, Romer & Weil 1992; Miller & Upadhyay 2000). Iradian (2014) who examined the contribution of capital, labour and TFP growth in the former Soviet Union republics found that the latter accounted for 25% to 49% of overall growth in these countries, which were significantly higher than some other fast-growing economies.

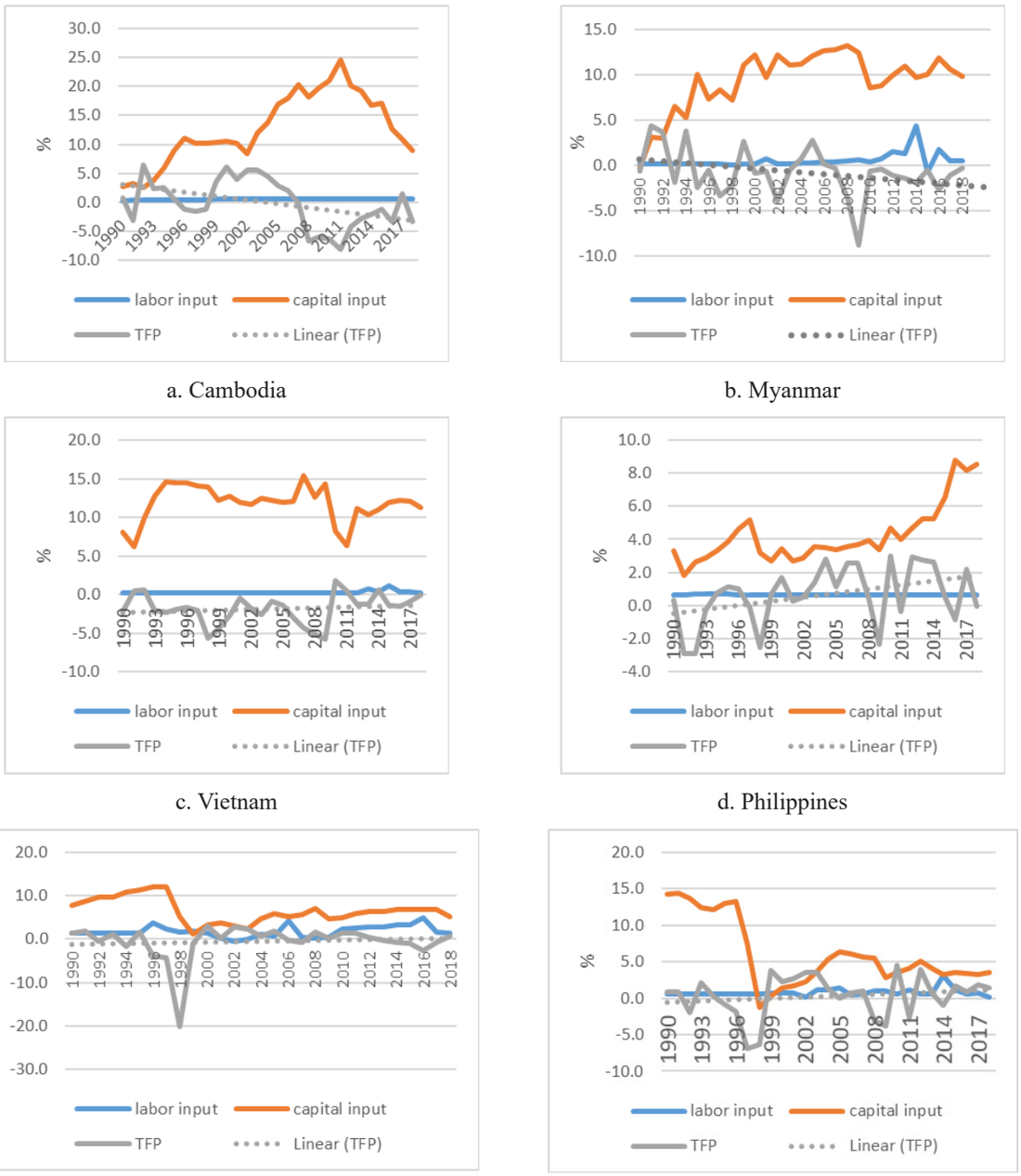

FIGURE 1. Factor accumulation and TFP growth in ASEAN

Human capital accumulation through investment was found to be accountable in the divergence of the output growth, productivity and economic growth (Yunus, Said & Hook 2014). According to Krugman (1994) and Young (1995), almost seven per cent of rapid economic growth of East Asian tiger economies before 1997 primarily resulted from the accumulation of capital. Nevertheless, several studies still view TFP as singularly important for economic growth compared to factor accumulation. Eichengreen, Park, & Shin (2012) noted that a reduction in the TFP growth rate on average was able to explain almost 85% of the slowdown in growth compared to the relatively negligible role of labour and capital growth. The growth accounting of the Solow model stressed that the rate of capital utilization facilitates adjustment of TFP contribution to cyclical movement of an economy. The absence of capital utilization potential led to TFP growth being underestimated during an economic slowdown and is overestimated during booms (Levenko, Oja & Staehr

2019). This is due to the fact that some of capital stock may be left idle during a crisis and often overutilized during the expansion period (Levenko et al. 2019). Besides that, the inactive or unused capital seems to be greater in the transition economies, especially during the early stage of transition due to structural reform and reduction in output (Levenko et al. 2019).

However, most of the empirical studies that investigated the effect of human capital on the growth of TFP found an ambiguous link. Several studies that examine the impact of human capital on TFP growth reported significant positive results (Fleisher & Chen 1997; Vandenbussche, Aghion & Meghir 2006), while others found a significant negative relationship in their investigation. Several researchers (Bils & Klenow 2000; Krueger & Lindahl 2001; Pritchett 2001; Tzeremes 2014) argued that results from the study of 123 countries between 1970 and 2011 revealed that human capital leads to the mutual acceleration of technological change and efficiency for technological catch-up.

The theoretical literature that found a positive association among human capital and TFP suggest human capital facilitates the adoption of new exogenous technology developed elsewhere by adapting in the production of domestic technology (Aghion et al. 1998; Nelson & Phelps 1966; Romer 1989, 1990; Siang, Noor, & Ann 2012). One of the widely held reasons for the negative association includes potential human capital endogeneity (Bils & Klenow 2000; Krueger & Lindahl 2001) and the lack in the measurement of human capital quality (Bosworth & Collins 2003; Hanushek & Kimko 2000) as well as the common challenges in measuring TFP growth. There are also many empirical studies that show a positive effect of human capital on a country's economic growth (Bassanini & Scarpetta 2002; Glaeser 1994) without explicitly indicating the role of TFP in the process. Eicher (1996) highlighted the relationship of endogenous human capital accumulation with a technical change that potentially imply an inverse effect on TFP growth. Besides this, some other researchers found the direct effect of human capital accumulation on TFP by including indicators related to experience, health and education to gauge the implication of absorptive capacity of an economy. Another study by Cole and Neumayer (2004) investigated the impact of health on TFP in 52 developed and developing countries from 1965 to 1996 found consistent results in previous studies that found poor health negatively affects TFP. Nonetheless, it is also suggested that human capital may potentially imply an indirect effect on TFP by raising income.

Benhabib and Spiegel (1994) argued that TFP growth depends on a country's human capital capacity to advance its own technological innovations. This is due to how the diffusion of technology from abroad leads to technology transfer that is highly conditional to the quality of the human capital in a county. Therefore, technology spills over from home to host country depending on education levels. Later, the result of Benhabib and Spiegel (2000) studying 84 countries found that human capital serves as an engine of innovation and facilitates TFP catch-up between 1960 and 1995. Conversely, Miller and Upadhyay (2000, 2002) found no supporting evidence for education as one of the indicators for human capital to cause a positive effect on TFP. They found a negative association between human capital and TFP at low-level income countries and a positive effect for middle and high-income countries. Likewise, Bulman, Eden and Nguyen (2014) and Jitsuchon (2012) noted that TFP growth is essential to avoid the middle-income trap.

The role of physical capital as the accumulation factor of production is evident because the extension of saving model by Cass (1965) and Koopmans (1965). It is widely accepted that physical capital accumulation contributes almost 50% to steady-state growth and the remaining accumulation is due to labour quality and technological advancement (Funke & Strulik, 2000). The new growth models regard physical capital accumulation as the engine of growth while the capital intensity determines TFP growth (Sargent & Rodriguez 2001). However, the contribution of physical capital is subject to the age of capital stock. The older the physical capital, the less productive it becomes, unlike the longer value of the level of education and greater productiveness of human capital. Therefore, it is important to upgrade capital stock in terms of quality that has a potential contribution to TFP growth. Although extensive studies are focused on the association between labour and capital with TFP, there has been no or if not little effort made to distinguish the effect of the factor accumulation and TFP between different time dimensions of short run and long run.

METHODOLOGY

This section discusses the panel unit root, cointegration test and panel cointegration estimation that were used to investigate the long-term and short-term relationship between factor accumulation, namely capital input and labour input quality based on Murthy (2002)as follows:

$$Q = f(K, L)$$

Where, Q = real value added output, K = real capital input and real value labor input. This study uses the total factor productivity as Q, capital input as K and labour input as L. The transformation of this function into model as below:

$$TFP = \alpha + \beta(LBR) + \beta_2(CPL) + \varepsilon$$

Where, LBR for labor input, CPL for capital and TFP for total factor productivity growth.

Panel unit root test

The widely accepted and used panel unit root test is used in this study to measure the dynamic panel for statistical power. The two types of panel unit root tests, namely first-generation and second-generation, with distinction to whether there is the assumption of cross-sectional independence. This study adopts the first-generation panel unit root test initially to test the presence of cross-sectional dependence (CD) distortion (Yuhong, Nor & Sarmidi 2018). Thus, the model below is adopted from (Levin, Lin & Chu 2002) test;

$$Y_{i,t} = a_i + \rho Y_{i,t-1} + \Sigma\varphi_k Y_{i,t-k} + \delta_{it} + \theta_t + u_{it} \quad (1)$$

The model (1) above shows two-way fixed effects, firstly the unit-specific fixed effects (a_i) and secondly from unit specific time trends (θ_t). This model considers the Unit-specific fixed effects as an essential component as it allows heterogeneity as the coefficient of lagged Y_i is restricted to be homogeneous across all units of the panel. The hypothesis testing for this model is as below;

H0: $\rho = 0$ (each time series in the panel has unit root)
Ha: $\rho < 0$ (each time series is stationary)

Based on the proposed method of Maddala and Wu (MW) test (ADF - Fisher Chi-square / PP - Fisher Chi-square test), the Fisher-type test combines the p-values from unit root test for each cross-section i to test for unit roots in panel data. The following MW test assumes that there are N unit-root tests;

$$\lambda = -2 \Sigma \ln \pi_i \quad (2)$$

Where π_i refers to the probability limit values for regular DF (or ADF) unit-root tests of each cross-section i, since $-2 \ln \pi_i$ has a $\chi 2$ distribution with 2 degrees of freedom, the λ statistic will follow a $\chi 2$ distribution with 2N degrees of freedom as $T_i \rightarrow \infty$ for finite N.

Panel cointegRation test

Once the stability of the data is defined, Pedroni's cointegration test was conducted to account for heterogeneity by using specific parameters. The application of Pedroni's cointegration is required to estimate the long-run relationship as below;

$$TFP_{it} = \alpha_i + \delta_{it} + \beta_{1i}(LBR_{it}) + \beta_{2i}(CPL_{it}) + \varepsilon_{it} \quad (3)$$

Where, LBR (labour) and CPL (capital). The residual estimation is measured as below;

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \mu_{it} \quad (4)$$

According to Pedroni's panel data cointegration statistic test to test the "within" dimension, the alternative hypothesis is $\rho_i = \rho < 1$ for all *i*, while for the "between" dimension, the alternative hypothesis is $\rho_i < 1$, for all *i*.

THE MEAN GROUP (MG) AND POOL MEAN GROUP (PMG)

This study uses the MG estimator proposed by Pesaran and Smith (1995) and the PMG by Pesaran, Shin and Smith (1999). The MG estimator is used to fit a separate regression for each country to find a simple arithmetic average of the coefficients. At the same time, the PMG is an alternative estimator that combines both pooling and averaging that constrains the long-term coefficients across countries. Both of these estimators are based on the maximum likelihood procedure, the autoregressive distributed lag (ARDL) and when considering the long-run equilibrium, is used to test the dynamic heterogeneity of the adjustment process (Demetriades & Hook Law 2006). PMG estimators allow short-run coefficients, impose the speed of adjustment and error variances to differences across countries, yet impose homogeneity on long-run coefficients. In other words, with the PMG procedure, we estimated the following restricted version of the growth equation on annual data for eight ASEAN countries from 1990 to 2018 as follows:

$$\Delta TFP_{i,t} = - \varphi_i (TFP_{i,t-1} - \theta_1 LBR_{i,t} - \theta_2 CPL_{i,t} - \Phi_{3,i} t - \theta_{0,i}) + \beta_{1,i} \Delta LBR_{i,t} + \beta_{2,i} \Delta CPL_{i,t} + \varepsilon_{i,t}$$

Where TFP is the growth rate of TFP, LBR is labour input, and CPL is the capital input, (t) is a time trend, (i) is indicated country and ϵ for the error term.

The list of variables used and source of data are shown in Table 1. The data estimation period covers 1990 to 2018 and eight ASEAN countries. EViews and Stata software were used to analyse the data.

RESULTS AND DISCUSSION

We used the Im, Pesaran and Shin (2003), Fisher–ADF and Fisher–PP to test the unit root of the variables. As indicated in Table 2, almost all the variables are stationary at their level and first difference. We performed each of them by including an intercept and intercept plus linear trend.

Table 3 reports the results of the panel cointegration tests based on Pedroni (1999; 2004). Models where the TFP with labour indicates out of the seven statistics, only one rejects the null hypothesis of no cointegration. Models where the TFP with capital indicate that all the seven statistics accept the null hypothesis of, has the cointegration. Consequently, the findings provide the evidence of the presence of cointegration among TFP growth, labour input and capital input.

TABLE 1. List of Variables

Variables	Actual data measure	Data source
Dependent variable Total Factor of productivity growth (TFP)	TFP growth measures the two-period average labour share divided by input growth rates from the output growth.	The Conference Board Total Economy Database
Independent variable Labour input – quality (Labour)	Measure on employment and wages by educational attainment	The Conference Board Total Economy Database
Capital input-total (Capital)	Growth in total capital services, which refers to change in the flow of productive services provided by capital assets, such as buildings, transport equipment, and machines	The Conference Board Total Economy Database

Source: The Conference Board

TABLE 2. Panel Unit root test

Series	TFP		Labour		Capital	
	No trend	Trend	No trend	Trend	No trend	Trend
Level						
Levin, Lin & Chu	-4.99732***	-4.15821***	-1.84029**	-2.56544***	-1.55376*	0.11005
Im, Pesaran & Shin	-5.39181***	-4.10446***	-4.01367***	-10.2026***	-1.88149**	0.25151
Fisher–ADF	60.3640***	44.3545***	44.6797***	118.707***	29.6599**	17.9430
Fisher–PP	84.9777***	66.4990***	120.840***	146.612***	26.3722**	11.5498
First differences						
Levin, Lin & Chu	-10.8242***	-8.86559***	-2.06420**	-0.50967	4.80404***	-3.12297***
Im, Pesaran & Shin	-11.8631***	-10.2570***	-3.73374***	-7.92337***	-6.79032***	-5.78055***
Fisher–ADF	139.219***	109.788***	41.4988***	91.1050***	75.9569***	60.5148***
Fisher–PP	223.505***	1067.25***	351.702***	1158.43***	124.163***	136.826***

Notes: Figures in parentheses are probability values. ** and *** denote rejection of the null of non-stationary at 1% and 5% levels of significance. The maximum number of lags is set to be three. SBC is used to select the lag length.

TABLE 3. Results of Panel Cointegration (Dependent variable: Total Factor Productivity (TFP)

	TFP: Labour		TFP: capital	
	Model 1a: Without trend	Model 1b: With the trend	Model 1a: Without trend	Model 1b: With the trend
Pedroni cointegration				
Panel v-stat	-0.687729	-2.922577	1.483349*	-1.379683
Panel rho-stat	-7.059501***	-4.745696***	-8.093602***	-4.752137***
Panel pp-stat	-6.862772***	-7.212611***	-7.885591***	-7.924125***
Panel adf-stat	-4.590969***	-4.501332***	-5.486148***	-5.163004***
Group rho-stat	-5.255334***	-2.779858***	-6.174592***	-3.040850***
Group pp-stat	-7.321604***	-6.923619***	-8.384773***	-8.760385***
Group adf-stat	-5.313733***	-4.354530***	-5.795809***	-5.295640***

Notes: *, ** and *** denote significance level at 10, 5 and 1 per cent levels, respectively. Number of countries (N) = 8 and periods (T) = 28. Maximum lags on Schwarz information criterion (SIC) is 2.

Table 4 shows that the coefficient estimates on the error correction term are negative, significant and lie within the acceptable range for MG and PMG estimators. This demonstrates that there is a long-run relationship, and the residuals are stationary. This means that our data series are cointegrated. In the long-run analysis for both panels, the MG estimates are more preferred than the PMG estimates. The Hausman- statistic was used to select the most suitable estimator between the MG and the PMG. In our analysis, the chi-square value

TABLE 4: The estimation of PMG and MG model

Variables	PMG estimator		MG estimator	
	Coefficient	Standard error	Coefficient	Standard error
Labour input- quality				
Long term	-0.8509***	0.2246	-0.1027	6.3736
Short term	0.4630	7.2674	-5.2269	3.8178
Capital input				
Long term	-0.2351***	0.0447	-0.4655***	0.0960
Short term	0.7872***	0.2998	0.9180***	0.2887
Error correction term	-0.8985***	0.1115	-0.9723***	0.0855
Hausman test	7.94 (0.0189)			

Notes: ***, **, * significant at 1, 5, and 10 percent respectively. The lag order is chosen using the AIC criterion

TABLE 5. Mean group estimator

	Cambodia	Indonesia	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Labour input- quality								
Long term	-0.7624 (0.3838)**	-0.5066 (0.9679)	36.0503 (28.8801)	-0.6018 (0.5040)	-30.9399 (23.3309)	-3.8621 (1.9267)**	-1.0798 (0.7373)	0.8809 (2.4845)
Short term	0.6560 (0.4349)	0.0334 (0.5639)	-13.9803 (184.6091)	0.09488 (0.3892)	-28.9054 (37.7277)	1.4156 (1.3149)	0.0474 (0.6681)*	-1.17721 (1.3345)
Capital input								
Long term	-0.3546 (0.1687)**	-0.5478 (0.2469)**	-0.7796 (0.3696)**	-0.1970 (0.0847)**	-0.2054 (0.2814)	-0.7840 (0.28886)***	-0.1500 (0.0681)**	-0.7057 (0.2199)***
Short term	2.1512 (0.3346)***	-0.0491 (0.3083)	0.3505 (0.3555)	1.1255 (0.1567)***	0.9345 (0.4505)**	1.7421 (0.5793)***	1.2098 (0.1786)***	-0.1211 (0.1859)

for the Hausman test shows a value of less than 0.05 (0.0189), which indicates that the MG estimator is more preferred. The MG estimates of the long-run coefficient of capital on total factor productivity are -0.4655 with p-value significant at 1%. This implies that the lower level of capital input in the long run and higher at short run will increase the TFP growth. Table 5 reports the individual countries' result from MG estimators.

Table 5 shows that labour input growth has a significant negative long-run relationship between the TFP growth in Cambodia and Singapore in contrast to a positive relationship in short-run in Thailand. A significant negative relationship exists between TFP growth and capital input in all counties in the long run except in the Philippines.

Similar to the findings of Yuhong et al. (2017; 2018); this study did not find consistent empirical results to support the theoretical view of the positive relationship between labour input quality and TFP growth. The findings show a negative relationship between labour input quality and TFP growth in seven out of eight ASEAN countries in the long term. Singapore, being in the country with a high human capital regime, finds significant negative of labour input quality on TFP growth in the long term. This could be mainly due to the inequality of human capital distribution within the factor accumulation model that generates important influences on TFP growth (Gong 2016; Yuhong et al. 2018)

Capital accumulation will increase capital per worker and is positively correlated with higher TFP. However, it requires a certain level of adoption threshold to support domestic innovation and TFP growth in the ASEAN countries. This study finds a significant negative association between capital input and long term TFP growth in most ASEAN economies. Although it was assumed to be best to compare productivity in the long term, the year to year comparison helps to demonstrate the long-term effect on the economic cycle in relation to output and economic growth. It is important to note the rate of capital utilization in these countries and not just the absolute capital accumulation. The underestimation on capital utilization, especially during an economic slowdown, would negatively affect TFP. The economic recession and financial crisis markedly retards the growth of capital accumulation and TFP during and post-crisis (Chiacchio, Gradeva & Lopez-Garcia: 2018; Levenko et al. 2019). It is important to note that the ASEAN economies had experienced a double dip during the examined period, namely the Asian financial crisis in 1997 and the global financial crisis in 2008. In support of

the empirical model presented earlier, the two financial crises indicate the high possibility of a negative effect stemming from weaker private credit performance that could have affected innovative engagement of firms that seem to contribute to the TFP growth (Mousa 2017). In 1992, Katz and Murphy argued that there is an inverse relationship between relative wage and supply of skilled labour since 1963. The rapid technological change in the 1980s implied strong demand for skill-biased labour that resulted in a rapid increase in the relative wage in most of the countries. Thus, this study found evidence supporting Eicher (1996) where most of the ASEAN countries that experienced drastic change in technology since 1990's may have suffered from a sharp increase in the relative wage to a relative decline in supply of skilled labour.

However, the results in the short run show that capital input renders a significant positive effect on TFP growth in Cambodia, Myanmar, Philippines, Singapore and Thailand while having no substantial effect in Malaysia, Indonesia and Vietnam. This could be mainly due to economic openness and free trade that led to import and export growth during the last three decades. An export orientation contributed to not only economic growth but also capital accumulation in the form of emulation of advanced foreign technology and foreign markets competition due to import of capital goods that enhances overall productivity growth (Haider, Ganaie, & Kamaiah 2019).

CONCLUSION

In conclusion, the result of the panel cointegration analysis indicates that there is a significant relationship between TFP and capital input. The unique point of our study suggests that the positive growth on the TFP in most ASEAN countries was due to the short-run effect of capital accumulation but not in the long run. Although the growth of labour input is considered important to economic growth, it was not the source of TFP growth in these countries.

The result of MG estimator analysis, however, corroborates the consistent finding of some of those other studies that argued there is a significant association between TFP and capital accumulation in both the short run and long run. However, the growth of capital accumulation only in the short run rendered a significant positive effect on TFP growth in most ASEAN economies. There are several potential explanations for this inverse relationship in the long run. However, this study argues that this was due to a possible effect of a lower rate of capital utilization on long run growth in most ASEAN countries. Ideally, the rapid TFP growth will be due to factor accumulation and should be accompanied by a higher rate of innovation that is associated with a higher quality of human capital. However, this study found that the factor accumulation in these countries possibly results in a relatively lower supply of skilled labour that inversely affects the TFP level in the long run.

The contribution of TFP to the output growth is paramount for the sustainability of long-term economic growth. A TFP slowdown will result in the inability of the economy to generate growth or buffer the effect of a recession. The most realistic scenario for most of the ASEAN countries is to accelerate capital accumulation in the short term by sustaining relatively high labour quality in the long term that will lead to tremendous growth of TFP. The long-run economic policy should target containing inflation and trade openness that strengthens TFP growth. Sustainability of high TFP growth will require substantial structural reforms to remove constraints and distortions in the private sector to the expansion of the modern sector and, hence, on the accumulation of physical and human capital. However, this will be one biggest challenge to ASEAN countries due to competition of fast-growing Asian tigers like China and India. Several policy measures targeting technology adoption, product innovation, knowledge sharing, and governance would positively contribute to TFP growth through efficient resource allocation.

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