Openness, Productivity and Allocation Efficiency in ASEAN-4

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INTRODUCTION

The prolonged interesting debates is whether the nature of the growth in the East Asian economies is due to the accumulation of factors (e.g. labor and capital) or the results of employing the latest technology. No one denies that all three elements (capital, labor and technology) must be present to some degree if an economy is to grow. However, the subject of debate is the contribution of the factors of production relative to that of technology. Some believe that increased use of factors of production (labor and capital) can explain all growth (Young, 1994; Krugman, 1994; Collins and Bosworth, 1997; Senhadji; 2000), while others are persuaded that the answer to growth lies in the use of more efficient technology (Romer, 1994; Nelson and Pack; 1997; Klenow and Rodriguez-Clare, 1997; Easterly and Levine, 2000; Sonobe and Otsuka, 2001). In the neutral sense, Iwata et. al. (2002) and Dowling and Summers (1998) noticed that the role of the capital is equally if not more important in explaining the high and sustained level of exemplary economic performance in Asia.

One of the missing elements regarding the variation in the efficiency of investment and productivity is the role of trade openness (henceforth, openness). Openness refers to the extent or magnitude of trade liberalization. The relationships between openness and allocation efficiency as well as openness and productivity have a general link with the phenomenon in the developing countries, namely the extent of adverse selection which resulted in inefficient resource allocation and low TFP[1]. Therefore, it is the purpose of this paper to investigate the impact of openness on allocation efficiency (proxy by incremental capital output ratio, or ICOR) and productivity (proxy by total factor productivity, or TFP, growth).

In the case of ASEAN countries, the role of distortions in economic development is certainly inevitable because of the similarity in their factor endowments. None of member countries is ready to open and may finally give up any sector, especially the agricultural sector, which for a long time serve and sustain their economies. This has been done for many reasons but basically due to fear that openness may cause distress to some local industries and economies as a whole. However, the rising concern is regarding the status of capital accumulation as the core process by which all other aspects of growth is made possible.

Table 1 shows the incremental capital-output ratio (ICOR) rose in all four East Asian economies in the 1990s (but until 1995) with the largest in Thailand and the least in Indonesia. The rising ICOR suggests the declining returns to new investments before the crisis.

Table 2 shows the estimated TFP growth for selected Asian countries. The result gives an idea that Korea and Singapore, which are the first tier of newly industrializing economies (NIEs), experiencing a tremendous increasing of TFP growth. Within the rest of ASEAN, TFP growth is highest in Malaysia and moderate in Thailand while relatively worse in Indonesia. The relationship between openness and growth of TFP that embedded technology transfer is ambiguous.

[1] The central motivation of this paper is to investigate the extent to which openness to international trade which followed by the sequencing of capital as well as current account liberalization and the readily available external foreign funds have possibly resulted in a degree of adverse investment selection in the ASEAN-4, namely Indonesia, Malaysia, Philippines and Thailand.

Table 1 Incremental capital-output ratio for selected East Asian economies, 1987-1999

	1987-89	1990-92	1993-95	1997	1998	1999
Indonesia	4.0	3.0	4.4	1.7	0.4	1.8
Malaysia	3.6	4.4	5.0	3.9	8.2	4.3
Philippines	3.0	1.0	5.0	5.0	3.8	6.0
Thailand	2.9	4.6	5.2	12.9	-11.5	14.5

Source: Jomo (2001) and World Development Indicator CD-ROM 2003 (World Bank)

Table 2 TFP growth estimates, King-Levine capital stock, Summers-Heston Output

Period	Indonesia	Malaysia	Thailand	Korea	Singapore	India
1961-95	0.4	2.2	2.0	3.1	3.1	1.1
1961-75	-1.1	2.1	1.5	2.7	3.1	0.1
1976-85	1.2	1.5	2.3	2.3	1.6	1.8
1986-95	1.5	3.2	0.8	4.4	4.6	1.9

Source: Dowling and Summers (1998)
Note: capital share is 0.35. Unfortunately, the data for Philippines are not available in Dowling and Summers (1998).

The main motivation of this paper is to find additional supporting evidence on the nature of economic growth in Indonesia, Malaysia, Thailand and Philippines in relation to movement towards more open or outward-oriented economy. In other words, this paper wants to investigate the impact of openness on allocation efficiency as well as on technological improvement. Although we could see few attempt to quantify the effect of openness on total factor productivity (TFP) in order to gain clearer insight regarding the role of openness in the technological development (i.e. Okabe, 2002), however, very rare we could see any attempt to measure the impact of openness on allocation efficiency by using incremental capital-output ratio (ICOR). Therefore, the set up of ICOR equation can be seen as part of the contribution of this paper. Our ultimate goal is to investigate whether or not openness has lead to improvement in allocation efficiency and/or technological innovation.

The next section discusses empirical model specifications. The third section addresses the estimation procedure and data. The fourth section provides empirical results which are then followed by concluding remarks.

EMPIRICAL MODEL SPECIFICATION

Total factor productivity (TFP)

Assuming that the production process in each economy is follows two-factor (labor and capital) of Cobb-Douglas model[2], the production function can be written as:

$$Yt = f(At, Kt, Lt) \qquad (1)$$

where Yt is the output, Kt denotes physical capital stock, Lt stands for labor force, and At signifies technological progress that is not embodied in the physical capital stock as well as labor

[2] Iwata et. al. (2002), among others, argued that this assumption not actually applicable to developing countries and prefer to use non-parametric approach instead.

force. Following Dollar and Sokoloff (1990), we can decompose labor productivity growth into the contribution of capital deepening plus a TFP growth, such that:

$$\ln\left[\frac{Yt}{Lt}\right] = \alpha \ln\left[\frac{Kt}{Lt}\right] + \ln TFP \qquad (2)$$

where:
Yt/Lt = Labor productivity
Kt/Lt = Capital deepening
lnTFP = residual = Productivity growth
α = the coefficient of capital labor ratio

Rearranging equation (2), we got the TFP growth measurement as:

$$\ln TFP = \ln\left[\frac{Yt}{Lt}\right] - \alpha \ln\left[\frac{Kt}{Lt}\right] \qquad (3)$$

In examining the determinants of TFP, many studies incorporate human development index such as educational attainment as well as research and development (R&D), with special reference to foreign R&D spillovers. However, due to lack of R&D data, most of the studies are cross sectional (Coe and Helpman, 1995; Engelbrecht, 1996) and only recently, panel analysis (e.g. Okabe, 2002) gain attention with a gradual increase in number of data for each country.

Openness can be an important explanation for the TFP improvement. Dollar (1992) for example argued that outward orientation results in more rapid growth of exports and there might be externalities associated with increasing exporting competitiveness that causes open economies to grow more rapidly over long periods. The same argument came from Krueger (1997) who noted that the growth prospects for developing countries could be enhanced if the country follows an outward-oriented path.

Although Korea also had attracted FDI inflow, but there is significant different in the degree of reliance in order to boost technological capability. Northeast Asia such as Korea has generally had a much more sophisticated and effective industrial policy compared to Southeast Asia. This accounts for the very important differences in industrial and technological capabilities between Northeast and Southeast Asia. Also, industrialization in the latter is still primarily driven by FDI, whereas industrialization in the former is primarily an indigenous phenomenon (Nam and Kim, 2000). Southeast Asian industrialization has been far more dominated by foreign capital (Jomo, 2001), and has, as a consequence, fewer industrial and technological capabilities that may be considered indigenous or under national control. Southeast Asian high-performing economies have generally been less successful in developing indigenous industrial and technological capabilities for various reasons (Jomo et al., 1997)[3]. This might be the good reason of why Southeast Asia countries (Singapore is excluded) are facing difficulty to emulate or replicate the success of the Northeast Asian countries. Therefore, FDI is considered as one of the explanatory variable in the TFP equation, mainly used as a control variable.

We have two empirical models for TFP growth equation. The first one is without FDI variable and the second equation will be with FDI variable.

$$TFP = \alpha_{11} + \alpha_{12}\ln GDP + \alpha_{13}OPEN + \varepsilon_{11} \qquad (4)$$
$$TFP = \alpha_{21} + \alpha_{22}\ln GDP + \alpha_{23}OPEN + \alpha_{24}FDI + \varepsilon_{21} \qquad (5)$$

[3] This seems to be partly due to the greater reliance on FDI in the region for political as well as other reasons.

where TFP stands for total factor productivity growth, lnGDP denotes real GDP in logarithmic form, OPEN stands for trade openness and proxied by trade volume (as % of GDP), and FDI denotes foreign direct investment (as a % of GDP). ε refers to residual.

Incremental capital-output ratio (ICOR)

The incremental capital-output ratio (ICOR) is a measure of how well investment is being used by a country. ICOR is equal to 1 divided by the marginal product of capital (1/MPC), and since MPC is equal to investment divided by the change in output, it then simply the number of units of investment required to produce an additional unit of output.

For example, ICOR of 3 means that it takes 3 units of investment (in any currency unit) to produce a unit currency of output. The higher the ICOR, the lower the productivity of capital would be, vice versa. Therefore, the ICOR can be thought of as a measure of the extent of inefficiency (as well as efficiency) with which capital is used.

$$\text{ICOR} = 1/\text{MPC} = \left[\frac{1}{\Delta Y / INV}\right] = \left[\frac{INV}{\Delta Y}\right] \quad (6)$$

or, in relation to growth, the above equation can be expressed as follow:

$$\text{ICOR} = \left[\frac{INV / Y}{\Delta Y / Y}\right] = \left[\frac{INVratio}{GROWTH}\right] \quad (7)$$

The ICOR is generally being used by comparing the figure in one country with other countries or within a certain period of time. However, international comparisons of ICOR, although roughly acceptable, actually suffer from the inequivalent nature of data. In other words, the content of 'investment' and 'output/income' are not necessarily the same through out the world. Therefore, comparing ICOR of one country with another country's ICOR may not reflect the true story. Another effort is to compare the value of ICOR within a period of time so as to investigate whether the ICOR is falling or increasing. This is more appropriate and relevant since the ICOR of one country is comparable among each other.

lnGDP, which captures broad measures of local efforts, will be used instead of domestic savings and government expenditures, as a factor affecting ICOR. The rising ICOR in recent years may also be due to increasing investments into capital-intensive projects with long gestation periods, leakages and initially underutilized capacity. Much of them are not only undertaken by government, but also due to largely available foreign capital (Malaysian Economic Recovery Plan). Therefore, we add FDI, as a proxy for foreign capital, mainly as control variable.

In short, we will have the following two types of specifications as follows:

$$\text{ICOR} = \beta_{11} + \beta_{12}\text{lnGDP} + \beta_{13}\text{OPEN} + \mu_{11} \quad (8)$$

$$\text{ICOR} = \beta_{21} + \beta_{22}\text{lnGDP} + \beta_{23}\text{OPEN} + \beta_{24}\text{FDI} + \mu_{21} \quad (9)$$

where the definition of each variable is as before.

METHODOLOGY

Unrestricted error correction model – BOUND TEST

Pesaran et al. (2001) proposed unrestricted error correction model (UECM) that is appropriate for small sample size as well as regardless of the level of integration for each variable. The UECM is a simple reparameterization of a general autoregressive distributed lag (ARDL) model. The bounds test

procedure is merely based on an estimate of unrestricted error-correction model using Ordinary Least Squares (OLS).

Under the unrestricted error correction model (UECM), both equations of (4) and (8) become[4]:

$$\Delta TFP_t = \Phi_1 + \Phi_2 TFP_{t-1} + \Phi_3 OPEN_{t-1} + \Phi_4 FDI_{t-1} + \sum_{i=0}^{p} \Phi_{5,i} \Delta OPEN_{t-i} + \sum_{i=0}^{q} \Phi_{6,i} \Delta FDI_{t-i} + \sum_{i=1}^{s} \Phi_{7,i} \Delta TFP_{t-i} \quad (10)$$

and;

$$\Delta ICOR_t = \delta_1 + \delta_2 ICOR_{t-1} + \delta_3 OPEN_{t-1} + \delta_4 FDI_{t-1} + \sum_{i=0}^{p} \delta_{5,i} \Delta OPEN_{t-i} + \sum_{i=0}^{r} \delta_{6,i} \Delta FDI_{t-i} + \sum_{i=1}^{s} \delta_{5,i} \Delta ICOR_{t-i} \quad (11)$$

where Δ stands for first difference operator.

There are two steps in testing the cointegration relationship between economic growth and its explanatory variables. First, we estimate Equation 10 and 11 by ordinary least square (OLS) technique. Second, the presence of cointegration can be traced by restricting all estimated coefficients of lagged level variables equal to zero. For example, if take equation (10), we will test for the null hypothesis of $\Phi_2 = \Phi_3 = \Phi_4 = 0$ against its alternative of $\Phi_2 \neq \Phi_3 \neq \Phi_4 \neq 0$. If the computed F-statistic is less than lower bound critical value, then we do not reject the null hypothesis of no cointegration. Conversely, if the computed F-statistic is greater than upper bound critical value, then we reject the null hypothesis and conclude that there exists steady state equilibrium between the variables under study. However, if the computed value falls within lower and upper bound critical values, then the result is inconclusive.

All data are collected from World Development Indicators 2003 CD-ROM (World Bank), as well as Key Economic Indicators (Asian Development Bank). This study covers the data for the period of 1965 to 2001.

EMPIRICAL RESULTS

In order to examine both short-run and long-run relationships between ICOR as well as TFP growth and their determinants, the bound test was applied. Unrestricted error correction model (UECM), which is reparameterization of autoregression distributed lag (ARDL) model, was used to estimate the model.

Using the Hendry's general to specific method, although the parameters have significantly reduced, the goodness of fit of the specification (R-squared) and the standard error (S.E) of regression remain superior as we can see from table 3.

On the other hand, from the same table 3, we could see that the robustness of the model has been confirmed by several diagnostic tests such as LM test (Breusch-Godfrey serial correlation test), ARCH test (heterogeneity test), Jacque-Bera test (normality test) and Cusum square test (stability test). All the tests (exception for CUSUM square test), as shown in lower part of each panel, revealed that the models have the desired econometric properties, namely the residuals are serially uncorrelated and normally distributed, homoscedasticity and all estimated parameters are stable over time, that is, all test statistics are fall within the 1% critical line. Therefore, the results reported are valid and reliable.

[4] We follow the third case of Pesaran et al. (2001), namely unrestricted intercept and no trend.

Table 3 R^2, standard error (S.E.) of regression and diagnostic tests[a]

Dependent Var[b]	$ICOR_1$	$ICOR_2$	$TFPGR_1$	$TFPGR_2$
Panel A: Indonesia				
R^2	0.9417	0.9794	0.9034	0.9262
S.E of reg.	0.0268	0.0193	0.0637	0.0541
No. of Obs.	34	27	34	26
Normality	0.8216 [0.6631]	0.5600 [0.7557]	0.4906 [0.7824]	0.0194 [0.9903]
LM-test	0.8994 [0.4306]	0.5481 [0.5982]	3.7831 [0.1047]	0.0227 [0.9776]
ARCH-test	1.4512 [0.2440]	2.0233 [0.1430]	1.0601 [0.3823]	2.2793 [0.1447]
Panel B: Malaysia				
R^2	0.8504	0.8438	0.8512	0.9418
S.E of reg.	0.0843	0.0916	0.0811	0.0580
No. of Obs.	34	30	34	28
Normality	0.9777 [0.6133]	0.1671 [0.9198]	2.5345 [0.2311]	2.0818 [0.3531]
LM-test	0.0658 [0.9365]	0.0240 [0.9762]	0.1514 [0.8605]	0.1668 [0.8484]
ARCH-test	1.2811 [0.3039]	1.1664 [0.2896]	1.3652 [0.2515]	0.4840 [0.4930]
Panel C: Philippines				
R^2	0.8927	0.8957	0.8620	0.9014
S.E of reg.	0.1108	0.1221	0.0760	0.0697
No. of Obs.	34	29	35	28
Normality	0.5362 [0.7647]	0.8174 [0.5455]	1.2944 [0.5235]	1.0470 [0.5924]
LM-test	0.0476 [0.9536]	2.0574 [0.2221]	1.3256 [0.2890]	0.2150 [0.8098]
ARCH-test	1.712305 [0.1930]	2.4715 [0.1280]	0.3081 [0.5826]	0.02857 [0.8671]
Panel D: Thailand				
R^2	0.8928	0.9149	0.9368	0.9653
S.E of reg.	0.0331	0.0352	0.0458	0.0342
No. of Obs.	34	28	33	28
Normality	0.0501 [0.9753]	0.5835 [0.7469]	0.4218 [0.8098]	1.8635 [0.3938]
LM-test	1.9224 [0.1829]	1.6186 [0.2508]	2.3784 [0.1385]	2.1020 [0.1729]
ARCH-test	0.4820 [0.4926]	0.4870 [0.4916]	1.3020 [0.2628]	1.6591 [0.2095]

Note: [a] The results of CUSUM square test are omitted to save space. Available upon request.

[b] Subscript 1 and 2 denote two types of specification as discussed in empirical models.

In table 4, the results of bound cointegration test obviously demonstrated that the null hypothesis of no cointegration against its alternative (of cointegration) is rejected at 0.01 significant level.

Table 4 Cointegration test - Bound tests[a]

Dependent var[b]	$ICOR_1$	$ICOR_2$	$TFPGR_1$	$TFPGR_2$
F-value				
Indonesia	12.85	20.62	14.69	12.98
Malaysia	6.72	7.65	14.21	9.56
Philippines	7.72	7.27	18.01	10.22
Thailand	14.52	15.54	13.11	24.60
Critical Value				
Lower bound	5.15	4.29	5.15	4.29
Upper bound	6.36	5.61	6.36	5.61

Note: [a] 1% significant level.
[b] Subscript 1and 2 denote two types of specification as discussed in empirical models.

The computed F-statistic (Wald test) is greater than the upper critical bound value in each equation for all four economies, and thus indicates that all variables in both equations are cointegrated in all economies. We could see that openness has led to an improvement in the level of allocation efficiency, even after controlling for the role of FDI in all four economies (as in table 5).

In short, openness generally has contributed in improving the level of domestic allocation efficiency. Similarly, FDI flow also seems to have significant and negative impact on allocation efficiency.

On the other hand, openness has a positive impact on TFP growth in the case of Indonesia, Malaysia and Philippines, while a negative impact in the case of Thailand before controlling the role of FDI. After controlling for the role of FDI, the impact of openness remains positive in the case of Indonesia, Malaysia and Philippines. However, in the case of Thailand, openness has remained negatively associated with TFP growth. Regarding the role of FDI in upgrading domestic technology, no clear indication can be seen from Table 5 since its impact is not significant in the case of Malaysia and Philippines. Although the impact of FDI in the case of Thailand and Indonesia is significant, the signs are not consistent. FDI has a positive impact on TFP growth in the case of Thailand, but negative in the case of Indonesia.

Table 5 Long-run coefficients

	$ICOR_{I1}$	$ICOR_{I2}$	$TFPGR_{I1}$	$TFPGR_{I2}$
Panel A: Indonesia				
Intercept	0.8238* (1.7887)	-0.7232* (-1.8201)	-5.4217*** (-4.3081)	-1.7867 (-1.7556)
LnGDP	-0.0290 (-1.4151)	0.0397** (2.2295)	0.2262*** (4.0810)	0.0708 (1.6661)
OPENNESS	0.0037** (2.3723)	0.0031* (1.9889)	0.0010 (0.3834)	0.0075** (3.1464)
FDI	-	-0.0232** (-2.4731)	-	-0.0887** (-2.4605)
Panel B: Malaysia				
Intercept	3.2033* (1.8267)	5.5329* (2.0748)	-3.2845* (-1.8524)	-4.6298** (-2.1674)
LnGDP	-0.1335* (-1.7499)	-0.2384* (-2.0563)	0.1325* (1.7399)	0.2028** (2.1972)
OPENNESS	-0.0002 (-0.2245)	-0.0031* (-2.0280)	0.0013 (1.0763)	0.0021* (-2.0642)
FDI	-	-0.0418** (-2.3786)	-	-0.0193 (-1.1570)
Panel C: Philippines				
Intercept	-10.252** (-2.6422)	-15.7105** (-2.7207)	13.231*** (3.7849)	3.4484 (0.9814)
LnGDP	0.4394** (2.6692)	0.6400** (2.7098)	-0.5606*** (-3.7648)	-0.1407 (-0.9765)
OPENNESS	-0.0099** (-2.2444)	-0.0008 (-0.2070)	0.0156*** (3.518)	0.0029* (1.9104)
FDI	-	-0.1317 (-1.4335)	-	-0.0182 (-0.6327)
Panel D: Thailand				
Intercept	-6.7244*** (-3.8143)	3.1393** (2.2921)	-2.1437* (-1.9947)	-4.1209*** (-3.0815)
LnGDP	-3.9346*** (-5.8645)	-0.1396** (-2.3141)	0.0887* (1.9366)	0.1923*** (3.2783)
OPENNESS	-0.2967*** (-3.8557)	-0.0068** (-2.9939)	-0.0033* (-1.9505)	-0.0098*** (-4.0186)
FDI	-	-0.0671* (-2.0010)	-	0.0881*** (3.1481)

Note: Asterisks *, ** and *** denote 10%, 5% and 1% significant level, respectively.

CONCLUSION

The aim of this paper is to investigate the impact of trade openness on allocation efficiency and technological improvement, the two channels through which we could gain from trade, in the case of four Southeast Asian economies.

Despite positive and significant, we could see the impact of openness in improving the level of resource allocation efficiency in ASEAN-4 can be considered as minimal, given the low value of the coefficients. The role of openness in improving technology level in ASEAN-4 is also relatively apparent with an exceptional for Thailand. Although after controlling for the role of FDI, openness

has generally led to higher TFP growth, but the impact is, as in the case of allocation efficiency, too minimal. Apart from that, it is negative in the case of Thailand.

Therefore, ASEAN's efficiency and productivity challenge must be tackled through both national reforms and regional integration.

ASEAN must find ways to reduce further the tariffs and non-tariff barriers that raise the cost of doing business across the region's borders. These reforms would, in effect, create a single production platform throughout Southeast Asia, thus enabling companies to realize economies of scale and to capitalize on the region's comparative advantages.

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