Master Plan on ASEAN Connectivity: assessing growth impacts and interdependencies

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Abstract: The ten members of the Association of Southeast Asian Nations (ASEAN) have quietly but steadily been taking steps to deepen economic linkages with the region. A milestone was reached in 2015 with the adoption of a blueprint on the ASEAN Economic Community (AEC) which came into force in 2016. As increased intra-regional connectivity is central to the realisation of the AEC, in October 2010, the ASEAN member states adopted the Master Plan on ASEAN Connectivity (MPAC), the regional blueprint for improved physical, institutional and people-to-people connectivity. This paper offers an empirical examination of the economic impact of the MPAC on the ASEAN region's growth. An individual country-based trend analysis shows very little effect of MPAC. A structural VAR analysis that accounts for both direct and indirect effects also shows that the impact of MPAC has hitherto been very low. Obviously the analysis also shows the decreasing influence of OECD and increasing influence of China on ASEAN with India remaining weak as an engine of growth for ASEAN. This calls for measures to enhance the region's intra-regional interdependencies as well as the interdependencies vis-à-vis ASEAN's traditional and emerging trading partners.

Keywords: Association of Southeast Asian Nations; ASEAN; ASEAN Economic Community; AEC; growth; connectivity; time trends; structural vector auto regression; SVAR.

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1 Introduction

While much of the focus on regional groupings in recent times has been on the European Union and its institutional weaknesses in the context of the Eurozone crisis, the ten members of the Association of Southeast Asian Nations (ASEAN) have quietly but steadily been taking steps to deepen economic linkages with the region. Established in 1967, the ten-member ASEAN bloc of economies has been hailed as one of the successful models of regionalism[1].

The regional integration process in ASEAN received a significant fillip in December 2015 when the ASEAN group of economies established the ASEAN Economic Community (AEC) which envisions a creation of a single market and production base defined by free flow of goods, services, investments, capital and skilled labour across borders within the region. While the blueprint for such a milestone to be achieved was laid in 2007, it was subsumed into the *AEC Blueprint 2025* that was the outcome of the 27th ASEAN leaders' summit in November 2015. This blueprint provides the strategic directions for the AEC to achieve its goals from 2016 to 2025[2].

One of the important components of the *AEC Blueprint 2025* pertains to "enhanced connectivity and sectoral cooperation", which is expected to support the vision for the AEC as envisaged in the ASEAN Community Vision 2025. The underlying strategic

thrust is to narrow the development divide within the bloc as well as to enhance regional competitiveness and resilience.

In order for the AEC vision to materialise, ASEAN as a region requires a significant enhancement in its logistical connectivity between its member economies. Recognising this, in October 2010, the ten ASEAN member states signed the Hanoi Declaration on the Adoption of the Master Plan on ASEAN Connectivity (MPAC) which is the regional blueprint for improved physical, institutional and people-to-people connectivity (ASEAN Secretariat, 2010). As Banomyong (2015) notes, "the MPAC was designed to enable the AEC and improve ASEAN's internal integration through enhanced physical infrastructure development, effective international institutional arrangements as well as citizen-to-citizen connectivity". Thus the primary goal of the MPAC was to devise strategies to address infrastructural and regulatory bottlenecks in the region with a view to deepening regional linkages. As emphasised by the World Bank, when it comes to enhancing trade performance, apart from physical distance, connectivity and logistics performance appear to matter more than other trade barriers (Arvis and Ojala, 2014).

In terms of physical connectivity, the MPAC aims to both upgrade and newly construct multi-modal transport infrastructure that includes roads, railways, maritime, port and aviation facilities as well as information and communication technology infrastructure. Institutional connectivity covers a wide range of impediments to the movements of goods, services and skilled labour across borders. Under this pillar are reduction of non-tariff barriers, policies to harmonise trade and investment regulations and transport facilitation agreements that include the ASEAN Single Aviation Market and the ASEAN Single Shipping Market. The third and last pillar, people-to-people connectivity, aims to promote social and cultural exchanges through greater intra-ASEAN people mobility. As the ASEAN-World Bank Integration Monitoring Report (2013, pp.i–ii)[3] points out,

> "The AEC also seeks to bridge the development divide amongst ASEAN countries … [O]n the supply side, the freer flow of investment, technology and services across the region under AEC will boost productivity and supply. Last, but not least, the deep integration of AEC will provide a strong platform for the larger economic integration being discussed under the ASEAN + 3 and ASEAN + 6 umbrellas."

According to the 2013–2014 ASEAN Annual Report, major progress has been achieved in physical connectivity (ASEAN Secretariat, 2014). In particular, the ASEAN Highway Network and the Singapore-Kunming Rail Link sections from Singapore to Phnom Penh are progressing well. Three priority roll-on/roll-off shipping routes, namely General-Santos-Bitung route, Melaka-Dumai route and Belawan-Phuket-Penang route are already in operation. With regard to institutional connectivity, two work plans have been devised and implemented to facilitate the establishment of the ASEAN Single Aviation Market. Harmonisation of trade procedures is also under way with the adoption of ASEAN Trade in Goods Agreement and ASEAN Customs Declaration Document by seven ASEAN member states. For people-to-people connectivity, the ASEAN Curriculum Sourcebook for primary and secondary schools has been completed.

Nonetheless, the pace of adoption and implementation of the MPAC has been uneven among the ten ASEAN members. Additionally, some infrastructural projects have been postponed due to financial constraints (ASEAN Secretariat, 2014). While ASEAN has kick-started the creation of the ASEAN Infrastructure Fund and utilisation of public-private partnerships, among other financing mechanisms, much needs to be done

to improve the region's capacity in managing such schemes. Notwithstanding the challenges that ASEAN as a region faces in realising the success of AEC, the ultimate goal of such regional integration attempts is to foster deep economic integration by boosting connectivity that will have a significant bearing on accelerating economic growth and development in the region.

Considering that the MPAC is a large policy program that is pivotal to the success of the AEC goal, this is one of the first papers that offers empirical insights on the MPAC and its potential contribution to the success of AEC. Specifically, we offer an empirical examination of the economic impact of the MPAC on the ASEAN region's growth as well as the impact of economic interdependence within ASEAN economies as well as between ASEAN and the rest of the world (ROW). Our empirics focuses on various economic and connectivity dimensions during the first three years since its official implementation in 2011–2013.

The remainder of the paper is structured as follows. Section 2 uses an autoregressive distributed lag (ADL) model with a trend term to assess if the MPAC has produced any quantifiable impact in fostering economic growth within ASEAN. In addition to the growth effects, recognising that one of the core objectives of the MPAC is to boost connectivity both within ASEAN and also between ASEAN and its major trading partners, in Section 3 we employ a structural vector auto regression (SVAR) model to examine both the region's intra-regional interdependencies as well as the interdependencies vis-à-vis ASEAN's traditional and emerging trading partners namely the OECD bloc of economies, China and India. Section 4 concludes the paper with some policy implications.

2 Literature review

Economic integration is a complex and multi-dimensional issue which encompasses issues such as trade, infrastructure, finance and access to information among others. In economic literature, economic integration is typically viewed through the lens of free trade and its impacts on growth. Bretschger and Steger (2004) provide a concise review of the existing literature and theory surrounding the impact of free trade on economic growth. The impact of free trade is expressed through two channels, scale-effect and factor-reallocation. The strand of literature focused on scale-effects based on the increased size of the economic unit post integration finds consistently positive effects on economic growth. The literature on factor-reallocation posits that resource allocations may shift and there is the possibility of negative impacts from integration.

There is a paucity of literature on the impact of ASEAN integration. Some empirical work on the topic before the implementation of the AEC and MPAC finds limited potential gains from ASEAN FTAs due to limited intra-ASEAN trade and also due to trade barriers (Sharma and Chua, 2000). Tan et al. (2015) find that even within more developed ASEAN5 (Indonesia, Malaysia, Philippines, Singapore, Thailand) mutually re-enforcing growth effects have been very low and in fact weakened prior to the introduction of MPAC. However, some studies on intra-ASEAN FTAs and reduced trade barriers find that participation in FTAs tends to enhance economic welfare and that reduction in non-tariff barriers significantly increase the benefits of liberalisation and integration (Itakura, 2014; Petri et al., 2012).

There is recognition of the value of lowering non-tariff barriers to trade in the MPAC's emphasis on infrastructure and logistics. This emphasis is also reflected in academic work surrounding the nexus of infrastructure, physical connectivity and economic integration. The dire lack of infrastructure in driving integration into global networks for trade and its relevance in accelerating economic growth, poverty alleviation and development has been well recognised by major institutions (Bhattacharyay, 2009; UNESCAP, 2006). There is also a focus on physical connectivity which has also been well studied, with empirical estimates showing potential gains. This strand of literature finds that the improved connectivity enhances the benefits of trade, enhances productivity and narrows development gaps (Bhattacharyay, 2012; Isono and Kumagai, 2016; Itakura, 2014).

The literature in general holds that the concept of improved ASEAN integration is beneficial to the participating economies and besides short term benefits that arise from efforts such as infrastructure investment, the long term benefits from integration in general are gained from increased trade, improved access for isolated locations and accelerated productivity improvements. The literature also widely recognises financing as a major requirement and limiting factor to regional integration. Nevertheless, as emphasised in the previous section, empirical assessments of the impact of MPAC are yet to be seen and our exercise provides an opening for this investigation.

3 Trend analysis of real GDP

We begin with a trend analysis of growth in ASEAN economies. The aim here is to analyse the trends of real GDP for the ASEAN-10 economies before and after the implementation of the MPAC in 2010. To understand the differential impact, we employ an ADL model with a trend term. The model for quarterly real GDP of a particular country is formulated as:

$$\ln\left(real\ GDP_t\right) = cons + \beta_1 \ln\left(real\ GDP_{t-1}\right) + \beta_2 t + \beta_3 MPAC\ dummy + \beta_4 t * MPAC\ dummy + \varepsilon_t$$

where

cons	constant term
ln(*real GDP*$_t$)	natural log of current value of seasonally adjusted quarterly real GDP
ln(*real GDP*$_{t-1}$)	natural log of the first lag of seasonally adjusted quarterly real GDP
t	time trend (*t* = 1,2,…)
MPAC dummy	a step dummy variable indicating when the MPAC took effect
t * *MPAC dummy*	interaction term between the trend term and the MPAC dummy
ε_t	error term.

This regression function allows us to study the effect of past values on the current values of the variables on real GDP, the time effect and the effect of MPAC. The coefficients we are most keen to investigate are those of the MPAC dummy and the interaction term

between the trend term and the MPAC dummy in the equation which enables us to assess whether MPAC has yielded any impact on the variables of interest.

In our model for real GDP, the MPAC dummy essentially divides the sample used in this equation into two parts: before and after MPAC took effect. If the MPAC did not have any impact on quarterly real GDP, the regression function would be the same over both parts of the sample, so the terms involving the MPAC dummy would not enter the regression function at all. In other words, $\beta_3 = \beta_4 = 0$. On the contrary, if the MPAC affected quarterly real GDP, the regression function would be different before and after the MPAC took effect, which means at least one of β_3 and β_4 would be non-zero.

The regression function was estimated for each ASEAN country, subject to data availability using simple ordinary least squares (OLS) method. Finally, it should be noted that the Hanoi Declaration on the Adoption of MPAC was signed in late October 2010 so the effects of MPAC, if there were any, could only become apparent post-2010. However, the exact timing when the MPAC began to affect the variables of interest is uncertain. While it is true that ASEAN policies and agreements are non-binding and hence the adoption of policy at the ASEAN level does not immediately translate to adoption and implementation in ASEAN member states. To control for this uncertainty, we adopt different specifications for the MPAC dummy.

3.1 Data

The real GDP data of the ASEAN-10 economies were obtained through a variety of methods. Data for Indonesia, Malaysia, Philippines, Singapore and Thailand were retrieved from the Econometrics Studies Unit (ESU), Singapore Centre for Applied Economics (SCAPE)[4]. The base year for each GDP series varies across the economies studied.

For Brunei, Cambodia, Laos and Vietnam, we got the quarterly real GDP data at constant 2000 prices by disaggregating the annual real GDP data at constant 2000 prices using the Chow-Lin technique with a serial correlation adjustment. Details about this disaggregation technique are discussed in Abeysinghe and Rajaguru (2004). The basic idea here is to first come up with a predictive equation by estimating a regression function of the annual real GDP series on annual series of related macroeconomic variables. One can then use the quarterly figures of the related series to predict the quarterly GDP figures before adjusting them to match the annual aggregates. For Myanmar, we used spline interpolation to get quarterly real GDP data at constant 2000 prices from the corresponding annual real GDP.

In particular, for Brunei, real quarterly GDP data are available from the first quarter of 2003 onwards in the International Financial Statistics database published by the International Monetary Fund (IMF). We thus employed the Chow-Lin technique with a serial correlation adjustment to obtain quarterly real GDP growth rates. The related series used were nominal export growth rates. We then filled the missing quarterly values before 2003 using the disaggregated real GDP growth rates.

In Vietnam's case, the related series used were nominal trade and real M1 growth rates. We used the disaggregated real GDP growth rates and nominal GDP in the base year obtained from Vietnam's General Statistics Office to derive the quarterly real GDP series. For Cambodia, the methodology is the same as for Vietnam. The related series used were nominal trade and real M1 growth rates.

Similarly for Laos, the disaggregation was based on nominal exports as the related series. Afterwards, we divided the real GDP in 2000 prices for the year 2000 into four quarters equally and used the disaggregated quarterly real GDP growth rates to derive the real quarterly GDP values for the remaining years.

All quarterly real GDP series start in 2000 but some have shorter coverage than the rest. Specifically, the series for Brunei, Cambodia, Laos, Myanmar and Vietnam are from the first quarter of 2000 to the fourth quarter of 2013. For Indonesia, Malaysia, the Philippines and Singapore, the data is from the first quarter of 2000 to the second quarter of 2014. Thailand's GDP series is from the first quarter of 2000 to the third quarter of 2014. We used the Census X12 method to seasonally adjust the data.

3.2 Empirical results: trend analysis of quarterly real GDP

Table 1 summarises the estimation results for the constant term, the coefficient of the MPAC dummy and the coefficient of the interaction term between MPAC dummy and the trend term for each ASEAN country. The results are reported for two scenarios:

1 MPAC dummy equals to 1 for all quarters from 2011 onwards and 0 for all previous quarters

2 MPAC dummy equals to 1 for all quarters from 2012 onwards and 0 for all previous quarters.

As explained, we investigated two scenarios to account for uncertainty in the actual time taken for the impacts of MPAC, if any, to become apparent.

In fact, our results seem to suggest that the implementation of MPAC had no effect on real GDP for most ASEAN member states. The coefficient of the MPAC dummy turns out to be insignificant in most cases. Exceptions include the Philippines in scenario 1 and Thailand in scenario 2. The coefficient of the MPAC dummy for the former is negative and significant at the 5% level while that for the latter is positive and significant at the 5% level.

Meanwhile, the coefficient of the interaction term between the MPAC dummy and the trend term is also insignificant in most regressions. This term represents the change in the slope of the trend line for quarterly real GDP due to MPAC implementation. Exceptions in scenario 1 include the Philippines and Myanmar whose coefficients are positive and significant at 5% and 10%, respectively. In scenario 2, Thailand's coefficient is negative and significant at 5%. Such changes in significance levels for different specifications of the MPAC dummy may be attributed to the year effect, rather than the effect of the MPAC *per se*. It should be noted, however, that in all exceptions, the magnitude of the coefficients of the interaction term for Philippines, Myanmar and Thailand are close to zero.

To verify the robustness of our ADL model, we also produce a graphical analysis of the ASEAN-10's quarterly real GDP as a supplement to see if it supports the results of the ADL model. Figures 1 and 2 as well as Tables 2 and 3 present the corresponding results. While Figure 1 presents the year-on-year growth rates of seasonally adjusted quarterly real GDP in individual ASEAN economies, the corresponding logarithmic transformations are captured in Figure 2 for all the ASEAN economies. Tables 2 and 3 show the average year-on-year growth rates of seasonally adjusted quarterly real GDP for all the ASEAN economies.

Table 1 Trend analysis of quarterly GDP

Country	*Independent variables*	*MPAC dummy = 1 for all quarters from the first quarter of 2011 onwards*		*MPAC dummy = 1 for all quarters from the first quarter of 2012 onwards*	
		Coefficient	*P-value*	*Coefficient*	*P-value*
Brunei	Constant term	7.857866***	0.001	7.969072***	0.001
	MPAC dummy	0.099739	0.233	0.255572	0.108
	t*MPAC dummy	–0.002010	0.228	–0.004920	0.105
Cambodia	Constant term	0.693400	0.634	0.825822	0.519
	MPAC dummy	–0.02932	0.592	–0.049460	0.636
	t*MPAC dummy	0.000645	0.559	0.001002	0.615
Indonesia	Constant term	2.841125***	0.004	2.457289***	0.006
	MPAC dummy	0.0093372	0.585	0.022183	0.427
	t*MPAC dummy	–0.0001089	0.750	–0.000383	0.462
Laos	Constant term	2.087209**	0.023	2.004591**	0.016
	MPAC dummy	–0.005911	0.541	–0.020347	0.260
	t*MPAC dummy	0.000147	0.495	0.000435	0.247
Malaysia	Constant term	1.781912**	0.034	1.746253**	0.035
	MPAC dummy	–0.004854	0.895	0.001312	0.983
	t*MPAC dummy	0.000080	0.911	–0.000016	0.989
Myanmar	Constant term	–0.235030	0.164	–0.06847	0.633
	MPAC dummy	–0.046540	0.126	–0.015900	0.787
	t*MPAC dummy	0.001206*	0.053	0.000515	0.647
Philippines	Constant term	2.865845***	0.005	2.571257**	0.013
	MPAC dummy	–0.074365**	0.023	–0.032408	0.539
	t*MPAC dummy	0.001500**	0.020	0.000760	0.447
Singapore	Constant term	1.873537**	0.025	1.926953**	0.019
	MPAC dummy	0.075868	0.319	0.056364	0.652
	t*MPAC dummy	–0.001758	0.240	–0.001364	0.561
Thailand	Constant term	4.793769***	0.002	2.755224**	0.050
	MPAC dummy	0.034157	0.662	0.322479**	0.011
	t*MPAC dummy	–0.001134	0.463	–0.005816**	0.014
Vietnam	Constant term	0.260938	0.617	0.038624	0.935
	MPAC dummy	0.008596	0.476	–0.006276	0.765
	t*MPAC dummy	–0.000210	0.403	0.000089	0.826

Notes: *, ** and *** denote 10%, 5% and 1% significance level, respectively.

Source: Authors' calculation

Table 2 Average year-on-year growth rates analysis of seasonally adjusted quarterly real GDP*

	Before 2010	*2010–2014*	*2011–2014*	*2012–2014*	*2013–2014*
Indonesia	5.1064	6.0406	5.9677	5.7800	5.5013
Malaysia	4.3576	5.7716	5.3515	5.4288	5.3251
Philippines	4.4121	6.2091	5.8850	6.7731	6.7761
Singapore	4.9274	6.5693	4.0656	3.2550	3.7535
Thailand	4.0088	3.7549	2.6575	3.5667	1.7496

Note: *Indonesia, Malaysia, Philippines, Singapore and Thailand.

Source: Authors' calculation

Table 3 Average year-on-year growth rates analysis of seasonally adjusted quarterly real GDP*

	Before 2010	*2010–2013*	*2011–2013*	*2012–2013*
Brunei	1.2150	1.4332	0.9106	0.2352
Cambodia	8.2880	6.9305	7.2607	7.3630
Laos	6.9724	8.2756	8.1930	8.2712
Myanmar	10.7241	6.8705	7.3671	7.9288
Vietnam	6.6442	5.8356	5.6392	5.3367

Note: *Brunei, Cambodia, Laos, Myanmar and Vietnam.

Source: Authors' calculation

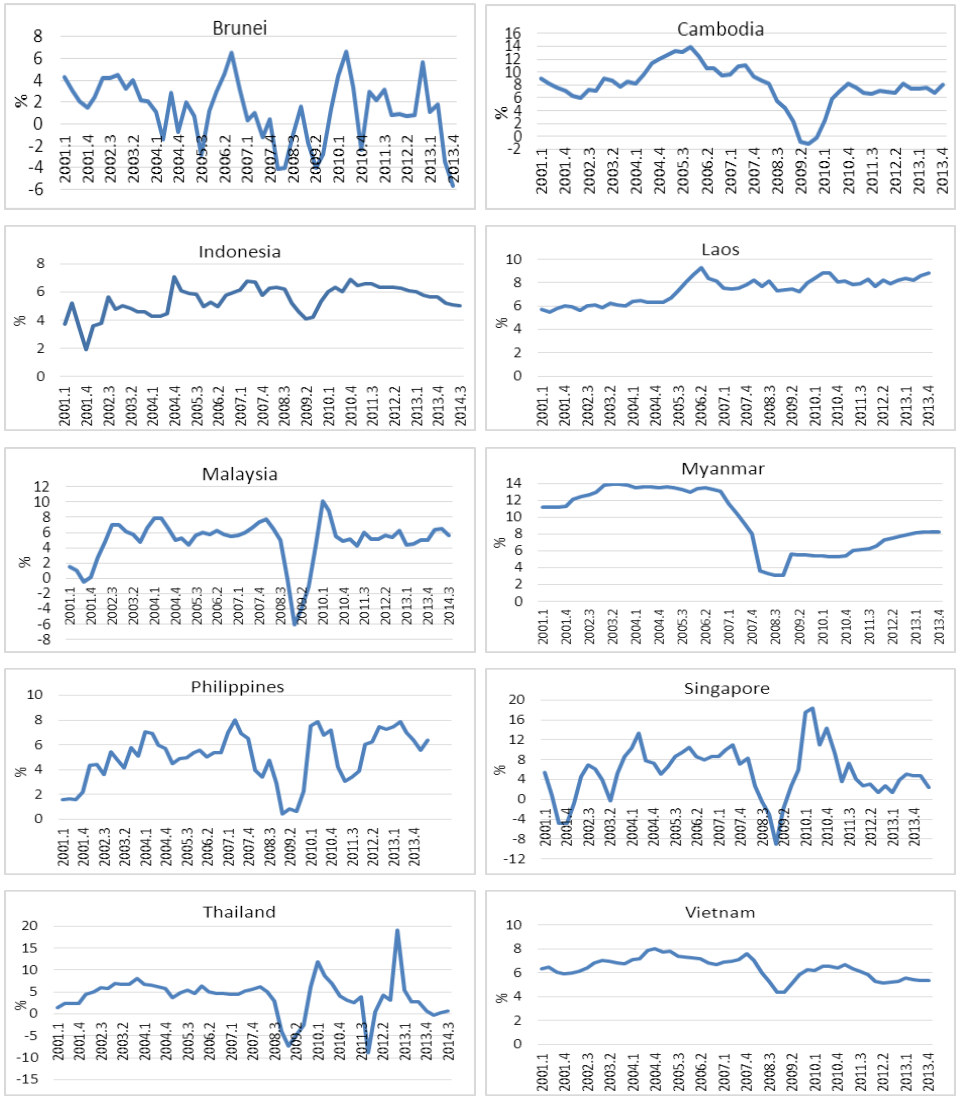
Some interesting trends emerge. First, we can observe that there is a small increase in the slope of the graphs for Myanmar and the Philippines after 2010. However, for other ASEAN economies, there is no clear shift in the level of GDP following the implementation of the MPAC in 2010. There is a dip in the GDP values in 2009 for all economies, with the exception of Laos, which corresponds to the 2008–2009 Global Financial Crisis. For Thailand, there is a second prominent dip in 2012, after which the country's slope (growth rate trend) declined. This can be seen in the significantly negative interaction dummy of Thailand. For the Philippines, there is a dip in the GDP value in the year 2011 and this is supported by the significant and negative MPAC dummy.

Finally, we analysed the average year-on-year growth rates of the quarterly real GDP before 2010, between 2010 and 2013 (or 2014, depending on data availability), between 2011 and 2013 (or 2014), and from 2012 to 2013 (and from 2013 to 2014, subject to data availability). For Laos, Indonesia, Malaysia, the Philippines and Brunei, there was an upward shift in the average year-on-year growth rates, while Thailand, Cambodia, Vietnam and Myanmar saw a decline in their average growth rates from 2010 onwards. However, as shown in Figures 1 and 2, for economies that registered higher average year-on-year growth rates of quarterly real GDP from 2010, there was no clear shift in the level of the growth rates.

While the trend analysis does not seem to suggest that the MPAC has had any discernable effect on real GDP for most ASEAN economies, this could well be due to the implementation lags that are not potentially captured in the model. However, beyond the effects of enhanced connectivity on growth, of equal importance is the issue of

intra-regional and inter-regional interdependence of the ASEAN region. How does the MPAC affect the degree of interdependence among ASEAN economies? We take up this question for analysis empirically below.

Figure 1 Year-on-year growth rates of seasonally adjusted quarterly real GDP in individual ASEAN economies (see online version for colours)



Source: Authors' calculation

Figure 2 Natural log of seasonally adjusted quarterly GDP in individual ASEAN economies (see online version for colours)

Source: Authors' calculation

4 Assessing interdependence: SVAR model

In this section, we assess the dynamics of integration before and after the implementation of MPAC for the ASEAN economies. We adopt a SVAR model developed in Abeysinghe (2001) and Abeysinghe and Forbes (2005) to examine the evolution of ASEAN's economic interdependence, as well as dependence on the traditional and

emerging growth engines, before and after the implementation of MPAC. First, we will focus on the ASEAN-8 economies, namely Brunei (BRN), Cambodia (KHM), Indonesia (IDN), Malaysia (MYS), the Philippines (PHL), Singapore (SGP), Thailand (THA) and Vietnam (VTN). The complete SVAR model specified here includes quarterly GDP growth rates of the ASEAN-8 economies and three control economies, namely China (CHN), India (IND) and OECD, over the period 2000–2013. For each of these 11 economies, we require their exports to each of the other 10, making up a total of 110 bilateral export share series, to generate multiplier effects of a growth shock in one economy on the growth of others in the model. The linking matrix of bilateral export shares changes over time. In this matrix, one country's export share to itself is set to unity[5].

4.1 SVAR methodology

The SVAR model allows us to directly estimate the multiplier effects of a growth shock in one economy on the growth of the others by capturing the transmission of a growth shock through both direct and indirect trade channels. The steps involved in deriving the VAR structure are as follows.

The first step is to focus on the determinants of total output (Y_i) for an individual country i and then extend the framework to a system of equations linking all n economies in the sample (with $i = 1, 2, \ldots, n$). Since we initially focus on only one country, we drop the subscript i to simplify notation. A country's output can be written as:

$$Y = X + A \tag{1}$$

where X and A are the export and non-export components of output, respectively. The country's total exports can also be expressed as the sum of exports to each of the other n economies and exports to the ROW:

$$Y = \sum_{j=1}^{n+1} X_j + A \tag{2}$$

where $i \neq j$ and the index value $(n + 1)$ indicates ROW. This condition continues to apply to all of the equations below.

Writing equation (2) in terms of growth rates instead of levels yields:

$$dY/Y = 1/Y\left[\sum_{j=1}^{n+1} dX_j + dA\right]. \tag{3}$$

Next, express exports from country i to country j as a reduced-form function of output (income) of country j:

$$X_j = X_j\left(Y_j\right) \tag{4}$$

Differentiating (4) yields:

$$dX_j = \left(\partial X_j/\partial Y_j\right) dY_j \tag{5}$$

Next, inserting (5) into (3) and rearranging terms yields:

$$dY/Y = X/Y \sum_{j=1}^{n+1} \left[\eta_j \left(X_j/X \right) \left(dY_j/Y_j \right) \right] + dA/Y \tag{6}$$

where $\eta_j = (\partial X_j/\partial Y_j)\ (Y_j/X_j)$ is the income elasticity of exports with respect to country j's income. We assume that income elasticities are equal across economies and set $\eta_j = \eta$. Then adding country and time subscripts and using lower-case letters to indicate growth rates, equation (6) can be written as:

$$y_{it} = \alpha_i y_{it}^f + u_{it}, \quad i = 1, 2, \ldots, n \tag{7}$$

where $\alpha = \eta X/Y$, $y^f = \sum_{j=1}^{n+1} \left(X_j/X \right) y_j$ and u_{it} captures any omitted variables not included in trade linkages. $\alpha = \eta X/Y$ is assumed to be time-invariant. The omitted variables captured by u_{it} are likely to be correlated over time as well as across equations. We assume that the vector $u_t = (u_{1t}, u_{2t}, \ldots, u_{nt})'$ follows a vector ARMA process, $D(L)u_t = E(L)e_t$, where $D(L)$ and $E(L)$ are vector polynomials in the lag operator L of orders p^* and q^*, respectively, and e_t is a vector white noise process with a zero mean and a diagonal covariance matrix. Using this error structure and rewriting (7) in vector format yields:

$$\begin{aligned} y_t &= A y_t^f + u_t \\ &= A y_t^f + D(L)^{-1} E(L) e_t \\ &= A y_t^f \left[D(L)^* / \left| D(L) \right| \right] E(L) e_t \end{aligned}$$

or

$$\left| D(L) \right| y_t = \left| D(L) \right| A y_t^f + v_t \tag{8}$$

where $A = diag(\alpha_1, (\alpha_2, \ldots, (\alpha_n)$, $|D(L)|$, and $D(L)^*$ are the determinant and adjoint matrices of $D(L)$, respectively, and $v_t = D(L) * E(L)e_t$ is an $(n \times 1)$ vector. Note that every equation of (8) has the same autoregressive (AR) polynomial given by $|D(L)|$, while each v_{it} follows a separate MA process.

Next, we assume that the serial correlation of v_{it} can be captured through an AR structure. This has the additional benefit of relaxing the constraint that each equation (8) must follow the same AR polynomial. Equation (7) can therefore be expressed as an ADL model with white noise errors:

$$y_{it} = \lambda_i + \sum_{j=1}^{p} \varphi_{ji} y_{it-j} + \sum_{j=0}^{p} \beta_{ji} y_{it-j}^f + \varepsilon_{it} \tag{9}$$

where $y_{it}^f = \sum_{j=1}^{n+1} w_{ij} y_{jt}$, $i \neq j$, and w_{ij} is the export share from the i^{th} country to country j. The entire system of equations is formed by estimating equation (9) for each of the n economies in the world. One may consider the similarity of (9) to factor models mentioned in Introduction.

Although these n equations appear to take the form of seemingly unrelated regressions (SUR), they can also be expressed as a structural VAR. This SVAR formulation is useful for the purpose of estimation, forecasting, and impulse-response

analysis. More specifically, if $n = 3$ and $p = 1$, then the system of equations can be written as:

$$(B_0 \cdot W)\, y_t = \lambda + (B_1 \cdot W)\, y_{t-1} + \varepsilon_t \tag{10}$$

where

$$B_0 = \begin{pmatrix} 1 & -\beta_{01} & -\beta_{01} \\ -\beta_{02} & 1 & -\beta_{02} \\ -\beta_{03} & -\beta_{03} & 1 \end{pmatrix}, B_1 = \begin{pmatrix} \varphi_{11} & \beta_{11} & \beta_{11} \\ \beta_{12} & \varphi_{22} & \beta_{12} \\ \beta_{13} & \beta_{13} & \varphi_{33} \end{pmatrix}, W = \begin{pmatrix} 1 & w_{12} & w_{13} \\ w_{21} & 1 & w_{23} \\ w_{31} & w_{32} & 1 \end{pmatrix}$$

and '$\cdot$' indicates the Hadamard product giving the element-wise product of two matrices. Note that in the W matrix w_{ij}'s in each row do not sum to unity because ROW is not a country to be modelled in our study.

The general VAR(p) form of (10) is:

$$(B_0 \cdot W_t)\, y_t = \lambda + (B_1 \cdot W_{t-1})\, y_{t-1} + \ldots + (B_p \cdot W_{t-p})\, y_{t-p} + \varepsilon_t \tag{11}$$

where y_t, ε_t and λ are ($n \times 1$) vectors, $B_j (j = 0, 1, \ldots, p)$ W and $Var(\varepsilon_t) = \Omega$ are ($n \times n$) matrices, and ($B_j \cdot W_{t-j}$) are the effective parameter matrices that vary over time as the trading pattern changes.

Since n is large (14 in our case) the lag length, $p = 1$, would be sufficient to capture the dynamics. We use OLS to estimate the model. Abeysinghe and Forbes (2005) have experimented with 2SLS and 3SLS and found there was not much gain over OLS estimates. For a given W, and $p = 1$ the forecasting model can be written as

$$y_t = A_1 y_{t-1} + u_t$$

where $A_1 = (B_0 \cdot W)^{-1} (B_1 \cdot W)$ and $u_t = (B_0 \cdot W)^{-1} \varepsilon_t$.

In order to calculate the impulse responses and hence the output-multipliers, we write the moving-average representation of the VAR model as

$$y_t = \sum_{i=0}^{\infty} C_i u_{t-i} = \sum_{i=0}^{\infty} C_i \left(B_0 \cdot W\right)^{-1} \varepsilon_{t-i} \tag{12}$$

where C_i matrices are computed from the recursive relationship:

$$C_0 = I_n, C_i = \sum_{j=1}^{i} C_{i-j} A_j, i = 1, 2, \ldots$$

and if Ω is diagonal the impulse response matrix is $C_i(B_0 \cdot W)^{-1}$. Thus the effect of a unit shock in the j^{th} country on itself and others at time $t + i$ is given by $\partial y_{t+i}/\partial \varepsilon_{jt} = C_i b_j$, where b_j is the j^{th} column of $(B_0 \cdot W)^{-1}$. Instead of a unit shock we may use a one-standard deviation shock to account for the relative variability of different shocks. For diagonal Ω, using the result that $P\Omega P' = I$, where $P = diag(\sigma_1^{-1}, \sigma_2^{-1}, \ldots, \sigma_n^{-1})$, we can replace ε_{t-i} in (12) with $P^{-1}\varepsilon_{t-i}$ to obtain the standardised innovations $v_{t-I} = P\varepsilon_{t-i}$ with var(v_{t-i}) = I. The corresponding impulse-response matrix is $C_i(B_0 \cdot W)^{-1}P^{-1}$, from which we obtain $\partial y_{t+i}/\partial \varepsilon_{jt} = C_i b_j \sigma_j$, where σ_j is the innovation standard deviation of country j. The impulse responses corresponding to a unit shock can be rescaled to obtain the effect of a shock of a desired magnitude.

4.2 Data

Quarterly bilateral export values (in USD) were obtained from the Direction of Trade Statistics (DOTS) database. We computed the export shares and converted them to 12-quarter moving averages to smooth out the movements of the data.

For OECD, the nominal quarterly GDP in USD was collected from OECD database and then deflated to real GDP using GDP deflator and 2010 as the base year. For Indonesia, Malaysia, Philippines, Singapore, Thailand, China and India, the quarterly real GDP was retrieved from the SCAPE website[6]. We disaggregated quarterly real GDP series from annual data for remaining ASEAN economies by applying the Chow-Lin technique with a serial correlation adjustment as noted earlier.

In our SVAR model, China, India and OECD are the control economies. We have thus included ASEAN's biggest trading partners, namely the EU and the USA, as well as smaller ones including Australia, Japan, South Korea under the OECD grouping.

4.3 Empirical results for ASEAN-8

We estimated the SVAR model and obtained the impulse response matrices using two different export share matrices representing the periods of 2001–2010 and 2011–2013 to examine the relative importance of the three external engines of growth as well as ASEAN-8 as growth engines for each other before and after the adoption of the MPAC in 2010. Thus, we first introduced the shock to the economies using the export share matrix fixed at the fourth quarter of 2008 which is the 12-quarter moving average over 2006–2008. We did the same with the export share matrix as of the fourth quarter of 2013 which is the 12-quarter moving average over 2011–2013.

Table 4 One-year multiplier effects of a one percentage point positive growth shock on ASEAN-8 and others (pre-2010)

	Engine of growth										
	ASEAN-8								*Others*		
	BRN	*KHM*	*IDN*	*MYS*	*PHL*	*SGP*	*THA*	*VTN*	*CHN*	*IND*	*OECD*
BRN	0.740	0.003	**0.207**	0.103	0.033	0.115	0.064	0.066	**0.311**	0.110	**2.010**
KHM	0.002	1.160	0.089	0.152	0.045	0.184	0.085	0.134	**0.481**	0.085	**3.190**
IDN	0.000	0.001	0.746	0.036	0.010	0.038	0.016	0.020	0.094	0.013	**0.516**
MYS	0.006	0.012	0.192	1.221	0.087	**0.403**	0.180	0.175	**0.813**	0.147	**4.242**
PHL	0.002	0.006	0.096	**0.203**	0.822	**0.203**	0.098	0.104	**0.557**	0.072	**2.953**
SGP	0.010	0.019	**0.378**	**0.640**	0.137	1.189	**0.250**	**0.304**	**1.206**	0.195	**6.065**
THA	0.005	0.032	**0.205**	**0.367**	0.106	**0.361**	0.848	**0.237**	**0.942**	0.152	**4.931**
VTN	0.000	0.005	0.016	0.027	0.009	0.028	0.015	1.839	0.077	0.013	**0.419**
CHN	0.001	0.004	0.053	0.100	0.029	0.105	0.053	0.066	1.157	0.044	**2.045**
IND	0.000	0.002	0.001	0.035	0.008	0.029	0.005	0.036	0.130	0.477	**0.894**
OECD	0.002	0.005	0.078	0.136	0.042	0.146	0.077	0.075	**0.480**	0.081	3.309

Notes: Each row shows the effect on that country's GDP growth from a shock originating in the country listed in the given column. Values greater than 0.20 are in bold, except for own-country effects.

Source: Authors' calculation

Table 5 One-year multiplier effects of a one percentage point positive growth shock on ASEAN-8 and others (post-2010)

	Engine of growth										
	ASEAN-8								*Others*		
	BRN	*KHM*	*IDN*	*MYS*	*PHL*	*SGP*	*THA*	*VTN*	*CHN*	*IND*	*OECD*
BRN	0.743	0.008	0.156	0.168	0.038	0.141	0.109	0.186	**0.535**	0.147	**2.320**
KHM	0.006	1.166	0.142	0.200	0.052	**0.255**	0.131	0.178	**0.772**	0.117	**3.198**
IDN	0.001	0.002	0.751	0.040	0.011	0.041	0.020	0.031	0.141	0.016	**0.525**
MYS	0.011	0.020	**0.239**	1.218	0.087	**0.390**	**0.201**	**0.259**	**1.145**	0.173	**4.036**
PHL	0.005	0.012	0.140	**0.205**	0.828	**0.240**	0.130	0.178	**0.844**	0.096	**3.160**
SGP	0.018	0.032	**0.440**	**0.631**	0.130	1.187	**0.270**	**0.421**	**1.641**	**0.221**	**5.755**
THA	0.009	0.053	**0.272**	**0.375**	0.109	**0.355**	0.874	**0.337**	**1.318**	0.187	**4.752**
VTN	0.001	0.006	0.020	0.028	0.009	0.027	0.017	1.845	0.112	0.017	**0.416**
CHN	0.003	0.007	0.075	0.108	0.031	0.112	0.066	0.111	1.309	0.055	**2.045**
IND	0.000	0.003	0.002	0.036	0.008	0.030	0.007	0.057	0.190	**0.474**	**0.864**
OECD	0.005	0.010	0.123	0.165	0.051	0.179	0.109	0.142	**0.796**	0.115	3.663

Notes: Each row shows the effect on that country's GDP growth from a shock originating in the country listed in the given column. Values greater than 0.20 are in bold, except for own-country effects.

Source: Authors' calculation

Table 6 Difference in one-year impulse responses before and after 2010 for ASEAN-8

	Engine of growth										
	ASEAN-8								*Others*		
	BRN	*KHM*	*IDN*	*MYS*	*PHL*	*SGP*	*THA*	*VTN*	*CHN*	*IND*	*OECD*
BRN	0.003	0.005	–0.051	0.065	0.005	0.026	0.045	0.120	0.224	0.037	0.310
KHM	0.004	0.006	0.053	0.048	0.007	0.071	0.046	0.044	0.291	0.032	0.008
IDN	0.001	0.001	0.005	0.004	0.001	0.003	0.004	0.011	0.047	0.003	0.009
MYS	0.005	0.008	0.047	–0.003	0.000	–0.013	0.021	0.084	0.332	0.026	–0.206
PHL	0.003	0.006	0.044	0.002	0.006	0.037	0.032	0.074	0.287	0.024	0.207
SGP	0.008	0.013	0.062	–0.009	–0.007	–0.002	0.020	0.117	0.435	0.026	–0.310
THA	0.004	0.021	0.067	0.008	0.003	–0.006	0.026	0.100	0.376	0.035	–0.179
VTN	0.001	0.001	0.004	0.001	0.000	–0.001	0.002	0.006	0.035	0.004	–0.003
CHN	0.002	0.003	0.022	0.008	0.002	0.007	0.013	0.045	0.152	0.011	0.000
IND	0.000	0.001	0.001	0.001	0.000	0.001	0.002	0.021	0.060	–0.003	–0.030
OECD	0.003	0.005	0.045	0.029	0.009	0.033	0.032	0.067	0.316	0.034	0.354

Source: Authors' calculation

Table 7 Five-year multiplier effects of a one percentage point positive growth shock on ASEAN-8 and others (pre-2010)

	Engine of growth										
	ASEAN-8								*Others*		
	BRN	*KHM*	*IDN*	*MYS*	*PHL*	*SGP*	*THA*	*VTN*	*CHN*	*IND*	*OECD*
BRN	0.751	0.003	0.186	0.128	0.042	0.137	0.073	0.100	**0.409**	0.090	**2.703**
KHM	0.002	1.162	0.114	**0.206**	0.060	**0.241**	0.111	0.193	**0.670**	0.112	**4.406**
IDN	0.001	0.001	0.762	0.042	0.012	0.047	0.021	0.024	0.116	0.022	**0.631**
MYS	0.007	0.013	**0.221**	1.271	0.101	**0.455**	**0.207**	**0.233**	**0.989**	0.183	**5.376**
PHL	0.003	0.006	0.118	**0.232**	0.836	**0.238**	0.119	0.135	**0.661**	0.101	**3.611**
SGP	0.011	0.019	**0.426**	**0.709**	0.158	1.266	**0.294**	**0.380**	**1.443**	**0.265**	**7.531**
THA	0.005	0.033	**0.234**	**0.421**	0.122	**0.418**	0.894	**0.304**	**1.135**	0.192	**6.195**
VTN	0.000	0.005	0.021	0.038	0.012	0.041	0.019	1.952	0.117	0.018	**0.686**
CHN	0.002	0.004	0.065	0.114	0.032	0.123	0.063	0.080	1.207	0.066	**2.338**
IND	0.001	0.002	0.039	0.068	0.020	0.080	0.037	0.049	**0.214**	0.632	**1.209**
OECD	0.001	0.005	0.096	0.175	0.053	0.185	0.096	0.114	**0.612**	0.100	4.162

Notes: Each row shows the effect on that country's GDP growth from a shock originating in the country listed in the given column. Values greater than 0.20 are in bold, except for own-country effects.

Source: Authors' calculation

Table 8 Five-year multiplier effects of a one percentage point positive growth shock on ASEAN-8 and others (post-2010)

	Engine of growth										
	ASEAN-8								*Others*		
	BRN	*KHM*	*IDN*	*MYS*	*PHL*	*SGP*	*THA*	*VTN*	*CHN*	*IND*	*OECD*
BRN	0.753	0.009	0.163	**0.203**	0.048	0.180	0.122	**0.266**	**0.745**	0.131	**3.266**
KHM	0.006	1.169	0.184	**0.263**	0.070	**0.318**	0.166	**0.282**	**1.078**	0.151	**4.533**
IDN	0.001	0.003	0.770	0.048	0.013	0.053	0.027	0.040	0.177	0.031	**0.665**
MYS	0.012	0.023	**0.281**	1.278	0.104	**0.451**	**0.238**	**0.358**	**1.426**	**0.221**	**5.243**
PHL	0.006	0.013	0.177	**0.244**	0.844	**0.288**	0.162	**0.241**	**1.035**	0.141	**3.971**
SGP	0.019	0.036	**0.511**	**0.711**	0.154	1.277	**0.328**	**0.552**	**2.014**	**0.309**	**7.333**
THA	0.010	0.057	**0.319**	**0.438**	0.128	**0.425**	0.929	**0.448**	**1.636**	**0.239**	**6.131**
VTN	0.000	0.007	0.030	0.042	0.012	0.041	0.025	1.970	0.178	0.024	**0.706**
CHN	0.003	0.009	0.092	0.127	0.038	0.135	0.083	0.136	1.397	0.088	**2.398**
IND	0.003	0.004	0.056	0.072	0.019	0.083	0.041	0.076	**0.297**	**0.642**	**1.188**
OECD	0.005	0.013	0.157	**0.215**	0.065	**0.232**	0.139	**0.224**	**1.048**	0.147	4.747

Notes: Each row shows the effect on that country's GDP growth from a shock originating in the country listed in the given column. Values greater than 0.20 are in bold, except for own-country effects.

Source: Authors' calculation

Tables 4 and 5 present the one-year multiplier effects for pre-2010 and post-2010 periods which are calculated by summing up the impulse responses over four quarters. The difference in the one-year impulse responses before and after 2010, as shown in Table 6, provides an interesting snapshot of the decreased dependence of some ASEAN nations on OECD, namely Malaysia, Singapore, Thailand and, to a much lesser extent, Vietnam. Increased dependence on China as a growth engine is evident in all economies, albeit to various degrees. Increased interdependence within ASEAN can also be seen from the table. For instance, Singapore's interactions with Brunei, Cambodia and Philippines have increased in the period after 2010.

Table 7 and 8 present the five-year multiplier effects for pre-2010 and post-2010 periods. The five-year multiplier effects are calculated by summing up the impulse responses over 20 quarters. As shown in Table 7 and 8, the importance of ASEAN-8 as the growth engines for each other has not substantially increased, and even decreased in some cases, after the adoption of MPAC. ASEAN-8's multiplier effects on each other remain rather limited as compared to OECD and China. OECD is still the dominant engine of growth for ASEAN-8 although its relative importance has declined over time. China's growth effect on the ASEAN-8 has increased considerably, particularly for Cambodia, Malaysia, the Philippines, Singapore and Thailand, but has not surpassed the level of OECD. India's multiplier effects remain very small in both periods.

Table 9 Difference in the five-year multiplier effects pre- and post-2010 for ASEAN-8

	Engine of growth										
	ASEAN-8								*Others*		
	BRN	*KHM*	*IDN*	*MYS*	*PHL*	*SGP*	*THA*	*VTN*	*CHN*	*IND*	*OECD*
BRN	0.002	0.006	–0.023	0.075	0.006	0.043	0.049	0.166	0.336	0.041	0.563
KHM	0.004	0.007	0.070	0.057	0.010	0.077	0.055	0.089	0.408	0.039	0.127
IDN	0.000	0.002	0.008	0.006	0.001	0.006	0.006	0.016	0.061	0.009	0.034
MYS	0.005	0.010	0.060	0.007	0.003	–0.004	0.031	0.125	0.437	0.038	–0.133
PHL	0.003	0.007	0.059	0.012	0.008	0.050	0.043	0.106	0.374	0.040	0.360
SGP	0.008	0.017	0.085	0.002	–0.004	0.011	0.034	0.172	0.571	0.044	–0.198
THA	0.005	0.024	0.085	0.017	0.006	0.007	0.035	0.144	0.501	0.047	–0.064
VTN	0.000	0.002	0.009	0.004	0.000	0.000	0.006	0.018	0.061	0.006	0.020
CHN	0.001	0.005	0.027	0.013	0.006	0.012	0.020	0.056	0.190	0.022	0.060
IND	0.002	0.002	0.017	0.004	–0.001	0.003	0.004	0.027	0.083	0.010	–0.021
OECD	0.004	0.008	0.061	0.040	0.012	0.047	0.043	0.110	0.436	0.047	0.585

Source: Authors' calculation

Within ASEAN-8, the multiplier effects of each of the growth engines on Vietnam and Indonesia are the smallest, indicating that both being big economies with low per capita income are less dependent on external engines to drive the economy. Likewise, the multiplier effects of growth engines on the Philippines and Brunei are also small, which signifies the country's relatively lower dependence on external drivers of growth. In the case of Brunei, a small country with high per capita income, OECD is the most important engine of growth while China's importance has risen. China's importance on Cambodia has also increased over time and that of OECD has declined although OECD still remains

the country's primary growth engine. For Malaysia, while Singapore remains as a driver of growth, its importance has decreased over time as compared to China which sees an increase in its multiplier effect on Malaysia. Singapore is the prominent engine of growth within ASEAN as reflected in its relatively high multiplier effects on the remaining economies. Among Singapore's main growth engines, the effects of China, Vietnam and Indonesia on Singapore have increased while those of OECD and Malaysia have declined.

The differences in the five-year multiplier effects pre- and post-2010 are presented in Table 9. Overall, they are consistent with the direction of changes seen in Table 6, and larger in magnitude. In particular, the multiplier effects of Indonesia, Thailand and Vietnam, and to a lesser extent, Malaysia, on the majority of the remaining ASEAN member states have increased in the post-2010 period. Singapore's effect on Malaysia has declined slightly, while those on other ASEAN economies have gone up.

To summarise the results of our SVAR analysis we have obtained so far, Singapore, Malaysia and Thailand are more dependent than the rest of the ASEAN-8 economies on the external engines of growth. The dynamics of the growth engines have evolved over time, with China and India increasing in importance post-2010. However, the impact that India has on ASEAN-8 remains minimal. While China's multiplier effects on ASEAN-8 increased significantly after 2010 while those of OECD declined, they have not surpassed the effects of OECD on the regional grouping. OECD's growth effects on ASEAN-8 are still the largest in magnitude, reflecting the dominancy of OECD as a growth engine for the regional grouping.

4.4 Empirical results: the dynamic evolution of growth engines of ASEAN-5

As an additional empirical exercise, we also assess the dynamics of integration before and after the implementation of MPAC for the ASEAN-5 economies, namely Indonesia, Malaysia, the Philippines, Singapore and Thailand. OECD, China and India are again employed as control economies. We thus require the exports of each of these eight economies to the other seven, which makes up a total of 56 bilateral export share series. Using data over 2000–2013, we link the GDP growth rates of the eight economies and 56 bilateral export shares through the SVAR model to generate multiplier effects of a growth shock in one economy on the growth of others in the model.

We estimated the SVAR model and obtained the impulse response matrices using two different export share matrices for the periods of 2000–2010 and 2011–2013 to examine the relative importance of the external engines of growth on each of the ASEAN-5 economies before and after the implementation of the MPAC in 2010. Tables 10 and 11 present the multiplier effects between 2000 and 2010, and 2011 and 2013.

The multiplier effects in Table 10 and 11 show that the importance of ASEAN-5 as the growth engines for each other has increased, albeit to a limited extent, after the implementation of MPAC. ASEAN-5's multiplier effects on each other remain rather limited as compared to OECD and China. OECD is still dominant engine of growth for ASEAN-5. China's growth effect on the ASEAN-5 has increased markedly but has not surpassed the level of OECD. The Philippines and Thailand's multiplier effects on other economies remain small in both periods.

Within the ASEAN-5, the multiplier effects of each of the growth engines on Indonesia are the smallest, indicating that Indonesia, being a big country with low per capita income, is less dependent on external engines to help drive its economy. Hence,

the impact that each external engine has on Indonesia is smaller as compared to the remaining ASEAN-4. However, Indonesia's multiplier effects on other economies, particularly Singapore and Thailand, have increased over time.

Table 10 Multiplier effects of a one percentage point positive growth shock on ASEAN-5 and others (pre-2010)

	Engine of growth							
	ASEAN-5					*Others*		
	IDN	*MYS*	*PHL*	*SGP*	*THA*	*CHN*	*IND*	*OECD*
IDN	0.780	0.097	0.012	0.095	0.031	0.181	0.010	**0.917**
MYS	0.072	1.322	0.030	0.196	0.073	**0.298**	0.061	**1.447**
PHL	0.078	**0.233**	0.723	**0.210**	0.092	**0.477**	0.065	**2.319**
SGP	**0.236**	**0.508**	0.068	1.124	0.147	**0.643**	0.127	**2.919**
THA	0.160	**0.387**	0.074	**0.333**	0.857	**0.730**	0.120	**3.539**
CHN	0.064	0.156	0.027	0.152	0.069	1.263	0.074	**2.438**
IND	0.101	**0.213**	0.039	**0.240**	0.087	**0.521**	0.716	**2.695**
OECD	0.033	0.079	0.017	0.080	0.037	**0.234**	0.039	1.854

Notes: Each row shows the effect on that country's GDP growth from a shock originating in the country listed in the given column. Values greater than 0.20 are in bold, except for own-country effects.

Source: Authors' calculation

Table 11 Multiplier effects of a one percentage point positive growth shock on ASEAN-5 and others (post-2010)

	Engine of growth							
	ASEAN-5					*Others*		
	IDN	*MYS*	*PHL*	*SGP*	*THA*	*CHN*	*IND*	*OECD*
IDN	0.797	0.121	0.022	0.117	0.050	**0.300**	0.063	**1.058**
MYS	0.099	1.333	0.030	0.198	0.088	**0.450**	0.082	**1.529**
PHL	0.130	**0.240**	0.730	**0.272**	0.133	**0.741**	0.104	**2.660**
SGP	**0.285**	**0.521**	0.066	1.142	0.167	**0.895**	0.157	**2.978**
THA	**0.238**	**0.430**	0.085	**0.350**	0.888	**1.070**	0.173	**3.720**
CHN	0.105	0.180	0.034	0.172	0.094	1.459	0.107	**2.578**
IND	0.142	**0.232**	0.039	**0.261**	0.107	**0.686**	0.743	**2.677**
OECD	0.060	0.107	0.023	0.106	0.056	**0.408**	0.065	2.130

Notes: Each row shows the effect on that country's GDP growth from a shock originating in the country listed in the given column. Values greater than 0.20 are in bold, except for own-country effects.

Source: Authors' calculation

Likewise, the multiplier effects of growth engines on the Philippines are also small. Just like Indonesia, the Philippines with the lowest per capita income within the ASEAN-5 group is less dependent on external engines. For the Philippines, OECD remains the main driver of growth while China's importance has grown over the years.

For Malaysia, again OECD plays the dominant role as a growth driver by producing multiplier effects exceeding unity over both periods. China's multiplier effect has increased considerably but has not surpassed OECD's level. Malaysia's multiplier effects are substantial for Singapore, Thailand and, to a smaller extent, the Philippines but not for Indonesia.

Singapore's multiplier effects largely parallel that of Malaysia despite their difference in population size and land area. The similarities stem from the fact that the two neighbors are each other's largest trading partners. Despite China's substantial increase in its importance as a driver of growth, OECD remains the largest growth engine for Singapore. The impacts of both Malaysia and Indonesia on Singapore have increased slightly after the implementation of MPAC.

For Thailand, the multiplier effects of Singapore, Malaysia and Indonesia increased in the period 2011–2013. Similar to the other ASEAN-4, while China's importance as an external growth engine has increased considerably over time, OECD still exerts the most significant impact on Thailand's economy. Thailand's multiplier effects on the remaining ASEAN-4 economies remain small, albeit larger than that of the Philippines.

5 Conclusions and policy implications

This paper is a pioneering attempt to empirically evaluate the economic impact of the MPAC – the flagship connectivity policy package of the ASEAN bloc – on its member states' economies and component measures of physical and institutional connectivity. As such, it is a significant step forward for ASEAN to evaluate and recalibrate its policies and programs on community-building and connectivity, based on quantitative evidence and this paper does so by evaluating the impact of MPAC on the region's economic growth as well as its intra-regional and inter-regional interdependence.

While the trend analysis of growth in the region points to the existence of relatively modest effects of MPAC on economic growth in ASEAN, this could potentially be due to the implementation lags that are likely not captured in the analysis. More instructive, however, were the results of the SVAR model analysis that links bilateral export share series to GDP growth rates to estimate multiplier effects of eight ASEAN economies and three control economies (China, India, and OECD) on each other. These multiplier effects represent the impacts of an economic shock in one economy on others. Growth multipliers derived in our paper show that intra-ASEAN growth interdependence, while generally increasing, remains limited after the official adoption of MPAC in 2010. The ASEAN-8 economies still rely on OECD as their primary drivers of growth. China has emerged as an important external growth engine for ASEAN-8 as its multiplier effects on ASEAN-8 increased substantially in the period 2011-2013. Within ASEAN-5, Singapore and Malaysia are still important engines of growth for each other, although their growth effects have declined over time. Singapore and Malaysia are major engines of growth for Thailand.

Our results clearly emphasise the need for ASEAN members to be more earnest in their implementation of regional integration policies which will help them strengthen their trade and investment linkages within the region – a goal that the MPAC can help achieve that will eventually contribute to the realisation of the AEC vision. In fact, one of the intended objectives of the MPAC is to enhance the region's connectivity that will in turn throw open avenues for increased investment, trade and economic growth through

the deepening and widening of the production and distribution networks in the region. Enhanced regional connectivity will continue to uphold the ASEAN region's central role in the evolving global architecture. The positive spillover effects resulting from the success of the objectives of MPAC could go a long way in narrowing the development gaps among member economies in ASEAN.

References

Abeysinghe, T. (2001) 'Thai meltdown and transmission of recession within the ASEAN4 and NIE4', *International Financial Contagion*, Springer, Boston, MA, pp.225–240.

Abeysinghe, T. and Rajaguru, G. (2004) 'Quarterly real GDP estimates for China and ASEAN4 with a forecast evaluation', *Journal of Forecasting*, Vol. 23 No. 6, pp.431–447.

Abeysinghe, T. and Forbes, K. (2005) 'Trade linkages and output-multiplier effects: a structural VAR approach with a focus on Asia', *Review of International Economics*, Vol. 13 No. 2, pp.356–375.

Arvis, J.F. and Ojala, L. (2014) 'Connecting to compete: the 2014 logistics performance index', *Transport Business Summit 2014*, Brussels [online] http://ec.europa.eu/transport/media/events/2014-03-27-business-summit/world-bank-presentation.pdf (accessed 11 January 2016).

ASEAN Secretariat (2010) *Master Plan on ASEAN Connectivity*, ASEAN Secretariat, Jakarta [online] http://www.asean.org/images/2012/publications/Master%20 Plan%20on%20ASEAN %20Connectivity.pdf (accessed 10 July 2015)

ASEAN Secretariat (2014) *Association of Southeast Asian Nations Annual Report 2013–2014: Moving Forward in Unity – To a Peaceful and Prosperous Community*, ASEAN Secretariat, Jakarta [online] https://www.asean.org/storage/images/ASEAN_RTK_2014/8.%20ASEAN% 20Annual%20Report%202013-2014.pdf (accessed 27 September 2018).

Banomyong, R. (2015) *Business Potential of the ASEAN Economic Community in 2030*, SMU Asian Management Briefs, Singapore [online] http://cmp.smu.edu.sg/amb/article/20150804/business-potential-asean-economic-community-2030 (accessed 11 January 2016).

Bhattacharyay, B.N. (2009) *Infrastructure Development for ASEAN Economic Integration*, ADBI Working Paper, Asian Development Bank Institute, Tokyo [online] http://www.adbi.org/working-paper/2009/05/27/3011.infrastructure.dev.asean.economic/ (accessed 11 January 2016).

Bhattacharyay, B.N. (2012) 'Seamless sustainable transport connectivity in Asia and the Pacific: prospects and challenges', *International Economics and Economic Policy*, Vol. 9, No.2, pp.147–89.

Bretschger, L. and Steger, T.M. (2004) 'The dynamics of economic integration: theory and policy', *International Economics and Economic Policy*, Vol. 1, No. 2, pp.119–134.

Isono, I. and Kumagai, S. (2016) 'Economic impacts of improved connectivity for ASEAN: an application of the geographical simulation model', *Asian Economic Policy Review*, Vol. 11, No. 2, pp.290–306.

Itakura, K. (2014) 'Impact of liberalization and improved connectivity and facilitation in ASEAN', *Journal of Asian Economics*, Special Issue on the *ASEAN Economic Community*, December, Vol. 35, pp.2–11.

Petri, P.A., Plummer, M.G. and Zhai, F. (2012) 'ASEAN economic community: a general equilibrium analysis', *Asian Economic Journal*, Vol. 26, No. 2, pp.93–118.

Sharma, S.C. and Chua, S. Y. (2000) 'ASEAN: economic integration and intra-regional trade', *Applied Economics Letters*, Vol. 7, No. 3, pp.165–169.

Tan, K.Y., Abeysinghe, T. and Tan, K.G. (2015) 'Shifting drivers of growth: Policy implications for ASEAN5', *Asian Economic Papers*, Vol. 14, No. 1, pp.157–173.

UNESCAP (2006) *Enhancing Regional Cooperation in Infrastrucuture Development Including That Related to Disaster Management*, United Nations Economic and Social Commission for Asia and the Pacific, New York [online] https://www.unescap.org/sites/default/files/themestudy_2006_full.pdf (accessed 11 January 2016).

Notes

1 Ten member states, viz. Brunei, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

2 The AEC Blueprint 2025 succeeded the AEC Blueprint (2008–2015) adopted in 2007 and was formally adopted as a part of 'ASEAN 2025: Forging Ahead Together', at the recently concluded ASEAN leaders' 2015 summit.

3 The report is accessible from: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2014/01/10/000333037_20140110130228/Rendered/PDF/839140WP0P14480Box0382116B00PUBLIC0.pdf (accessed 11 January 2016).

4 See http://www.fas.nus.edu.sg/ecs/esu/data.html.

5 Please refer to the report on 'Economic Interdependence among ASEAN-5 Before and After the Implementation of the Master Plan on ASEAN Connectivity (MPAC)' which is based on Tan et al. (2013) for details on the SVAR methodology.

6 See http://www.fas.nus.edu.sg/ecs/esu/data.html.