Chapter 12

Business-Cycle Transmission Mechanism in ASEAN+3: Financial Integration or Trade?

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CHAPTER 12

Business-Cycle Transmission Mechanism in ASEAN+3: Financial Integration or Trade?

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The recent global recession requires policymakers to identify the relative importance of shock-transmission mechanisms in each region and devise policy counter-measures against future external-country shocks. In the past decade world dynamics have changed considerably due to increased openness and integration, requiring examination of the characteristics of business cycles at regional levels. This chapter shows that due to the presence of a short-term causal relationship of financial variables with GDP in the Association of South-East Asian Nations Plus Three (ASEAN+3) region, the slowdown contagion spread to most countries within the region. The slowdown triggered a trade variables shock-transmission mechanism, too. As a result, we observe co movements of business cycle of the region with the business cycle of the shock originating external country. Therefore, business cycle convergence and decoupling phenomena of the region to the shock originating external country (US) depend not only on the origin of the shock in the external country but also on the relative importance of the transmission mechanisms between shock originating external countries and other regions. For policy purposes, knowing the correct transmission mechanism will help in tailoring an appropriate response to the idiosyncratic disturbance and is helpful in achieving long-term regional development goals.

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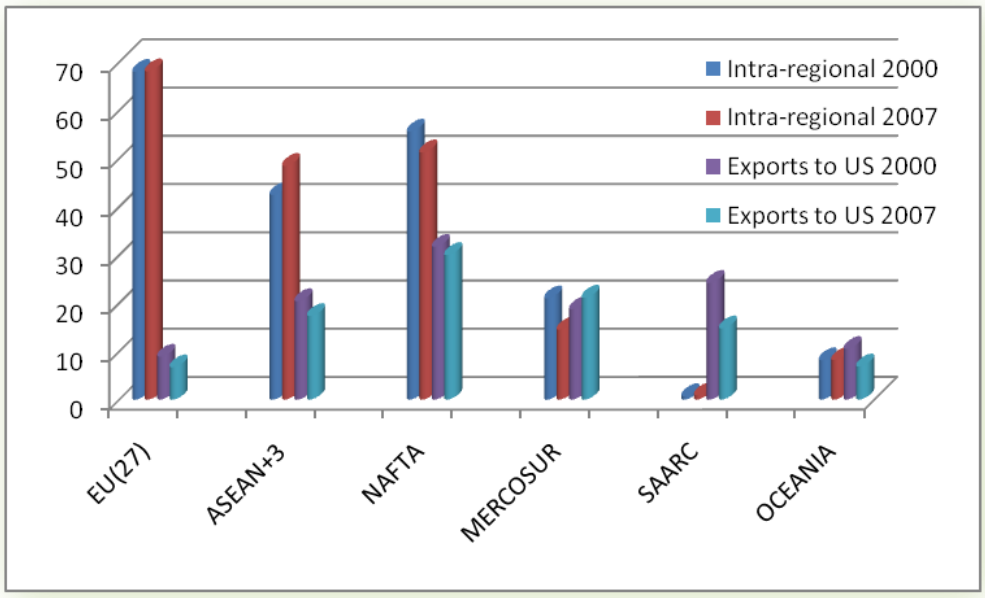
***JEL Classifications*:** E32, R11, F44

1. Introduction

The increased openness and integration across nations—whether through trade liberalization or financial integration—has changed world dynamics. Regional blocs are growing and the share of intra-regional trade in world trade is now more than the share of inter-regional trade. In the Association of South-East Asian Nations Plus Three (ASEAN+3) region, intra-regional trade accounts for almost half of its total trade (Figure 1). The most significant development in the world arena was the accession of China to the World Trade Organization (WTO) in 2001. Since its accession, China has increased its exports almost four times while its imports have increased three times. Some 45 percent of its trade receipts stem from Asia while the United States and the European Union account for 21 per cent of its exports (WTO, 2008). Given the increasing globalization, economies have enhanced their integration regionally and globally.

Figure 1. Evolving Trade Patterns Around the World



In this context, if economic turbulence originates from external-country shocks, so far, most research has focussed on exploring whether other countries or regions are

decoupled from the shock or not. If, however, the disturbance is global and systemic in nature, affecting all countries at the same time, the studies focus on examining correlations among the macroeconomic variables at country or regional levels. In the case of external-country shocks, the studies focus on observing the business-cycle movements of countries or regions to the business cycle of the crisis-affected country or region. If there is co-movement in the business cycle of the region to the shock originating external country, then the countries are said to have convergence in their business cycles with the shock originating external country. If not, then countries or regions business cycles are said to be decoupled to the business cycle of the shock originating external country. By focussing on outcomes and not considering transmission mechanisms, the task of designing policy to dampen the effect of shocks on a country's or region's output becomes cumbersome.

Despite consensus on the spill-over determinants of the business cycles that include trade integration, financial integration, exchange rate, remittances, commodity prices and fiscal convergence, ambiguity persists in the spill-over impact of these determinants on business-cycle synchronization. We hypothesize that in the case of external-country shocks, all spill-over determinants of business cycles might not be relevant at the same time. Rather, the spread of contagion might depend on the origin and nature of the shock, the relative importance of the transmission mechanisms and the specific characteristics of each region or country due to the interplay of integration forces such as production networks.[1] To explore this, we identify the relative importance of shock propagation channels in ASEAN+3, and test the empirical findings for each country by observing the region's responses to the external-country shocks.

The remainder of the paper is organized as follows: Section 2 provides a brief overview of previous studies, while Section 3 sets out the methodological framework along with data sources. Section 4 presents test results for panel unit-root and panel co-integration and also traces the transmission mechanism among macroeconomic variables. Section 5 concludes.

[1] The regional propagation dynamics, however, might be different from the country-specific channels and therefore regional and countries' decoupling outcomes could be different.

2. Evidence from the Literature

Apart from other explanations such as industrial structure, we investigate, at the regional level, whether out of all the shock-transmission channels—namely, trade integration, financial integration, exchange rate, industrial structure, commodity prices and fiscal convergence—there are any specific channels that behave like an Achilles heel for ASEAN+3 under different crisis scenarios. Examples are: the relative importance of each transmission mechanism during the sub-prime mortgage crisis shock of August 2007 (falling US housing prices) and the shock generated by the fall of Lehman Brothers in September 2008. Due to the different origins of the shocks, knowing the relative importance of each channel would tell us about the special characteristics of ASEAN+3 (production networks) (Figure 2).

Figure 2. Growth Pattern Across ASEAN+3

In the literature, there is theoretical agreement on the factors that cause movements in business cycles. There is, however, no consensus on the role of these factors (channels) in bringing about convergence or decoupling among countries' or regions' business cycles. This is important because apart from the domestic determinants of growth such as human capital, there are exogenous channels—for example, foreign direct investment (FDI), short-term capital flows, exports and imports—that contribute to growth and also act in the same manner as growth-destabilizing factors such as in times of crisis.

Agreement is lacking among empirical theorists on the impacts of international trade linkages on business cycles. Closer trade ties could result in either a tighter or a

looser correlation of business cycles and there will be output correlations among trading partners trading intensively (Baxter and Kouparitsas 2005; Frankel and Rose 1998). Kenen (2000), using a Keynesian model, and Kose and Yi (2006), using the international business-cycle model, conclude a positive relationship between trade and output. Imbs (2004) finds a sizeable impact of intra-industry trade on bilateral correlations compared with the smaller inter-industry trade impacts. Empirical findings also show common business cycles for the East Asian region (Sato and Zhang, 2006). Rana (2006, 2007) and Shin and Sohn (2006) find trade to be an important determinant of business-cycle synchronizations. Kumakura (2006) suggests the increasing share of electronic products in foreign trade as a reason for business-cycle co-movements for Pacific countries, while Hallet and Richeter (2008) find the declining importance of the United States for Asia. Therefore, we include industrial structure in our empirical estimations to account for its effect on GDP. In addition, Arndt (2006) argues that intra-industry trade in countries of the European Economic Community (EEC) is intra-industry in nature but different from production sharing as the former involves the two-directional flows of finished varieties. Therefore, production sharing under a preferential trading arrangement (PTA) would be trade creating and would reduce asymmetries between countries, resulting in cyclical convergence. The opposing view, however, suggests that trade integration leads to more specialization based on comparative advantage in the production of goods. Consequently, the importance of asymmetrical or sector-specific shocks increases with economic integration, leading to idiosyncratic business cycles (Krugman, 1993). Hence, consensus is lacking among theorists.

Financial integration also presents ambiguous theoretical support for its impact on business-cycle synchronization. Imbs (2004, 2006), Inklaar et al. (2008) and Kose et al. (2003) find a positive correlation between financial integration and business-cycle co-movements. This relationship is, however, weak in developing countries due to a plunge in stock-markets distributing negative wealth effects for asset holders around the world. Bordo and Helbling (2004) find no significant effect of financial integration. Conversely, international diversification of portfolios might allow consumption smoothing due to risk-sharing that might not require diversification in production bases and might lead to greater specialization and fewer co-movements in business cycles

(Kalemli-Ozcan et al., 2001). Kose et al. (2008) find evidence for the convergence of business cycles within Organization for Economic Cooperation and Development (OECD) countries and emerging countries but suggest decoupling of business cycles between these two groups. Fidrmuc and Korhonen (2009) also find little correlation between the business-cycle frequencies of India and China and the OECD. Again, we observe ambiguous theoretical support for the role of financial integration in bringing about business-cycle synchronization.

Regarding exchange rate volatility, Leung (1997) argues that empirical evidence has failed to show any systematic link between short-term exchange rate volatility and the volume of bilateral and multilateral trade. She further suggests, however, that patterns of trade could be affected by exchange rate volatility and argues that currency invoicing of trade matters and currency hedging provide reasonably cost-effective ways of managing exchange rate volatility. Siregar et al. (2010) have argued that volatile local currencies are central to the poor performance of trade and overall economic growth in many countries in the ASEAN+3 region. McKinnon (2000) comments on the East Asian currency standards by considering the financial depth in these countries. He argues that while a common monetary standard is not as good as a common currency, it is preferable among close trading partners compared with (unrestricted) exchange rate flexibility. Similarly, Mundell (2000) argues that free-trade areas and currency areas reinforce each other. Using a gravity equation, Baldwin (2006), Glick and Rose (2002), Micco et al. (2003) and Rose (2000) find currency unions raise bilateral trade. Cappiello et al. (2006) and Lane and Milesi-Ferretti (2007), however, show greater financial integration as a result of euro introduction. Co-movements of business cycles can also occur when a country pegs its exchange rate (Patnaik et al., 2007). Thus, diverging views are formed regarding exchange rate volatility and its impact on business cycles.

Currency carry trade can also be used as a speculative vehicle to transmit shocks and bring about co-movements in other regions. The World Bank *Global Development Finance* report (2009) estimates the volume of carry trade between US$200 billion and US$1 trillion. The report suggests that carry trades keep high-yielding currencies such as the Indonesian rupiah, Mexican peso, South African rand and Brazilian real at relatively high appreciated levels. During the Global Financial Crisis (GFC), however, sudden withdrawals from affected countries led to rapid currency depreciations as

investors sought safe havens in US Treasury securities. Estimates of recent losses by emerging-market corporations from their foreign exchange positions exceed US$40 billion, with perhaps the largest losses in Brazil (where some 200 firms incurred losses of an estimated US$28 billion, (Jara et al. 2009), Poland (where authorities estimate total losses at US$5 billion), and the Republic of Korea (where the government had spent US$1.3 billion by January 2009 to stave off bankruptcies of firms with derivative losses) (World Bank, 2009).

Fiscal convergence could also lead to business-cycle co-movements because of lowering country-specific shocks (Darvas et al., 2005; Inklaar et al., 2008). In the current crisis, the World Bank is of the view that stimulating aggregate demand would be helpful but countries would be reluctant to do this due to its spill-over effects on other countries. If, however, a country such as the United States does this alone, investors will lose confidence in its fiscal sustainability and will withdraw financing. These constraints can be handled through global commitment to coordinated action of fiscal expansion (World Bank, 2009). The World Bank *GDF* report (2009) also refers to commodity prices and remittances as other channels affecting business-cycle co-movements. Commodity prices affect the business cycles because a fall in consumer demand also results in a fall in commodity demand due to a cut in investment and consumption decisions. Therefore, those countries highly dependent on commodity exports are affected while in other countries it might help to buffer the adverse impacts due to improvement in the current account because of a fall in commodity prices. In addition to FDI and other sources, the United States, Europe and the United Arab Emirates (UAE) have become important sources of financing through remittances for the developing countries of the region. The dampening of income and investment flows is likely to slow growth in certain regions (World Bank, 2009).

Regarding the special characteristics of each region—for example, in ASEAN+3—the global value-chain and production networks are different from those in Europe. According to Gill and Homi (2007), production networks have more extensive spread in East Asia than in other regions. Gill and Homi (2007) suggest that the spread has been due to regionalism and regionalization, and note that low trade barriers, an efficient duty drawback regime for exports, encouragement of export-oriented FDI, good logistics and wage differentials across the countries have been the result of regionalism.

Furthermore, proximity to production networks, scale economies and other agglomeration economies that affect the cost structure of intermediate inputs are mainly due to regionalization. Because of these processes, the economies become closely integrated and one country's income growth generates demand for parts and components in other countries in the value supply chain. Ando and Kimura (2003) describe the production networks in ASEAN+3 as a vertical intra-industry trade phenomenon that involves back-and-forth links where several countries participate in various stages of single production chains compared with the horizontal intra-industry trade pattern in Europe. The European intra-industry trade model involves bi-directional flows of finished-goods varieties. Kimura et al. (2007) further find in the vertical intra-industry trade in East Asia that unit prices of exports and imports differ widely. The fragmentation theory proposed by Jones and Kierzkowski (1990) explains the structure of production networks in ASEAN+3.

Gill and Homi (2007) assert that ASEAN+3 first integrated globally and is now increasing its share regionally. Comparative intra-regional trade patterns are shown in Figure 1, demonstrating that intra-regional trade was more developed in the regions where intra-industry trade was predominant, such as ASEAN+3 and the European Union. Gill and Homi (2007) further argue that production networks require low-cost, long-term financing for capital investment and short-term working capital for financing trade. Moreover, production networks are exposed to currency risk when the cost structure of different components is dependent on local currency wages and credit risk and the network comprises a large and diverse number of companies governed by different contractual agreements.

In order to find convergence or decoupling phenomena in regions with the business cycle of the crisis-originating country, we employ a panel vector error correction (PVEC) framework to explore the short and long-term transmission channels in the ASEAN+3 region. Our focus will be on the short-run dynamics active in the region. We separate the financial flows (financial integration) from real economy variables such as goods exports and services exports (trade integration), and industrial structure and find their short and long-term effects on growth. We do not consider imports in a regional framework due to the presence of intra-industry trade phenomena, and one

country's imports are reflected in other countries' exports. In addition, the effects of exchange rate changes can be reflected in the export figures and financial flows.

Based on the discussions above, four external channels—namely, long-term FDI, short-term foreign equity and creditors' flows of world financial markets, goods and services exports in markets for goods and services and internal manufacturing structure (MF)—are considered to influence economic growth. The analysis concerns examining the effect of FDI, short-term capital flows, services and goods exports, and MF on ASEAN+3's GDP in the short run and the long run in a PVEC framework.

The literature also explains output co-movements across various countries and regions. Kose et al. (2008) have argued that differences in country coverage, sample period, aggregation methods for creating country groups and different econometric methods could lead to different conclusions and business-cycle co-movements. For example, some empirical researchers find declining business-cycle co-movements such as between the United States and other Group of Seven (G7) countries (Helbling and Bayoumi, 2004); the United States and the aggregate of Europe, Canada and Japan (Heathcote and Perri, 2004). In contrast, some studies find strengthening of business-cycle co-movements such as across industrialized countries (Bordo and Helbling, 2004). Similarly, Hecq et al. (2005) find output co-movements among five Latin American countries: Brazil, Argentina, Mexico, Peru and Chile. For North American Free Trade Agreement (NAFTA) economies, Kose et al. (2003) find increases in business-cycle co-movements in the past decade. Fidrmuc et al. (2008) favored a decoupling hypothesis between OECD countries' business cycles and India and China. Artis et al. (2008) and Fidrmuc (2004) find intra-industry trade a better indicator for business-cycle asymmetries than simple trade intensities. Sato and Zhang (2006) find common business cycles for East Asia. Hughes and Richter (2008) observe decoupling of the US business cycle from Asia.

3. Data and Methodology

During the past two decades, linkages across countries at the regional level as well as across regions have been transformed. Apart from bilateral and multilateral forces, the emergence of regional blocs and the resultant intra-industry trade phenomena have been important in transforming the structure of economies at the regional level. Hence, the response of countries and regions to external-country shocks will be different. In view of the integration forces at work, we analyze separately the likely impact of the shock-propagation mechanism on ASEAN+3's business cycles.

The data cover the period from 1980 to 2009 inclusive. The GDP, FDI and export (EX) figures are collected from the *World Development Indicators* and the UN Conference on Trade and Development (UNCTAD). Standard and Poor's Index (S&P) data are sourced from Robert Shiller (2001) and US 10-year Treasury Constant Maturity Rate (T-Bill) data are sourced from the Federal Reserve Bank of St Louis. GDP, FDI and EX figures are defined in real values by deflating to 2000 prices using GDP deflators and expressed in natural log form. S&P data are January/June averages in index form; US T-Bill data are in percentage yield form.

The use of a panel data format allows reliable detection of long and short-term relationships between independent and dependent variables. The 13 members of ASEAN+3 included in this estimation are: Cambodia, China, Hong Kong, Indonesia, Japan, Laos PDR, Malaysia, Myanmar, the Philippines, Singapore, South Korea, Thailand and Vietnam. We estimated for only 12 countries, however, by excluding Myanmar due to data issues.

The GFC had an impact on the business cycles of all ASEAN+3 members. The depth and timing of the impact differed between economies; the proximate cause of this impact is not completely empirically determined in the literature. This paper explores the causal relationship between the dependent variable GDP and independent variables of FDI, exports, industrial structure proxied by manufacturing share in GDP (MF), and short-term capital flow instruments for the members of ASEAN+3. Short-term capital flows are estimated separately by the use of two instrumental variables: S&P and T-Bills.

The selection of S&P Index and US T-Bill yields as instruments is relatively well based in the literature. Claessens et al. (1995) provide a summary of the research into the relationship between T-Bills and capital flows: alternative means of generating returns are important motivators for capital flows to developing countries. Moreover, the US Treasury yields are generally viewed as having a low risk profile, making T-Bills an excellent instrument for evaluating the impact of a "flight to safety" in times of crisis. A similar logic underpins the selection of a stock-market indicator in the S&P. Rajan (2006) discusses the attractive influence of varying returns to capital, noting in particular the expanding attitude to risk of investors. Wongbangpo and Sharma (2002) note the high volatility of returns to assets amongst ASEAN nations. The S&P represents a riskier and higher-return alternative to T-Bills ("chasing alpha" in the *lingua franca* of hedge funds) and is therefore an appropriate instrument for evaluating short-term capital shifts.

3.1. Country-by-Country

We seek to test through causality testing whether the real, short or long-term financial channels are viable mechanisms for the impact transmission. In order to provide policy direction for individual members of ASEAN+3, we initially examine independent time series for all countries (IS). Cambodia and Myanmar are not estimated due to data paucity.

Our first examination is on a country-by-country basis where each equation, and the associated tests, is separately estimated. Macroeconomic time series typically contain unit roots (Granger, 1986; Wasserfallen, 1989). This might lead to spurious regression and unreliable estimates. The differencing procedure of Box and Jenkins (1976) might be appropriate for any estimations. As discussed by Granger (1988), any causality testing must be preceded by co-integration testing, as the existence of co-integration has implications for the evaluation of causality.

Perron (1989) discusses the potential for structural breaks in the permanent trend of time-series data. To further evaluate unit roots within each series, we test unit roots following Clemente et al. (1998) and Zivot and Andrews (1992). These tests endogenously determine the presence of structural break(s) to reduce the bias associated with standard unit-root tests.

If there are no unit roots present in a data series, the above estimation is valid on levels. If there is one or more unit roots then the above evaluation is valid on stationarity achieved by first differencing of the series. A unit-root series might, however, evince co-integration as defined by Engle and Granger (1987), where x_t and y_t are integrated processes of order 1, but where a stationary linear combination vector, $\beta^1 Z_t$, exists. We use the standard multivariate co-integration test based on Johansen-Juselius (1991) to evaluate the long-run relationship.

As discussed by Engle and Granger (1987), if x_t and y_t are I(1) and co-integrated, an error-correction model (ECM) should be specified:

$$\Delta y_t = \alpha_1 + \theta_1 \Delta y_{t-1} + \theta_2 \Delta x_{t-1} + \theta_3 (x_{t-1} - y_{t-1}) + \varepsilon_t, \quad (1)$$

where Δ is the first-difference operator. Granger (1988) noted the necessity of estimating an ECM when evaluating I (1) co-integrated processes to avoid spurious regressions and erroneous conclusions.

A particular advantage of this estimation methodology is the possibility of evaluating short-term dynamic effects in isolation from the long-term equilibrium adjustment influence. This allows our vector ECM models to distinguish between the short-term impact of financial and real shocks.

3.2. Panel Data

The 1990s development of ASEAN as a trading bloc, as demonstrated by the China–ASEAN free-trade agreement (FTA) and similar agreements, spurred significant analysis of East Asian economic integration. In particular, Gill and Homi (2007), Kimura et al. (2007) and Kumakura (2005) find extensive production networks vertically integrated throughout East Asia, whilst Kose et al. (2003) and Sato and Zhang (2006) find common business cycles for East Asia. Consequently, any evaluation of crisis-transmission mechanisms for any individual member of ASEAN+3 must be sufficiently flexible to evaluate the general impact of shocks across the group.

In order to empirically investigate the short-term determinants of business-cycle synchronization across ASEAN+3, defining the error-correction term as the lagged residual from the long-run equation, we are able to estimate the following panel vector error-correction model:

$$\Delta y_{it} = \alpha_i + \beta ec_{i,t-1} + \sum_{j=1}^{q} \gamma_j \Delta y_{it-j} + \sum_{j=1}^{q} \delta_j \Delta x_{it-j} + \varepsilon_{it} \quad (2)$$

where q is the lag length set at 2 based on likelihood ratio tests, *y* is GDP and *x* is the vector of independent variables. Subscripts *i* and *t* represent country panel and time respectively. This extension of the earlier-discussed vector ECM (VECM) is referred to as a panel VECM (PVECM). As above, this vector auto-regressive framework over panel data enables the separation of short-term dynamics from long-term equilibrium adjustment. This PVECM will allow us to determine the impact of the specified macroeconomic variables on ASEAN+3 GDP.

As with the VECM, we need to first check the stationarity of variables using unit-root tests. In the absence of stationarity, the variables are differenced and tested for co-integration across the panel data. This enables us to determine the presence or absence of a long-run relationship between dependent GDP and independent FDI, EX, MF, S&P and T-Bill variables. The presence of long-term adjustment vectors indicates the use of a PVEC technique to determine the short-term impact of variables.

4. Results

4.1. Unit-Root Tests

4.1.1. Country-by-Country

All dependent variables are tested for stationarity to reduce the risk of spurious regression: high t-values with no genuine economic meaning. We use three separate tests on country-by-country dependent variables: augmented Dickey–Fuller (ADF), Phillips–Perron (PP) and the KPSS test of Kwiatkowski et. al (1992). ADF and PP test against the null hypothesis of a unit root; KPSS tests against the null of stationarity. KPSS is used as a confirmatory test, as the low power of ADF-variety tests in small samples makes testing against the alternative hypothesis desirable (Thangavelu and Rajaguru, 2004).

Results of ADF, PP and KPSS unit-root tests for GDP of series are displayed in Table 1. All variables are non-stationary at levels. Myanmar and Japan are non-

stationary at first differences and stationary at second differences. All other variables are I(1), after first differencing all variables (Myanmar and Japan are second differenced) become stationary.

4.1.1.1. Structural Break Robust Unit-Root Testing

The potential for unit-root testing to be biased in the presence of permanent changes in the pattern of time series is discussed by Perron (1989). With the great degree of economic and social development experienced by members of ASEAN+3 over the period of our time series, the potential for structural breaks is significant. In particular, the Asian Financial Crisis (AFC) of 1998 has a strong apparent impact on GDP stationarity (Figure 1). Consequently, we test the time series for multiple structural breaks as suggested by Zivot and Andrews (1992). The results of these tests are displayed in Table 2. Given the variety of shocks experienced by East Asia over the past three decades, we also employ the Clemente–Montanes–Reyes unit-root test, as it is robust over two structural breaks. We employ the additive outlier method as this more closely represents economic history in the region—in particular, the experience associated with the AFC. The results of the Clemente–Montanese–Reyes unit-root tests are displayed in Table 3.

The structural-break robust unit-root test results indicate that the GDP series for all members of ASEAN+3 are stationary after differencing (rho is statistically significant).

4.2. Panel Data

With the panel data, different unit-root tests are proposed through the literature as the use of panel data allows for increased power of unit-root testing. The Levin et al. (2002) (LLC) test is the most widely used method for panel data unit-root tests. It is appropriate for our panel data tests due to its power over panels of moderate size. The LLC requirement of identical assumptions across individuals matches the ASEAN+3 testing concept. Im et al. (2003) (IPS) tests using averaged ADF statistics are also investigated, due to the IPS tests' relaxing of the identical serial correlation pattern assumption.

Results of LLC and IPS testing panel variables are displayed in Table 4. The results for all tests indicate stationarity after first differencing.

Table 1. Country-by-Country Unit-Root Results

Unit Root Tests			GDP	FDI	NetExports				GDP	FDI	NetExports
Cambodia	ADF	Level	-1.5	-1.1	-0.05	**Malaysia**	ADF	Level	-0.5	-1.94	0.06
		1st Diff	-2.07	-3.28**	-4.63***			1st Diff	-4.01***	-6.94***	-4.12***
		2nd Diff	-3.34**	-5.16***	-7.21***			2nd Diff	-6.22***	-6.7***	-6.16***
	PP	Level	-1.06	-1.1	-0.13		PP	Level	-0.5	-1.8	0.06
		1st Diff	-2.17	-3.28**	-4.63***			1st Diff	-3.99**	-6.94***	-4.08***
		2nd Diff	-3.34**	-9.82***	-12.59***			2nd Diff	-15.61***	-31.76***	-13.86***
	KPSS	Level	0.65*	0.69*	0.65*		KPSS	Level	0.67*	0.39	0.66*
		1st Diff	0.09	0.14	0.15			1st Diff	0.13	0.07	0.13
		2nd Diff	0.11	0.24	0.3			2nd Diff	0.32	0.24	0.5*
China	ADF	Level	-0.5	-1.92	2	**Myanmar**	ADF	Level	0.95	-1.83	1.17
		1st Diff	-2.96*	-4.64***	-4.16***			1st Diff	-2.14	-3.8**	-3.27**
		2nd Diff	-5.16***	-7.18***	-7.49***			2nd Diff	-6.26***	-3.89**	-5.99***
	PP	Level	-0.21	-4.69***	2.02		PP	Level	2.6	-2.71*	0.88
		1st Diff	-2.96*	-4.52***	-4.16***			1st Diff	-2.14	-3.8**	-3.18**
		2nd Diff	-5.27***	-6.95***	-21.56***			2nd Diff	-6.39***	-4**	-12.56***
	KPSS	Level	0.63*	0.63*	0.68*		KPSS	Level	0.6*	0.76**	0.6*
		1st Diff	0.1	0.52*	0.35			1st Diff	0.48*	0.12	0.41
		2nd Diff	0.09	0.21	0.37			2nd Diff	0.17	0.18	0.4
Hong Kong	ADF	Level	-0.54	-1.51	-1.36	**Philippines**	ADF	Level	3.97	-2.91*	0.15
		1st Diff	-2.78*	-4.24***	-3.17**			1st Diff	-2.66*	-9.19***	-3.86**
		2nd Diff	-4.72***	-3.97**	-6.13***			2nd Diff	-5.46***	-6.27***	-9.13***
	PP	Level	-0.28	-1.41	-1.2		PP	Level	2.02	-2.85*	-0.03
		1st Diff	-2.78*	-6.48***	-3.11**			1st Diff	-2.73*	-10.14***	-3.87**
		2nd Diff	-4.83***	25.25**[1]	-10.28***			2nd Diff	-5.71***	-53.83***	-9.77***
	KPSS	Level	0.75**	0.73*	0.64*		KPSS	Level	0.65*	0.53*	0.64*
		1st Diff	0.09	0.24	0.23			1st Diff	0.36	0.03	0.15
		2nd Diff	0.08	0.35	0.23			2nd Diff	0.21	0.05	0.15
Indonesia	ADF	Level	-1.27	-0.49	1.01	**South Korea**	ADF	Level	-2.59	-1.34	-0.66
		1st Diff	-3.75**	10.18**[1]	-3.81**			1st Diff	-4.13***	-5.48***	-4.32***
		2nd Diff	-6.76***	-5.44***	-7.6***			2nd Diff	-6.16***	-7.9***	-4.6***
	PP	Level	-1.2	0.2	0.84		PP	Level	-3.45**	-2.97*	-0.66
		1st Diff	-3.77**	11.08**[1]	-3.81**			1st Diff	-4.13***	-5.33***	-4.27***
		2nd Diff	-11.38***	31.44**[1]	-19.35***			2nd Diff	-18***	-10.06***	-16.58***
	KPSS	Level	0.66*	0.6*	0.63*		KPSS	Level	0.66*	0.59*	0.67*
		1st Diff	0.19	0.43	0.28			1st Diff	0.56*	0.34	0.1
		2nd Diff	0.5*	0.4	0.36			2nd Diff	0.25	0.2	0.4
Japan	ADF	Level	-2.04	-2.19	-0.79	**Singapore**	ADF	Level	-0.75	-1.38	0.15
		1st Diff	-2.45	-2.08	-5.21***			1st Diff	-4.2***	-6.81***	-3.17**
		2nd Diff	-5.75***	-8.64***	-6.21***			2nd Diff	-6.73***	-5.57***	-5.35***
	PP	Level	-2.22	-2.2	-0.79		PP	Level	-0.72	-0.98	0
		1st Diff	-2.43	-5.75***	-5.21***			1st Diff	-4.16***	-12.11***	-3.2**
		2nd Diff	-9.1***	12.51**[1]	-21.13***			2nd Diff	-17.23***	-27.57***	-8.34***
	KPSS	Level	0.63*	0.42	0.65*		KPSS	Level	0.67*	0.64*	0.66*
		1st Diff	0.35	0.05	0.12			1st Diff	0.11	0.5*	0.09
		2nd Diff	0.5*	0.17	0.34			2nd Diff	0.33	0.4	0.29
Lao	ADF	Level	0.2	-1.55	-1.59	**Thailand**	ADF	Level	-1.26	-1.3	-0.48
		1st Diff	-5.18***	-2.96*	-4.92***			1st Diff	-2.63*	-5.35***	-2.91*
		2nd Diff	-4.55***	-5.05***	-10.39***			2nd Diff	-5.29***	-8.78***	-6.63***
	PP	Level	0.58	-1.56	-0.8		PP	Level	-1.34	-1.29	-0.33
		1st Diff	-5.79***	-2.98*	-4.95***			1st Diff	-2.64*	-5.35***	-2.91*
		2nd Diff	-13.74***	-6.53***	-10.04***			2nd Diff	-6.32***	-16.75***	-7.12***
	KPSS	Level	0.68*	0.41	0.66*		KPSS	Level	0.65*	0.63*	0.65*
		1st Diff	0.2	0.15	0.08			1st Diff	0.23	0.06	0.11
		2nd Diff	0.44	0.5*	0.1			2nd Diff	0.28	0.26	0.12
S&P	ADF	Level	-1.05	**10 Year**	-4.2***	**Vietnam**	ADF	Level	2.12	-2.74*	-0.34
		1st Diff	-4.56***	**T-Bill**	-7.5***			1st Diff	-2.65*	-6.72***	-4.06***
		2nd Diff	-8.21***		-7.18***			2nd Diff	-4.83***	-0.45	-6.12***
	PP	Level	-1.05		-1.1		PP	Level	1.23	-2.74*	-0.35
		1st Diff	-4.56***		-11.94***			1st Diff	-2.17	-6.72***	-3.96**
		2nd Diff	-11.61***		-17.74***			2nd Diff	-4.83***	-14.07***	-11***
	KPSS	Level	0.65*		0.62*		KPSS	Level	0.68*	0.63*	0.67*
		1st Diff	0.12		0.5			1st Diff	0.22	0.17	0.06
		2nd Diff	0.5*		0.5			2nd Diff	0.06	0.47*	0.5*

*,**,*** denotes rejection of the hypothesis at the 0.1, 0.05 and 0.01 levels respectively

Table 2. Zivot–Andrews Unit-Root Results

Zivot–Andrews	Differences		
	T-stat	*P*	*Breaks*
China	–5.055**	1	2001
Hong Kong	–4.334	0	1998
Indonesia	–8.411***	1	1998
Japan	–3.366	0	1988
Laos	–6.67***	1	1988
Malaysia	–2.782	0	1991
Myanmar	–2.903	1	1987
Philippines	–2.831	2	2002
South Korea	–2.536	0	1998
Singapore	–3.288	1	2001
Thailand	–3.63	1	1997
Vietnam	–4.676	1	1985

Note: Value of P selected by AIC; **, *** denotes rejection of the hypothesis at the 0.05 and 0.01 levels respectively.

Table 3. Clemente–Montanes–Reyes Unit-Root Results

	Levels				Differences			
	rho	*T-stat*	*P*	*Breaks*	*rho*	*T-stat*	*P*	*Breaks*
China	–0.52	–2.82	0	1989, 1998	–1.42	–4.57	2	1987
Hong Kong	–0.46	–2.82	0	1989, 2001	–1.50	–6.28**	1	1996, 2001
Indonesia	–0.54	–3.09	0	1990, 2002	–0.90	–6.98**	1	1988, 1996
Japan	–0.61	–3.08	0	1987, 1997	–1.73	–6.69**	2	1989
Laos	–0.52	–2.98	0	1991, 2000	–1.95	–6.17**	2	1987
Malaysia	–0.56	–2.90	0	1990, 1997	–1.36	–6.55**	1	1987, 1996
Myanmar	–0.70	–3.33	0	1996, 2002	–2.19	–7.79**	2	1986, 1992
Philippines	–1.90	–1.30	0	1991, 2001	–1.71	–6.05**	2	1986, 2001
South Korea	–0.50	–2.90	0	1988, 1996	–1.59	–9.54**	1	1990, 1996
Singapore	–0.52	–2.83	0	1990, 1997	–2.38	–7.39**	2	1986, 2001
Thailand	–0.49	–2.89	0	1990, 2001	–2.28	–7.19**	3	1989, 1996
Vietnam	–0.49	–2.82	0	1992, 2001	–1.06	–5.78**	2	1987, 1996

Note: ** denotes rejection of the unit-root hypothesis at the 0.05 level.

Table 4. Panel Unit-Root Results

Panel unit-root testing

Levels—intercept					Levels—intercept and trend		
	GDP MF	FDI	EX	MF	GDP	FDI MF	EX
*Levin, Lin & Chu t**	–0.20 0.3	–0.86	0.69		–0.82	2.18 0.7	0.30
Breitung t-stat	- -	-	-		–1.02	–0.20 0.3	–0.84
Im, Pesaran and Shin W-stat	4.60 0.6	0.98	4.96		0.60	0.71 0.2	0.36
First differences—intercept					First differences—intercept and trend		
	GDP MF	FDI	EX		GDP	FDI MF	EX
*Levin, Lin & Chu t**	–6.61 –2.3	–2.62	–6.45		–6.26	–2.35 –2.1	–5.26
Breitung t-stat	- -	-	-		–7.58	–4.77 –4.5	–6.36
Im, Pesaran and Shin W-stat	–6.80 –2.6	–7.65	–6.25		–6.38	–5.18 –4.3	–4.35

4.3. Co-Integration Tests

4.3.1. Country-by-Country

The potential interrelation of FDI, short-term capital and exports is well discussed in the literature, particularly by Kose et al. (2003), who link these factors with business-cycle synchronization. As a consequence, separating genuine co-integration from spurious regression or correlation is an important statistical process.

Engle and Granger (1987) discuss a procedure for testing the presence of co-integration by using level OLS to generate residuals. These residuals, or errors in equilibrium, are then tested for integration. Johansen and Juselius (1990) developed a multivariate co-integration test using maximum likelihood estimators of the co-integrating vectors for an auto-regressive process, and a likelihood ratio test for the number of co-integrating vectors.

We use Johansen's (1988, 1991) maximum eigenvalue test and trace test to evaluate the number of co-integrating vectors. The optimum lag length is determined using Akaike's and Baysian Information Criteria (AIC, BIC). The results of Johansen's co-integration test for both S&P and T-Bill series are displayed in Table 5. The results from Johansen's tests indicate at least one co-integrating vector is present in all series, except Hong Kong, Malaysia, South Korea and Thailand.

Table 5. Johansen Trace and Maximum Eigenvalue Tests for Co-Integration

Trace test	GDP, FDI, MF, EX, S&P			GDP, FDI, MF, EX, T-Bill		
	v=0	v≤1	v≤2	v=0	v≤1	v≤2
Cambodia	115.85*	63.59*	30.70*	52.26*	32.88*	19.05
China	70.81*	39.96	16.87	30.85	23.09	11.34
Hong Kong	61.26	35.82	15.16	25.44	20.65	9.65
Indonesia	89.26*	39.75	14.1	49.50*	25.65	10.68
Japan	65.46*	31.62	7.58	33.85*	24.03	5.76
Laos	87.71*	45.15*	23.73	42.56*	21.43	14.39
Malaysia	57.27	31.1	17.21	26.18	13.88	10.23
Myanmar	82.95*	54.72*	29.03*	28.23	25.68	20.88*
Philippines	74.01*	35.13	16.42	38.88*	18.72	10.49
South Korea	61.53	37.28	20.28	24.25	17	14.48
Singapore	67.40*	34.42	15.66	32.98*	18.76	12.66
Thailand	49.93	28.16	14.76	21.78	13.39	9.14
Vietnam	76.95*	35.89	14.83	41.06*	21.05	13.06
Maximum eigenvalue test	GDP, FDI, MF, EX, S&P			GDP, FDI, MF, EX, T-Bill		
	v=0	v≤1	v≤2	v=0	v≤1	v≤2
Cambodia	122.72*	48.45*	26.83*	74.26*	21.62	15.19
China	93.17*	43.19*	19.23	49.97*	23.97	16.22
Hong Kong	61.25	35.81	15.16	25.44	20.65	9.65
Indonesia	89.26*	39.75	14.1	49.51*	25.65	10.68

Japan	65.47*	31.62	7.58	33.85*	24.03	5.76
Laos	87.72*	45.16*	23.73	42.56*	21.43	14.39
Malaysia	57.27	31.1	17.21	26.18	13.88	10.23
Myanmar	82.95*	54.72*	29.04*	28.23	25.68	20.88*
Philippines	74.02*	35.13	16.42	38.89*	18.72	10.49
South Korea	61.53	37.28	20.28	24.25	17	14.48
Singapore	67.40*	34.42	15.66	32.98*	18.76	12.66
Thailand	49.93	28.16	14.76	21.78	13.39	9.14
Vietnam	76.95*	35.89	14.83	41.06*	21.05	13.06

Note: * denotes rejection of the hypothesis at the 0.05 level.

4.3.2. Panel Data

The literature discusses in depth the trade, financial and growing political integration of ASEAN+3 nations. Consequently, it might be possible that the effects of a shock on the region as a whole are greater than the shock's measureable impact on individual countries. Therefore, we undertake co-integration testing of the ASEAN+3 panel data system.

Pedroni (2004) notes the existing Johansen tests for co-integration might not be useful when considering cross-sectional time-series analysis. Under the hypothesis that the cross-section shares a common co-integration pattern, Pedroni (2004) proposed a residual-based test statistic for the null of no co-integration. It enables heterogeneous cross-section members by allowing varying slope coefficients. The test is also robust to differing co-integrating vectors between panel members. This is possible by considering statistics from cross-sectional regression residuals and statistics from single time-series regression residuals. The significant, large positive values for *v-stat* in the intercept and trend test indicate rejection of the null of no co-integration, as displayed in Table 6.

Table 6. Pedroni Tests for Panel Co-Integration

	Pedroni residual—individual intercept	
	GDP, EX, FDI, MF, S&P	GDP, EX, FDI, MF, T-Bill
Panel v-Stat	–0.44	–0.57
Panel rho-Stat	2.67	2.73
Panel p-Stat	0.98	0.67
Pedroni residual—individual intercept and trend		
	GDP, EX, FDI, MF, S&P	GDP, EX, FDI, MF, T-Bill
Panel v-Stat	5.07***	4.92***
Panel rho-Stat	4.8	4.1
Panel p-Stat	4.12	1.56

Note: *** denotes rejection of no co-integration null at 1%.

4.4. Error-Correction Model Results

4.4.1. Country-by-country

Engel and Granger (1987) show the presence of co-integration implies an error-correction mechanism whereby the change in at least one of the current variables is a function of the previous period error in equilibrium. It is important to separately identify and analyze these long-term impacts from the short-run relationship. The ECM enables this identification. The null hypothesis of no long-run causality is tested by estimating the significance of the t-statistic for the error-correction coefficient, ρ. To establish the influence of the variables as part of a short-term system, we test for joint significance using a Wald test. If short-term causality cannot be established in the instances of non–co-integrated series (Hong Kong, Thailand, Malaysia and South Korea) then we employ the Charemza and Deadman (1992) strong exogeneity test to examine joint influence. The results of these tests are indicated in Table 7.

Table 7. VECM S&P Results

	Wald-J		**Coefficient**	
Dependent GDP	Overall	FDI	EX MF	S&P
China	No	-	- -	-
Indonesia	No	-	- -	-
Japan	No	-	- -	-
Laos	No	-	- -	-
Myanmar	No	-	- -	-
Philippines	No	-	- -	-
Singapore	No	-	- -	-
Vietnam	No	-	- -	-

Table 7 indicates no significant short-run relationship of FDI, EX, MF, or the S&P index on GDP growth. Table members are those whose VAR specification indicated at least one co-integrating vector after testing.

Table 8. VECM T-Bill Results

	Wald-J		**Coefficient**	
Dependent GDP	Overall	FDI	EX MF	T-Bill
China	No	-	- -	-
Indonesia	No	-	- -	-
Japan	No	-	- -	-
Laos	No	-	- -	-
Myanmar	No	-	- -	-
Philippines	No	-	- -	-
Singapore	Yes***	-	0.20** -	–0.014***
Vietnam	No	-	- -	-

Table 8 indicates no significant short-run relationship of FDI, EX, MF, or the S&P index on GDP growth for the majority of countries. Singapore's VEC analysis indicated a significant positive relationship between exports and GDP, and a significant negative relationship between US T-Bill yields and GDP. Indicated table members are those whose VAR specification indicated at least one co-integrating vector after testing.

Table 9. Granger Causality Joint Test Results for S&P Series

Dependent GDP	**Block causality F-stat**		
	FDI	EX MF	S&P
Hong Kong	-	- -	-
Malaysia	-	3.47* -	-
South Korea	-	- -	-
Thailand	-	- -	-

Table 9 indicates evidence at the 10 percent level that Malaysian exports Granger-cause Malaysian GDP. No other statistically significant causal relationships were present. Indicated table members are those whose VAR specification was unable to reject a zero co-integrating vector hypothesis

Table 10. Granger Causality Joint Test Results for S&P Series

Dependent GDP	**Block causality F-stat**		
	FDI	EX MF	T-Bill
Hong Kong	-	- -	-
Malaysia	-	3.47* -	3.48*
South Korea	-	- -	-
Thailand	-	- -	-

Table 10 indicates evidence at the 10 percent level that Malaysian exports and US T-Bill yields Granger-cause Malaysian GDP. No other statistically significant causal relationships were present. Indicated table members are those whose VAR specification was unable to reject a zero co-integrating vector hypothesis.

4.4.2. Panel Data

Given the variables are co-integrated in the panel data specification, the panel vector error-correction model is employed. This methodology allows separation of long-term and short-term impacts of independent on dependent variables. This

distinction enables an examination and comparison of these transmission channels in terms of short-term shocks as distinct from long-term trends.

This two-step process first involves estimating the long-run OLS equation to obtain the estimated residuals; and then, defining the lagged residuals as the error-correction term in the dynamic PVECM framework. The null hypothesis of no long-run causality is tested by estimating the significance of the t-statistic for the error-correction coefficient, β . To establish the influence of the variables as part of a short-term system, we test for joint significance with a block exogeneity Wald test. The results of these tests are displayed in Table 11.

Table 11. PVECM Results

GDP dependent			
GDP(-1)	0.018	**10-Year Treasury (-1)**	0.013
	[0.12]		[0.58]
GDP(-2)	0.146	**10-Year Treasury (-2)**	-0.013
	[0.94}		[-0.64]
Merch % (-1)	0.000	**S&P Index (-1)**	0.001
	[0.33]		[5.19]
Merch % (-2)	0.000	**S&P Index (-2)**	-0.001
	[0.34]		[-2.61]
Exports (-1)	-0.097	**FDI (-1)**	0.015
	[-0.60]		[0.37]
Exports (-2)	0.000	**FDI (-2)**	0.024
	[0.00]		[0.68]
R-Squared	0.15	**ECM**	-0.0000858 *[-1.14078]*

The PVECM results indicate the short-term capital instruments have a significant impact on GDP in the short-run analysis. The impact of the S&P instrument is small, but strongly significant at the 1 percent level. The S&P coefficients are notably more significant than the T-Bill coefficients, which might indicate a stronger effect of a change in the S&P index (our "chasing-alpha" instrument) than in T-Bill yields (our "flight-to-safety" instrument).

5. Conclusion

The recent economic history of East Asia is one of strong economic growth, widening international influence and growing regional cohesiveness. The strong influence of regional integration on growth is one of the unique characteristics of ASEAN+3, and a key part of the East Asian miracle. The emergence of Asia as an import member of the international community seems necessarily tied to the impact of global economic shocks upon Asia. The degree to which individual members are influenced by these idiosyncrasies depends on the form the shocks take.

The most recent shocks were those of 2007 and 2008: the real and financial shocks respectively of the GFC. The real shock was transmitted through trade variables. Our empirics indicate that, on a country-by-country basis, business cycles in Singapore and Malaysia were impacted directly by this crisis. As a whole, the region demonstrates no short-term relationship between GDP and exports. Due to this minimal degree of short-term exposure, we would expect to see ASEAN+3 exhibit decoupling from the US business cycle after the sub-prime crisis.

The 2008 shock associated with the collapse of Lehman Brothers was a financial shock, transmitted through short-term capital flows. On a country-by-country basis, evidence of convergence is again limited to Malaysia and Singapore. Notably, this effect is stronger with the T-Bill instrument than the S&P—possibly indicating Singapore and Malaysia are more vulnerable to a "flight to safety" than to influxes of capital "chasing alpha".

As a whole, the ASEAN+3 region demonstrates strong and significant vulnerability to short-term capital movements. This result is robust to either the "alpha" instrument of the S&P or the "safety" instrument of T-Bills. This result provides evidence against theories that hold short-term capital flows to be non-influential on economic growth. Due to the significant short-term capital exposure of the ASEAN+3 region, we would expect the financial channel-transmitted shock of 2008 to have a synchronizing influence on ASEAN+3 and US business cycles.

Our empirical analysis indicates business-cycle synchronization in ASEAN+3 is significantly influenced by shocks. Due to the integration process in the regions, the

importance of trade channels in transmitting external-country shocks from the major economies such as the United States has lessened. On the other hand, the recent shock has re-emphasized financial variables as the most significant channels for shock transmission. Knowing the correct transmission mechanism will help in tailoring an appropriate response to the idiosyncratic disturbance and is helpful in achieving long-term regional development goals.

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