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# Economic Integration and Business Cycle Synchronization in Asia\*

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## Abstract

This paper examines the effects of internal (or regional) vs. external (inter-regional) integration and of trade vs. financial integration on regional business cycle synchronization in Asia. The empirical results show the following: (1) similar and strong common external linkages have significant positive effects on regional business cycle synchronization; (2) after controlling for external linkages, internal trade integration has a positive effect on regional business cycle synchronization but internal financial integration has a negative effect; and (3) the measures of external linkages, particularly the measure of external financial linkages, are more important than those of internal linkages in explaining regional business cycle co-movements.

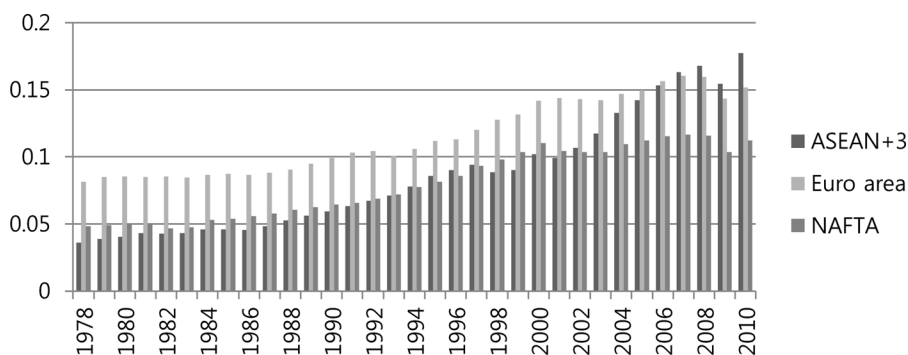
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## I. Introduction

After the 1997–98 Asian financial crisis (AFC), international linkages in both finance and trade have increased rapidly in Asian countries. On the trade side, reductions in trade barriers and free trade agreements, combined with the rise of production sharing networks in emerging Asian countries, have deepened regional integration. In 1990, the total exports and imports of ASEAN+3 countries was 56 percent of their GDP (3.5 percent of world GDP). This value increased to 104 percent of their GDP (15.8 percent

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**Figure 1. Total trade of various regions (percent of world GDP)**

Source: The World Bank, *World Development Indicators & Global Development Finance*.

Note: Constant 2000 US\$.

of world GDP) in 2010.<sup>1</sup> Figure 1 shows the total trade of ASEAN+3 countries from 1987 to 2010 in comparison with that of countries in the North American Free Trade Agreement (NAFTA) and the Euro Area. Asia is currently a vital region for world trade, with the total trade of ASEAN+3 becoming even larger than that of the Euro and NAFTA areas in recent years.

On the finance side, capital account liberalization and various forms of regional financial cooperation, such as the Chiang Mai Initiative Multilateralization (CMIM) and the Asian Bond Market Initiative (ABMI), have promoted the international integration of Asian economies. In 1990, the ratio of total assets and liabilities to GDP of ASEAN+3 countries was 122.6 percent (23.1 percent of world GDP). This value increased to 190.1 percent (40.9 percent of world GDP) in 2009. During the same period, the Euro and NAFTA areas recorded greater numbers at 347.05 percent (74.73 percent of world GDP) and 267.8 percent of their GDP (74.71 percent of world GDP), respectively. Nevertheless, the financial globalization trend in Asian countries remains strong.

Coinciding with the trends of rising trade and financial integration has been an increase in business cycle co-movements across the Asian region. Past studies have documented the substantial changes in the business cycle co-movements of Asian countries after the AFC. In particular, some studies (e.g., Moneta and Ruffer 2009;

<sup>1</sup> This paper considers nine economies in ASEAN+3: Japan, China, Republic of Korea, and the six economies (Malaysia, the Philippines, Indonesia, Thailand, Hong Kong, and Singapore) of ASEAN.

Imbs 2011; Kim and Lee 2012) found that business cycles of Asian countries have become more synchronized after the AFC and that these changes in business cycle properties are likely to be related to their economic integration process.

The business cycle co-movements of Asian countries have various important implications for the region. Some researchers and policymakers argue that the creation of an Asian monetary union or a common Asian currency unit is crucial for future development of the region.<sup>2</sup> In this regard, business cycle synchronization or business cycle asymmetry of countries in the region is an important criterion to judge the costs and feasibility of Asian monetary integration.<sup>3</sup> By investigating the effects of economic integration on regional business cycle co-movements, we may infer the possible effects of current trends of rapid economic integration on regional business cycle co-movements and the potential costs of Asian monetary integration.

Even without explicit monetary integration of Asian countries, the magnitude of business cycle synchronization in the region has important implications for macro-economic policy coordination; in particular, a high degree of business cycle synchronization within the region, common policy responses and/or policy cooperation within the region are needed to stabilize economic fluctuations in the region.

This paper investigates how economic integration affects the business cycle synchronization of Asian countries. In particular, we distinguish two types of integration, namely, (1) trade integration vs. financial integration, and (2) internal integration (regional integration or integration within Asia) vs. external integration (inter-regional integration or integration of Asian countries with the rest of the world). This paper examines how different types of integration (trade vs. financial and internal vs. external) affect the regional business cycle synchronization of Asian countries.

Distinguishing internal economic integration (within Asia) from external economic linkage (with the rest of the world) is important in explaining business cycle synchronization within Asia because both internal and external economic linkages can affect regional business cycle synchronization but in a different manner. The size of the effects of internal trade (or financial) integration on regional business cycle may differ from the size of external trade (or financial) linkages. In such a case, the effects of internal and external integration should be estimated separately. In addition, internal and external integration may affect regional business cycle co-movement in opposite directions. For example, a similar pattern of financial linkages of Asian

<sup>2</sup> For example, see Mundell (2003), Kuroda (2004), and Ogawa and Shimizu (2011).

<sup>3</sup> Refer to Mundell (1961).

countries and the rest of the world may increase business cycle synchronization of Asian countries. A strong financial integration among Asian countries, however, may decrease the business cycle synchronization of Asian countries. Furthermore, by separately estimating the effects, we can infer which one is more important in explaining business cycle synchronization of Asian countries. In addition, the effects of recent regional integration efforts on business cycle synchronization can be better understood. For example, we can clearly picture how trade integration within the region, such as free trade agreements (FTAs) among some ASEAN+3 countries and Asian financial cooperation such as CMIM and ABMI, has contributed to Asian business cycle synchronization. Based on our empirical results, we also draw some implications on these issues. To estimate the effects of internal and external integration separately, we apply the method developed by Gong and Kim (2012).

Although several studies have investigated the effects of economic integration on business cycle synchronization in Asia, these studies have not separated the effects of internal and external integration. Most studies (Rana 2007) concentrated on the effects of internal trade integration on regional business cycle synchronization. A few studies, such as those of Shin and Sohn (2006) and Imbs (2011), did examine the effects of both trade and financial integration. These studies either concentrated only on internal integration or did not distinguish between internal vs. external integration, however.

The rest of the paper is organized as follows. Section 2 shows the trends in internal vs. external integration and financial vs. trade integration as well as the business cycle synchronization of Asian countries. Section 3 explains the empirical methodology. Section 4 discusses the empirical results. Section 5 concludes with a summary of results.

## **2. Trends in economic integration and business cycle synchronization**

In this section, we briefly examine trends in internal vs. external integration and trade vs. financial integration, as well as in internal vs. external business cycle co-movements of Asian countries.

### **2.1 Economic integration**

Table 1 presents changes in the intra-regional and inter-regional trade relations of Asian countries between 1990 and 2009. The table shows that intra-regional trade among nine Asian economies (“ASEAN+3”) increased steadily to 46.1 percent of total trade in 2005 from 37.8 percent in 1990. This value declined to 44.6 percent (higher than the share of NAFTA economies but lower than the EU economies) in

2009, however, because of the global financial crisis. If measured by percentage of GDP, intra-East Asian trade reached 25.6 percent in 2005 and 21.7 percent in 2009 from 11.1 percent in 1990, higher than the EU economies and substantially higher than the NAFTA economies. The share of intra-regional trade is also substantial among 13 Asia-Pacific economies (“ASEAN+7”), peaking at 49.4 percent in 2005 from 41.4 percent in 1990, and declining only slightly to 49.2 percent in 2009.<sup>4</sup> As a percentage of GDP, intra-regional trade also increased through to 2005 but declined to 22.7 percent in 2009. This increasing trend in intra-regional trade is observed not only in the entire Asian region, but also in individual Asian countries. In 2009, the average of intra-regional trade between individual members of ASEAN+3 and the whole ASEAN+3 was over 60 percent of the GDP. This average is approximately 50 percent of GDP for ASEAN+7 economies in 2009, reflecting a tight trade linkage among Asian countries.

For external or inter-regional trade relations, the share of the G6 economies (G7 countries excluding Japan) in the trade of ASEAN+3 has been declining but remained substantial at 21.0 percent in 2009. The share of the G6 economies in the trade of ASEAN+7 has also been declining, reaching 20.8 percent in 2009. This does not necessarily imply that the trade linkages of Asian countries with G6 economies were weaker in the 2000s than in the 1990s, however. As a percentage of GDP, the trade of ASEAN+3 with G6 was 10.5 percent in 1990 and remained at 10.2 percent in 2009. Similarly, the trade of ASEAN+7 with G6 was 10.0 percent in 1990 and remained at 9.6 percent in 2009. Considering the rapid economic growth of Asian countries, these numbers imply that the actual trade amount with G6 economies increased. As documented by previous studies (ADB 2007; Brooks and Hua 2008; Kim, Lee, and Park 2011), a substantial part of intra-regional trade is driven by the trade of intermediate goods among Asian economies, with final production destined for export outside the region. In this context, intra-regional trade dynamics remain sensitive to changes in the external demand of industrialized economies or in the external economic linkages with major industrial countries.

Table 2 provides quantitative measures of financial integration and cross-border holdings of portfolio assets and liabilities, including equity and long- and short-term debt securities. For ASEAN+3, total portfolio assets increased from US\$ 0.95 trillion in 1997 to US\$ 4.86 trillion in 2010, whereas total portfolio liabilities increased from US\$ 0.57 trillion in 1997 to US\$ 3.07 trillion in 2010.

4 In this paper, ASEAN+7 includes the nine ASEAN+3 economies, India, Pakistan, New Zealand, and Australia.

**Table 1. Trade relations of selected economies in Asia****A. As percent of Total Trade**

	ASEAN+3					ASEAN+7					G6				
	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009
Hong Kong	53	55	56	64	67	56	57	59	67	70	27	24	23	17	14
China	56	54	48	40	35	58	57	50	44	40	25	27	29	28	26
Indonesia	54	50	51	58	57	58	55	57	65	66	24	26	22	16	14
Japan	24	34	34	40	43	29	39	38	44	48	44	38	37	28	22
Korea	35	41	40	45	44	38	45	43	49	49	39	32	30	22	17
Malaysia	54	54	54	55	57	59	58	58	59	64	28	28	26	24	17
Philippines	38	44	45	55	58	41	47	47	57	61	39	36	32	22	19
Singapore	44	51	50	52	52	49	55	54	58	58	30	27	25	20	17
Thailand	46	47	46	50	49	49	50	50	55	55	30	25	26	19	16
Australia	41	45	45	49	55	47	52	50	56	62	34	29	28	23	19
India	18	23	22	26	27	21	25	24	29	30	35	34	30	25	19
New Zealand	27	31	30	31	34	48	54	53	55	58	32	28	29	26	21
Pakistan	27	30	23	24	25	30	32	27	27	29	36	33	30	27	22
ASEAN+3	38	45	44	46	45	42	49	48	50	50	36	31	30	24	21
ASEAN+7	37	44	43	45	44	41	48	47	49	49	36	31	30	24	21

**B. As percent of GDP**

	ASEAN+3					ASEAN+7					G6				
	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009	1990	1995	2000	2005	2009
Hong Kong	103	112	110	177	177	107	117	115	184	187	51	49	46	47	37
China	18	25	22	27	16	19	26	23	29	18	8	12	13	19	12
Indonesia	20	19	30	34	24	21	21	33	37	28	9	10	13	9	6
Japan	4	5	6	10	10	5	6	7	11	11	7	6	7	7	5
Korea	17	19	25	29	36	19	21	27	32	40	19	15	18	14	14
Malaysia	73	94	110	107	91	79	101	118	117	101	38	49	54	46	28
Philippines	121	132	134	158	130	133	140	145	176	147	82	68	66	60	43
Singapore	30	37	50	64	53	31	39	54	70	60	19	20	28	25	17
Thailand	5	6	6	6	5	5	6	6	6	6	6	6	7	7	5
Australia	10	13	15	15	18	12	15	17	18	20	8	9	10	7	6
India	2	4	4	7	9	3	5	5	8	10	5	6	6	7	7
New Zealand	7	8	6	9	8	8	8	7	10	9	10	9	8	10	7
Pakistan	17	25	46	55	34	18	27	48	57	36	17	20	33	22	11
ASEAN+3	11	14	17	26	22	12	15	19	28	24	11	10	12	14	10
ASEAN+7	10	14	16	23	20	12	15	18	25	23	10	10	11	13	10

*Source:* Direction of Trade Statistics, International Monetary Fund.

*Note:* Total trade is the average of export and import. GDP uses the current price data.

We can also observe a substantial increase in intra-regional portfolio investments. The total recorded level of cross-border portfolio asset and liability holdings among ASEAN+3 economies was merely US\$ 85.52 and US\$ 44.98 billion, respectively, in 1997. These values increased to US\$ 579.03 and US\$ 541.75 billion, respectively, in 2010. The proportion of ASEAN+3's assets invested in ASEAN+3 constituted 9.0 percent of the total holdings of ASEAN+3 in 1997, but decreased to 5.7 percent in 2001, which could be partly attributed to the AFC; the value increased to 11.9 percent in 2010. In comparison, the proportion of their assets invested in G6 declined from 62.0 percent in 1997 to 46.6 percent in 2010. For liabilities, we can see an even sharper increase in the proportion of intra-regional portfolio investments. The proportion of intra-regional portfolio investment in liabilities increased from 7.9 percent

**Table 2. Total portfolio investment in Asia**  
**A. (US\$ billion)**

Year	Economy	Assets in				Liabilities from			
		ASEAN+3	ASEAN+7	G6	TOTAL	ASEAN+3	ASEAN+7	G6	TOTAL
1997	China	3.0	3.0	...	...	5.3	5.3	8.7	14.8
	Hong Kong	37.5	46.9	...	...	10.2	11.1	56.4	74.1
	Indonesia	0.2	0.2	0.1	1.1	2.3	2.4	6.5	9.8
	Japan	29.1	63.2	573.6	906.7	1.2	5.7	305.0	365.0
	Korea	4.4	4.6	2.8	13.5	8.5	8.7	22.1	32.7
	Malaysia	0.9	1.1	0.5	1.8	10.4	10.5	13.3	25.1
	Philippines	0.0	0.0	0.0	...	1.5	1.6	9.5	11.7
	Singapore	10.4	11.4	9.4	22.8	2.7	2.9	16.8	21.5
	Thailand	0.1	0.1	0.1	0.3	2.9	2.9	7.9	11.5
	Australia	5.5	6.1	29.5	41.5	30.6	31.6	73.3	116.3
	New Zealand	0.7	1.7	4.1	6.5	2.9	3.4	12.8	17.7
	Pakistan	0.0	0.0	...	...	0.0	0.0	1.8	1.9
	India	1.6	1.6	...	...	2.1	2.1	11.5	14.8
	ASEAN+3	85.5	130.5	586.5	946.1	45.0	51.2	446.2	566.2
	As percent of total	9.0%	13.8%	62.0%	100.0%	7.9%	9.0%	78.8%	100.0%
	ASEAN+7	93.3	139.9	620.0	994.1	80.6	88.4	545.7	716.8
As percent of total	9.4%	14.1%	62.4%	100.0%	11.2%	12.3%	76.1%	100.0%	
2001	China	6.9	6.9	...	...	11.7	11.7	6.0	20.3
	Hong Kong	30.3	48.8	82.9	205.6	11.6	13.9	59.5	96.7
	Indonesia	0.2	0.2	0.4	0.7	1.2	1.2	3.0	5.6
	Japan	21.1	42.9	832.2	1,289.8	20.0	25.3	346.6	542.3
	Korea	1.7	1.8	4.5	8.0	14.2	14.6	52.1	76.8
	Malaysia	0.8	0.8	0.7	2.3	12.3	12.4	7.5	22.6
	Philippines	0.1	0.1	1.9	2.1	4.2	4.2	5.6	12.8
	Singapore	31.3	42.4	46.2	105.2	5.7	6.5	38.1	50.7
	Thailand	0.3	0.3	0.4	0.8	4.8	4.8	5.4	12.0
	Australia	8.1	9.0	59.6	79.4	45.7	47.3	88.7	170.0
	New Zealand	0.8	2.5	8.1	12.4	5.3	6.2	7.8	18.3
	Pakistan	0.0	0.0	...	...	0.0	0.0	0.2	0.5
	India	0.1	0.1	...	...	0.8	0.8	10.5	15.4
	ASEAN+3	92.5	144.2	969.1	1,614.6	85.6	94.5	523.8	839.6
	As percent of total	5.7%	8.9%	60.0%	100.0%	10.2%	11.3%	62.4%	100.0%
	ASEAN+7	101.5	155.7	1,036.8	1,706.4	137.3	148.8	631.1	1,043.8
As percent of total	5.9%	9.1%	60.8%	100.0%	13.2%	14.3%	60.5%	100.0%	
2010	China	37.3	37.4	...	...	253.7	256.3	154.1	498.2
	Hong Kong	258.8	305.2	216.0	928.9	43.0	50.4	192.1	320.8
	Indonesia	1.2	1.3	1.4	6.5	25.4	26.3	46.1	101.9
	Japan	79.8	230.1	1,839.8	3,345.8	55.3	77.5	812.4	1,348.2
	Korea	25.8	31.4	51.3	116.7	78.3	82.7	230.9	407.8
	Malaysia	17.5	18.5	10.1	35.9	28.7	29.7	46.9	105.8
	Philippines	1.1	1.1	2.6	5.9	9.2	12.3	21.5	46.5
	Singapore	144.4	194.2	140.5	398.8	37.1	40.5	89.0	172.2
	Thailand	13.3	15.0	3.6	23.0	11.1	12.4	33.0	68.8
	Australia	44.5	54.0	298.2	468.0	198.7	216.4	483.5	931.5
	New Zealand	1.6	19.2	15.7	47.8	7.1	13.3	24.4	44.7
	Pakistan	0.0	0.0	0.0	0.2	0.1	0.1	1.5	4.6
	India	0.2	0.3	0.7	1.6	49.3	52.6	130.8	376.5
	ASEAN+3	579.0	834.2	2,265.3	4,861.4	541.8	588.1	1,625.9	3,070.1
	As percent of total	11.9%	17.2%	46.6%	100.0%	17.6%	19.2%	53.0%	100.0%
	ASEAN+7	625.4	907.8	2,579.9	5,379.0	796.9	870.4	2,266.1	4,427.4
As percent of total	11.6%	16.9%	48.0%	100.0%	18.0%	19.7%	51.2%	100.0%	

*Source:* Coordinated Portfolio Investment Survey (CPIS), International Monetary Fund.

*China's asset data are calculated by the counter data (the liabilities data) from IMF; Hong Kong's 1997, India's 1997 and 2001, and Pakistan's 1997 and 2001 are also calculated by the counter data from IMF.*

*Note:* ( . . ) = no data available.

**Table 2. (Continued)**  
**B. (As percent GDP)**

Year	Economy	Assets in			Liabilities from				
		ASEAN+3	ASEAN+7	G6	TOTAL	ASEAN+3	ASEAN+7	G6	TOTAL
1997	China	0.1	0.1	...	...	0.2	0.2	0.4	0.7
	Hong Kong	23.2	29.1	...	...	6.3	6.9	34.9	45.9
	Indonesia	0.0	0.0	0.0	0.2	0.5	0.5	1.3	1.9
	Japan	1.0	2.1	18.8	29.8	0.0	0.2	10.0	12.0
	Korea	0.7	0.7	0.4	2.1	1.3	1.3	3.4	5.0
	Malaysia	0.5	0.6	0.3	0.9	5.5	5.5	7.0	13.2
	Philippines	0.0	0.0	...	...	0.9	0.9	5.7	7.0
	Singapore	9.2	10.2	8.3	20.3	2.4	2.6	15.0	19.2
	Thailand	0.0	0.0	0.0	0.1	1.0	1.0	2.6	3.8
	Australia	1.2	1.4	6.6	9.3	6.9	7.1	16.5	26.2
	New Zealand	1.0	2.6	6.1	9.7	4.4	5.1	19.2	26.6
	Pakistan	0.0	0.0	...	...	0.0	0.0	0.9	0.9
	India	0.1	0.1	...	...	0.2	0.2	0.9	1.2
	ASEAN+3	1.8	2.7	12.2	19.6	0.6	0.7	6.0	7.6
ASEAN+7	1.8	2.6	11.6	18.6	0.9	0.9	5.8	7.6	
2001	China	0.2	0.2	...	...	0.4	0.4	0.2	0.6
	Hong Kong	16.7	27.0	45.8	113.5	6.4	7.7	32.8	53.4
	Indonesia	0.0	0.0	0.1	0.1	0.2	0.2	0.6	1.0
	Japan	0.6	1.3	25.3	39.2	0.6	0.8	10.5	16.5
	Korea	0.2	0.2	0.6	1.0	1.7	1.8	6.3	9.3
	Malaysia	0.4	0.4	0.3	1.0	5.6	5.6	3.4	10.3
	Philippines	0.1	0.1	1.0	1.1	2.1	2.1	2.9	6.5
	Singapore	23.2	31.4	34.2	78.0	4.2	4.8	28.3	37.6
	Thailand	0.1	0.1	0.1	0.3	1.5	1.5	1.7	3.7
	Australia	1.5	1.6	10.8	14.3	8.2	8.5	16.0	30.7
	New Zealand	1.1	3.1	10.2	15.6	6.7	7.7	9.8	23.0
	Pakistan	0.0	0.0	...	...	0.0	0.0	0.1	0.2
	India	0.0	0.0	...	...	0.1	0.1	0.6	0.9
	ASEAN+3	1.6	2.5	17.0	28.3	1.0	1.0	5.8	9.3
ASEAN+7	1.6	2.5	16.4	26.9	1.2	1.3	5.4	9.0	
2010	China	0.4	0.4	...	...	2.5	2.5	1.5	4.9
	Hong Kong	79.1	93.3	66.0	283.9	13.2	15.4	58.7	98.0
	Indonesia	0.1	0.1	0.1	0.6	2.5	2.6	4.5	9.9
	Japan	1.8	5.3	42.6	77.4	1.3	1.8	18.8	31.2
	Korea	1.8	2.1	3.5	8.0	5.3	5.6	15.8	27.8
	Malaysia	4.2	4.4	2.4	8.6	6.9	7.1	11.3	25.4
	Philippines	0.3	0.3	0.7	1.6	2.5	3.4	5.8	12.6
	Singapore	49.3	66.3	48.0	136.2	12.7	13.8	30.4	58.8
	Thailand	2.3	2.6	0.6	3.9	1.9	2.1	5.6	11.7
	Australia	5.0	6.1	33.7	53.0	22.5	24.5	54.7	105.4
	New Zealand	1.4	16.2	13.3	40.3	6.0	11.3	20.6	37.8
	Pakistan	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0
	India	0.0	0.0	0.0	0.0	1.2	1.3	3.2	9.3
	ASEAN+3	6.6	9.5	25.7	55.1	2.9	3.1	8.6	16.2
ASEAN+7	4.4	6.3	18.0	37.5	3.3	3.6	9.3	18.1	

*Source:* Coordinated Portfolio Investment Survey (CPIS), International Monetary Fund.

*China's asset data are calculated by the counter data (the liabilities data) from IMF; Hong Kong's 1997, India's 1997 and 2001, and Pakistan's 1997 and 2001 are also calculated by the counter data from IMF.*

*Note:* (...) = no data available.

in 1997 to 17.6 percent in 2010. As in the case of trade relations, these results do not imply that the financial linkage with the G6 has decreased in recent years. As shown in Table 2, the actual size of cross-border assets between Asian countries and the United States increased substantially, in line with ongoing financial globalization around the world.



## 2.2 Business cycle co-movements

As in many previous studies, we use the contemporaneous bilateral correlation coefficient of (the log of) cyclical real GDP of two countries to describe their business cycle co-movements. To obtain the trend of real GDP, an HP filter<sup>5</sup> is applied. To obtain the cyclical real GDP, the trend real GDP is subtracted from the real GDP. Annual data are used for 1990–2009.<sup>6</sup>

Table 3 presents the correlation coefficients of cyclical real GDP for pairs of 13 Asia-Pacific countries as well as the correlation coefficients of cyclical real GDP for 13 Asia-Pacific countries and G-6 countries. The business cycle co-movements of Asian countries are higher in the 2000s than in the 1990s, and the bilateral correlation among Asian countries increased in most cases. As depicted by the average number (Avg.), business cycle co-movements increased in six out of nine countries in ASEAN+3 and in ten out of 13 countries in ASEAN+7. In addition, the business cycle synchronization of Asian countries with the United States and G6 also increased. On average, the correlation of ASEAN+3 with the United States increased from  $-0.03$  to  $0.50$ , and the correlation with G6 increased from  $-0.23$  to  $0.69$ . Moreover, the correlation of ASEAN+7 with the United States increased from  $-0.02$  to  $0.49$ , and the correlation with G6 increased from  $-0.01$  to  $0.65$ .

The increase in the business cycle co-movements of Asian countries may be related to a higher degree of trade and financial integration within Asian economies as documented in the previous section. This increase may also be related to a higher business cycle co-movement of Asian countries with advanced countries (Table 3), however. This phenomenon in turn could be related to more similar and stronger economic linkages between Asian countries and advanced countries, possibly with stronger shocks in advanced countries. In the next section, we formally examine the effects of internal vs. external integration and trade vs. financial integration on business cycle co-movements of Asian countries.

## 3. Empirical method

### 3.1 Empirical model

Previous studies have used the following type of regression to analyze the effects of trade and financial integration on business cycle synchronization (i.e., Imbs 2004, 2006, 2011; Déés and Zorell 2011).

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- 5 The Hodrick–Prescott (1980) filter is a mathematical tool used in macroeconomics, especially in real business cycle theory to extract the cyclical component of a time series from the raw data.
- 6 Real GDP is measured in local units for all cases except for G6 aggregate, where real GDP in purchasing power parity is used.

**Table 3. Correlation of output in Asia**  
**A. 1990–1999**

	HK	CHN	INO	JPN	KOR	MAL	PHI	SIN	THA	AU	NZ	PAK	INA	US	G6
HK	1.00	-0.27	0.92	0.67	0.72	0.87	-0.08	0.71	0.91	-0.61	0.20	0.14	-0.60	-0.70	-0.73
CHN	-0.27	1.00	-0.09	-0.31	0.02	0.05	0.78	0.44	-0.20	0.90	0.81	-0.24	0.82	0.78	0.66
INO	0.92	-0.09	1.00	0.81	0.83	0.98	0.21	0.81	0.93	-0.47	0.39	0.28	-0.35	-0.61	-0.60
JPN	0.67	-0.31	0.81	1.00	0.67	0.78	0.25	0.47	0.63	-0.52	0.04	0.46	-0.30	-0.59	-0.44
KOR	0.72	0.02	0.83	0.67	1.00	0.89	0.37	0.77	0.80	-0.26	0.52	0.30	-0.04	-0.35	-0.24
MAL	0.87	0.05	0.98	0.78	0.89	1.00	0.36	0.87	0.89	-0.32	0.52	0.27	-0.18	-0.46	-0.44
PHI	-0.08	0.78	0.21	0.25	0.37	0.36	1.00	0.57	-0.03	0.68	0.75	0.01	0.78	0.56	0.61
SIN	0.71	0.44	0.81	0.47	0.77	0.87	0.57	1.00	0.70	0.08	0.80	-0.10	0.08	-0.10	-0.15
THA	0.91	-0.20	0.93	0.63	0.80	0.89	-0.03	0.70	1.00	-0.57	0.35	0.30	-0.45	-0.71	-0.71
Avg1	0.56	0.05	0.68	0.50	0.63	0.71	0.30	0.67	0.58	-0.12	0.49	0.16	-0.03	-0.24	-0.23
AU	-0.61	0.90	-0.47	-0.52	-0.26	-0.32	0.68	0.08	-0.57	1.00	0.56	-0.29	0.91	0.96	0.88
NZ	0.20	0.81	0.39	0.04	0.52	0.52	0.75	0.80	0.35	0.56	1.00	-0.13	0.59	0.36	0.29
PAK	0.14	-0.24	0.28	0.46	0.30	0.27	0.01	-0.10	0.30	-0.29	-0.13	1.00	0.00	-0.25	-0.16
INA	-0.60	0.82	-0.35	-0.30	-0.04	-0.18	0.78	0.08	-0.45	0.91	0.59	0.00	1.00	0.86	0.88
Avg2	0.30	0.23	0.44	0.30	0.47	0.50	0.39	0.52	0.36	0.01	0.45	0.08	0.11	-0.02	-0.01

**B. 2000–2009**

	HK	CHN	INO	JPN	KOR	MAL	PHI	SIN	THA	AU	NZ	PAK	INA	US	G6
HK	1.00	0.51	0.49	0.75	0.52	0.91	0.93	0.97	0.71	0.65	0.20	0.95	0.64	0.68	0.91
CHN	0.51	1.00	0.98	-0.12	-0.11	0.47	0.70	0.61	-0.11	0.22	-0.68	0.70	0.98	-0.24	0.18
INO	0.49	0.98	1.00	-0.15	-0.14	0.47	0.69	0.57	-0.13	0.23	-0.70	0.68	0.96	-0.28	0.14
JPN	0.75	-0.12	-0.15	1.00	0.79	0.73	0.57	0.66	0.94	0.71	0.75	0.52	0.01	0.98	0.94
KOR	0.52	-0.11	-0.14	0.79	1.00	0.56	0.37	0.50	0.69	0.71	0.59	0.28	-0.04	0.74	0.74
MAL	0.91	0.47	0.47	0.73	0.56	1.00	0.93	0.92	0.80	0.81	0.27	0.84	0.57	0.66	0.83
PHI	0.93	0.70	0.69	0.57	0.37	0.93	1.00	0.95	0.59	0.72	-0.01	0.93	0.78	0.46	0.75
SIN	0.97	0.61	0.57	0.66	0.50	0.92	0.95	1.00	0.67	0.68	0.12	0.95	0.72	0.59	0.83
THA	0.71	-0.11	-0.13	0.94	0.69	0.80	0.59	0.67	1.00	0.74	0.77	0.51	0.02	0.94	0.85
Avg1	0.72	0.37	0.35	0.52	0.40	0.72	0.72	0.73	0.52	0.61	0.15	0.71	0.52	0.50	0.69
AU	0.65	0.22	0.23	0.71	0.71	0.81	0.72	0.68	0.74	1.00	0.45	0.53	0.27	0.61	0.69
NZ	0.20	-0.68	-0.70	0.75	0.59	0.27	-0.01	0.12	0.77	0.45	1.00	-0.04	-0.58	0.83	0.50
PAK	0.95	0.70	0.68	0.52	0.28	0.84	0.93	0.95	0.51	0.53	-0.04	1.00	0.81	0.45	0.74
INA	0.64	0.98	0.96	0.01	-0.04	0.57	0.78	0.72	0.02	0.27	-0.58	0.81	1.00	-0.10	0.32
Avg2	0.69	0.35	0.33	0.51	0.39	0.69	0.68	0.69	0.52	0.56	0.10	0.64	0.43	0.49	0.65

*Source:* Bloomberg, CEIC, International Financial Statistics (International Monetary Fund), and national sources.

*Note:* The figures present the bilateral BCS as described in the paper. Average is the simple average of correlations among the nine East Asian economies (excluding own economy). Australia (AU); People's Republic of China (CHN); Hong Kong, China (HK); India (INA); Indonesia (INO); Japan (JPN); the Republic of Korea (KOR); Malaysia (MAL); New Zealand (NZ); Pakistan (PAK); Philippines (PHI); Singapore (SIN); Thailand (THA).

$$\rho_{ij} = \alpha_0 + \alpha_1 T_{ij} + \alpha_2 F_{ij} + \varepsilon_{ij} \quad (1)$$

where  $\rho_{ij}$  is the correlation between the cyclical components of real GDP of countries  $i$  and  $j$ ,  $T_{ij}$  is the intensity of bilateral goods trade between countries  $i$  and  $j$ , and  $F_{ij}$  is the intensity of bilateral asset trade between countries  $i$  and  $j$ .  $\alpha_1$  and  $\alpha_2$  show the impacts of trade and financial integration on business cycle synchronization.

In addition to economic integration among Asian countries, economic linkages between Asian countries and the rest of the world can contribute to business cycle comovements of Asian countries. For example, structural shocks in the United States can affect both Korea and Thailand in a similar manner, as Korea and Thailand have similar and strong common economic linkages with the United States. To consider

such effects based on economic relations with countries outside the region, two variables are added to equation (1) as follows:

$$\rho_{ij} = \alpha_0 + \alpha_1 \mathbf{T}_{ij} + \alpha_2 \mathbf{F}_{ij} + \alpha_3 \mathbf{EXT}_{ij} + \alpha_4 \mathbf{EXF}_{ij} + \varepsilon_{ij} \quad (2)$$

where EXT and EXF are the variables that show the external trade and financial linkages, respectively, that generate business cycle synchronization between countries  $i$  and  $j$ . The measures show how strong and similar the external linkages of countries  $i$  and  $j$  are to that of countries outside the region.

We also consider the following system of equations in which interactions among various types of economic integration are allowed.

$$\rho_{ij} = \alpha_0 + \alpha_1 \mathbf{T}_{ij} + \alpha_2 \mathbf{F}_{ij} + \alpha_3 \mathbf{EXT}_{ij} + \alpha_4 \mathbf{EXF}_{ij} + \varepsilon_{ij}^1, \quad (3)$$

$$\mathbf{T}_{ij} = \beta_0 + \beta_1 \mathbf{F}_{ij} + \beta_2 \mathbf{I}_{ij}^T + \beta_3 \mathbf{EXT}_{ij} + \beta_4 \mathbf{EXF}_{ij} + \varepsilon_{ij}^2,$$

$$\mathbf{F}_{ij} = \gamma_0 + \gamma_1 \mathbf{T}_{ij} + \gamma_2 \mathbf{I}_{ij}^F + \gamma_3 \mathbf{EXT}_{ij} + \gamma_4 \mathbf{EXF}_{ij} + \varepsilon_{ij}^3,$$

where  $\mathbf{I}_{ij}^T$  and  $\mathbf{I}_{ij}^F$  are instruments that affect bilateral trade and finance intensities between country  $i$  and  $j$ , respectively. In this system, interactions among internal financial and trade integration are allowed. Internal trade integration can have both direct ( $\alpha_1$ ) and indirect ( $\gamma_1 \alpha_2$ ) effect by affecting internal financial integration. Similarly, internal financial integration can have both direct ( $\alpha_2$ ) and indirect ( $\beta_1 \alpha_1$ ) effect by affecting internal trade integration. In addition, two measures of external linkages are allowed to affect the measures of internal integration.

Equations (1), (2), and (3) are estimated by ordinary least squares. Equation system (4) (next section) is estimated by three-stage least squares. More detailed explanations on the empirical model are found in Gong and Kim (2012).

### 3.2 Measurement and data

To measure the degree of trade integration, the following measure of trade intensity between countries  $i$  and  $j$  ( $T_{i,j}$ ) is constructed.

$$T_{i,j} = \frac{1}{2T} \sum_t \frac{(X_{i,j,t} + M_{i,j,t}) Y_t^W}{Y_{i,t} * Y_{j,t}}, \quad (4)$$

where  $X_{i,j,t}$  is the amount of country  $i$ 's export to country  $j$  at time  $t$ ;  $M_{i,j,t}$  is the amount of country  $i$ 's import from country  $j$  at time  $t$ ;  $Y_t^W$  is the world GDP at time  $t$ ; and  $Y_{i,t}$  is country  $i$ 's GDP at time  $t$ . This measure is traces to Deardorff's (1998) the-

oretical work based on the gravity model, and has been used in several studies including Imbs (2006). The measure depends on trade barriers and not on country size. This property is particularly useful in our case because Asian countries in our sample are quite diversified in terms of their sizes but we would like to use the measure that properly captures the extent of trade integration, independent of the country size.<sup>7</sup> Deardorff (1998) shows that the measure equals one if preferences are homothetic and if trade barriers are nonexistent.

To properly capture the size of financial integration, independent of the country size, a similar measure between countries  $i$  and  $j$  is constructed for financial integration.<sup>8</sup> The measure for financial integration between countries  $i$  and  $j$  ( $F_{ij}$ ) is given by:

$$F_{ij} = \frac{1}{2T} \sum_t \frac{(I_{i,j,t} + I_{j,i,t})Y_t^W}{Y_{i,t} * Y_{j,t}}, \quad (5)$$

where  $I_{i,j,t}$  is the amount of portfolio investment from country  $i$  to country  $j$  at time  $t$ . To measure the degree of financial integration, past studies often used portfolio investment data. In our case, we also used the bilateral portfolio investment data.<sup>9</sup>

The measure of external trade linkages that affects business cycle synchronization between countries  $i$  and  $j$  ( $EXT_{ij}$ ) is constructed as follows:

$$EXT_{ij} \equiv \sum_{k=1}^6 w_k \{ \text{MAXT} - |T_{i,k} - T_{j,k}| \} \min\{T_{i,k}, T_{j,k}\}, \quad (6)$$

where  $w_k$  is the relative weight of G6 countries based on real GDP, and MAXT is the largest value among  $T_{ij}$  and  $T_{ik}$  for all  $i, j$ , and  $k$ . The first term  $\{ \text{MAXT} - |T_{i,k} - T_{j,k}| \}$  in equation (6) shows the similarity in trade integration of countries  $i$  and  $k$  with that of countries  $j$  and  $k$ .  $|T_{i,k} - T_{j,k}|$  measures the difference between the trade integration of countries  $i$  and  $k$  and that of  $j$  and  $k$ . By subtracting from the largest possible value of  $T$  in the sample, the first term  $\{ \text{MAXT} - |T_{i,k} - T_{j,k}| \}$  shows the similarity. The second term  $(\min\{T_{i,k}, T_{j,k}\})$  in equation (6) shows the common part of the trade integration of countries  $i$  and  $k$  and that of countries  $j$  and  $k$ . The second term shows the strength of the common part of the trade integration of countries  $i$  and  $k$  and that of countries  $j$  and  $k$ .

7 Other things being equal, a larger country is likely to trade more.

8 Previous studies suggested that the gravity model can also explain international transactions in financial assets (i.e., Portes and Rey 2001).

9 The asset data of China are calculated by the counter party's (liability) data throughout the sample period. The same method is used for the asset data of the following countries: Hong Kong (1997), India (1997, 2001, 2002, 2003), and Pakistan (1997, 2001).

The rationale behind this measure is that if two countries in a region (e.g., Korea and Thailand in Asia) have similar and strong common external trade integration with countries outside the region (e.g., G6), the business cycle co-movement between Korea and Thailand is likely to be high. The first term naturally shows the similarity of Korea and Thailand's external trade linkages. The second term shows the strength of the common external trade linkages of Korea and Thailand. Trade intensities of Korea and Thailand with the G6 ( $\Gamma_{ik}$  and  $\Gamma_{jk}$ ) show the strength of the external trade linkages of Korea and Thailand. The business cycle correlation of Korea and Thailand is likely to be generated only to the extent that they have the common part, however. Therefore, the minimum of external trade intensities of two countries is used.

The measure of external financial linkages that affects business cycle synchronization between countries  $i$  and  $j$  ( $EXT_{ij}$ ) is constructed in a similar manner.

$$EXF_{ij} \equiv \sum_{k=1}^6 w_k \{ \text{MAXF} - |F_{i,k} - F_{j,k}| \} \min\{F_{i,k}, F_{j,k}\}, \quad (7)$$

where MAXF is the largest value between  $F_{ij}$  and  $F_{i,k}$  for all  $i, j$ , and  $k$ . The first term  $\{ \text{MAXF} - |F_{i,k} - F_{j,k}| \}$  shows the difference between the financial integration of countries  $i$  and  $k$  and that of  $j$  and  $k$ . The second term ( $\min\{F_{i,k}, F_{j,k}\}$ ) shows the strength of the common part of the financial integration of countries  $i$  and  $k$  and that of  $j$  and  $k$ .

Note that these measures for external linkages are different by nature from the measures for internal integration. The measures for internal integration simply show how intensive trade and financial integration are between countries  $i$  and  $j$ , whereas the measures for external linkages show how strong and similar the external integration of country  $i$  and countries outside the region is to that of country  $j$  and countries outside the region (see Gong and Kim 2012 for details).

Following previous empirical studies, we include the geographic distance of the capital cities of two countries, whether a border exists between two countries, and whether a common official language is used in both countries as instruments for the trade equation. These three instruments are usually argued as clearly exogenous with high predictive power when analyzing the determinants of bilateral trade. For the finance equation, two instruments are used: the sum of two countries' per capita real GDP and the difference between the per capita real GDP of the two countries. The combined income level may affect the degree of financial integration because financial markets and technologies are better developed in high-income countries, and financial integration between high-income countries may be easier. On the con-

trary, a large difference in the level of income may make financial integration more difficult.

We consider the following group of countries. First, we consider nine countries in ASEAN+3, as policy cooperation such as CMIM and ABMI has been discussed among this group of countries. Second, we consider “ASEAN+7” by adding four countries (India, Pakistan, New Zealand, and Australia) to ASEAN+3 because policy debates often include these four countries as potential candidates for extended policy cooperation in the Asia-Pacific area.

For the measure of business cycle correlation, we calculate the correlation of cyclical real GDP from 2001 to 2009 (annual data) as reported in Table 3. For all other measures, the annual average values from 2001 to 2009 are used. Correlations among various measures are reported in Table 4.<sup>10</sup> The table shows that the business cycle synchronization measure ( $\rho$ ) is more correlated with external linkage measures than with internal integration measures. This correlation may imply that external linkages are more important in explaining the business cycle synchronization of Asian countries compared with internal integration. A formal analysis of this possibility is performed in the next section.

## 4. Results

### 4.1 Basic results

Table 5 shows the estimation results based on the single equation method. When only the measure for internal trade integration (and a constant term) is included as the regressor, the coefficient is positive for the ASEAN+3 and ASEAN+7 samples, although it is significant at only the 10 percent level for ASEAN+7. Similarly, when only the measure for internal financial integration is included as the regressor, the coefficient is positive and significant at the 5 percent and 10 percent level for ASEAN+7 and ASEAN+3, respectively. When both internal trade and financial integration measures are included, however, no coefficients are significantly estimated, probably because of the high correlation between two measures as reported in Table 4.

When the measures for external financial and trade linkages (EXF and EXT) are added, the coefficients on the measures for internal trade integration and two external linkages are positively estimated, whereas the coefficient on the measure for

<sup>10</sup>  $\rho_1$ , EXT1, and EXF1 are alternative measures to check the robustness of the results. Section 4 explains those measures.

**Table 4. Correlation among various measures****A. ASEAN+3**

	$\rho$	$\rho_1$	T	F	EXT	EXT1	EXF	EXF1
$\rho$	1							
$\rho_1$	0.948	1						
T	0.261	0.231	1					
F	0.297	0.276	0.904	1				
EXT	0.382	0.374	0.675	0.811	1			
EXT1	0.382	0.374	0.676	0.812	1.000	1		
EXF	0.439	0.424	0.284	0.600	0.591	0.590	1	
EXF1	0.444	0.430	0.290	0.605	0.594	0.594	1.000	1

**B. ASEAN+7**

	$\rho$	$\rho_1$	T	F	EXT	EXT1	EXF	EXF1
$\rho$	1							
$\rho_1$	0.903	1						
T	0.208	0.164	1					
F	0.232	0.202	0.864	1				
EXT	0.281	0.243	0.712	0.757	1			
EXT1	0.282	0.244	0.712	0.758	1.000	1		
EXF	0.333	0.279	0.249	0.606	0.437	0.437	1	
EXF1	0.334	0.281	0.253	0.612	0.439	0.439	1.000	1

**Table 5. Single equation estimation****A. ASEAN+3**

$\rho$	OLS	OLS	OLS	OLS
T	0.005 (1.58)		-0.001 (-0.11)	0.027 (2.56)**
F		0.019 (1.82)*	0.021 (0.87)	-0.109 (-2.61)**
EXT				0.015 (1.45)
EXF				0.090 (3.20)***
$\bar{R}^2$	0.041	0.062	0.034	0.277

**B. ASEAN+7**

P	OLS	OLS	OLS	OLS
T	<b>0.006</b> (1.86)*		<b>0.001</b> (0.14)	<b>0.018</b> (2.09)**
F		0.020 (2.08)**	0.0177 (0.92)	-0.069 (-2.24)**
EXT				0.011 (1.18)
EXF				0.067 (3.16)***
$\bar{R}^2$	0.031	0.041	0.029	0.146

Note: \*Statistically significant at the 10 percent level. \*\*Statistically significant at the 5 percent level. \*\*\*Statistically significant at the 1 percent level.

internal financial integration is negatively estimated. The estimated coefficients on the measures for internal trade and financial integration are significant at the 5 percent level, whereas the estimated coefficients on the measure for external financial integration are significant at the 1 percent level. Table 5 shows the substantial increase in the adjusted  $R^2$  when both measures of external linkages are added to the regression.

Table 6 reports the estimation results for the equation system (3). The estimation results for the main equation (the first equation of equation [3]) are similar to those of the single equation estimation. The sign of the effects of each variable in the GDP correlation equation is the same; the internal trade integration and external trade and financial integration have positive effects on business cycle co-movements, but internal financial integration has a negative effect. The estimated coefficients are significant in most cases.

The results show that the measures of external trade and financial linkages positively affect regional business cycle co-movements. This finding implies that similar and strong common external linkages of two countries increase the business cycle co-movements between them. This is not surprising. For example, suppose the trade linkages between Korea and the United States and that between Thailand and the United States are strong and similar. Suppose further that the U.S. economy is hit by recession. Then, both Korea and Thailand will have difficulties exporting to the United States. Hence, both countries are likely to experience a fall in income and a worsening trade balance against the United States, which leads to business cycle synchronization of the two countries. Similarly, suppose the financial linkage between Korea and the United States and that between Thailand and the United States are strong and similar. Suppose further that the U.S. economy goes into recession, which decreases the price of U.S. financial assets. Then, the net investment income and capital gain on financial assets in the United States owned by Korea and Thailand are likely to fall. Such a case may lead to a fall in income of the latter two countries and therefore have a positive effect on the business cycle co-movement of the two.

The results also indicate that internal trade integration has a positive effect on business cycle co-movements. Many studies,<sup>11</sup> following Frankel and Rose (1998), likewise observed the positive effect of trade integration on business cycle co-movements. Frankel and Rose (1998) interpreted that a possible negative effect of trade-induced specialization can be weaker than the direct positive effect of trade

<sup>11</sup> For example, Canova and Dellas (1993) found that productivity shocks in the production of traded intermediate goods generate positive output co-movement across countries.



**Table 6. Equation system estimation**

	ASEAN+3	ASEAN+7
<b>GDP correlations (<math>\rho</math>) equation</b>		
T	0.070 (2.84)***	0.033 (1.60)
F	-0.303 (-2.82)***	-0.155 (-2.07)**
EXT	0.038 (2.20)**	0.023 (1.71)*
EXF	0.186 (3.28)***	0.112 (2.63)***
$\bar{R}^2$	-0.202	0.045
<b>Trade (T) equation</b>		
F	3.941 (7.02)***	3.794 (5.47)***
EXT	-0.285 (-1.16)	-0.059 (-0.22)
EXF	-1.950 (-5.32)***	-2.026 (-5.42)***
$\bar{R}^2$	0.915	0.848
<b>Finance (F) equation</b>		
T	0.217 (7.18)***	0.243 (5.95)***
EXT	0.122 (2.09)**	0.044 (0.49)
EXF	0.473 (4.34)***	0.517 (6.24)***
$\bar{R}^2$	0.948	0.908

Note: \*Statistically significant at the 10 percent level. \*\*Statistically significant at the 5 percent level. \*\*\*Statistically significant at the 1 percent level.

integration on business cycle co-movements; Imbs (2004) confirmed such a conjecture. We may attach a similar interpretation to our empirical results.

Interestingly, internal financial integration is found to have a negative effect on the regional business cycle correlation. Past empirical studies (e.g., Imbs [2004, 2006] and Kose, Prasad, and Terrones [2003] for the countries around the world; Shin and Sohn [2006] for Asian countries) mostly found that the effect is either positive or insignificant. The result of the current study is particularly interesting because the effect is positive when the measures for external linkages are not included in the estimation as in the past studies. External linkages are found to have a significant effect on internal business cycle synchronization. By omitting the measures for external linkages, the effect of internal integration on internal business cycle synchronization can be improperly estimated.<sup>12</sup>

<sup>12</sup> Gong and Kim (2012) applied a similar method to various regions of developing countries and found that the effect is negative after controlling external linkages. On the other

Theoretically, the effects of financial integration on business cycle correlation are ambiguous. On the one hand, some theories imply a negative effect. As suggested by Backus, Kehoe, and Kydland (1992) and Baxter and Crucini (1995), a country-specific positive productivity shock in the home country induces capital flows from the foreign country in a two-country model, by increasing the marginal productivity of capital gap between the home and the foreign countries, thereby generating a negative correlation between the two countries' outputs. Obstfeld (1994) suggested that financial integration can promote investments on risky projects, leading countries to specialize based on comparative advantages. This effect may lead to a negative output correlation. On the other hand, other theories, such as that by Calvo and Mendoza (2000) suggest a positive effect: Financial globalization may promote contagion and increase business cycle co-movement by weakening incentives for gathering costly information in the presence of short-selling constraints and by strengthening incentives for imitating arbitrary market portfolio if below-market performance is costly for portfolio managers. The former theory, which suggests a negative effect, is consistent with our results.

Our results also show that internal trade and financial integration affect each other positively; the estimated coefficients on the measure of internal trade integration in the finance equation and the measure of internal financial integration in the trade equation are both positive and significant. This result may imply that policy efforts to promote regional trade (or financial) integration lead not only to regional trade (or financial) integration but also to regional financial (or trade) integration. This result also suggests that regional financial integration has a negative direct effect on business cycle co-movement, but it also has a positive indirect effect by affecting regional trade integration positively. After considering this indirect positive effect, the overall negative effect of internal financial integration on regional business cycle co-movements may not be all that great.

#### 4.2 Extended analysis

Most coefficients are estimated significantly in the previous regressions. Thus, inferring which of the variables is the most important in explaining business cycle co-movements is difficult. To infer the relative importance of the variables, the method suggested by Kruskal (1987) is applied in calculating the proportion of variance of the business cycle correlation explained by each variable.<sup>13</sup>

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hand, the result is broadly aligned with that of Kalemli-Ozcan, Papaioannou, and Peydró (2009). The latter suggested that past studies suffer from omitted variable bias (e.g., not controlling the aggregate effect) and that the effect of financial integration on business cycle co-movements is negative after controlling such a bias.

<sup>13</sup> This method can be referred to as the averaging relative importance over all orderings of the independent variables. First, we calculate the proportion of variance of the dependent vari-

**Table 7. Partial and relative importance index****A. ASEAN+3**

Variable	Partial corr.	Semipartial corr.	Relative importance index
T	0.42	0.37	0.06
F	-0.42	-0.38	0.06
EXT	0.25	0.21	0.02
EXF	0.50	0.46	0.09

**B. ASEAN+7**

Variable	Partial corr.	Semipartial corr.	Relative importance index
T	0.24	0.22	0.02
F	-0.25	-0.24	0.03
EXT	0.14	0.12	0.01
EXF	0.35	0.33	0.05

*Note:* Partial correlation measures the degree of association between two random variables, with the effect of a set of controlling random variables removed. The semipartial correlation statistic is similar to the partial correlation statistic. Both measure variance correlations after certain factors are controlled, but to calculate the semipartial correlation, the third variable is held constant for either  $x$  or  $y$ , whereas for partial correlations, the third variable is held constant for both.

Table 7 shows that the most important variable is external finance linkages, followed by internal financial integration, suggesting that financial linkages may be more relevant than trade integration in explaining the business cycle synchronization of Asian countries. In addition, the sum of the proportion for the two external linkages is larger than the sum of the proportion for two internal linkages, which is consistent with the popular notion that Asian economies are significantly affected by the economic conditions of advanced countries.

We also perform various exercises to check the robustness of the results. First, we use the correlation of real GDP growth rate ( $\rho_1$ ) instead of the correlation of cyclical real GDP as the measure of business cycle correlation. Second, the following alternative measures for external linkages are used:

$$EXT1_{ij} \equiv \sum_{k=1}^6 \mathbf{w}_k \min\{T_{i,k}, T_{j,k}\}$$

$$EXF1_{ij} \equiv \sum_{k=1}^6 \mathbf{w}_k \min\{F_{i,k}, F_{j,k}\}$$

In these measures, the size of the common external linkage is only considered by dropping the term that shows the similarity of the external linkage. Third, alternative measures for trade and financial integration are considered.

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able linearly accounted by the first independent variable. Then, we calculate the proportion of the remaining variance of the dependent variable linearly accounted by the second independent variable, and so on. Then, we calculate the average proportion of all possible orderings. For the details, see Kruskal (1987).

$$T\mathbf{1}_{i,j} = \frac{1}{T} \sum_t \frac{(X_{i,j,t} + M_{j,i,t})}{Y_{i,t} + Y_{j,t}}$$

$$F\mathbf{1}_{i,j} = \frac{1}{T} \sum_t \frac{(I_{i,j,t} + I_{j,i,t})}{Y_{i,t} + Y_{j,t}}$$

In contrast to the original measures, these measures also depend on country size. Fourth, the business cycle co-movement structure might have caused economic integration. In this regard, business cycle correlation measures are constructed for the sample period of 2002–09, but integration measures are constructed based only on 2001 data. Fifth, we consider an alternative structure of the equation system in which the external financial (or trade) integration does not affect the internal trade (or financial) integration. The results, which are generally the same, are reported in Table 8.

## 5. Conclusion

This paper examines the effects of economic integration on the regional business cycle synchronization of Asian countries. In particular, we analyze the effects of internal vs. external integration and trade vs. financial integration on the business cycle synchronization of Asian countries. A similar and strong common external linkage was found to have a significant positive effect on the business cycle synchronization of Asian countries. This finding implies that shocks from major industrial countries outside Asia affect Asian countries and generate business cycle co-movement among countries in the region. Furthermore, external linkages, especially external financial linkages, were found to be the most important determinant of business cycle co-movements of Asian countries. The positive effect of internal trade linkages found in past empirical studies was also confirmed. Interestingly, we found that, after controlling for external linkages, internal financial linkages have a negative effect on Asian business cycle synchronization. This is in contrast with previous studies that found a positive effect of internal financial linkages but did not take external linkages into account.

The empirical results suggest that the regional policy efforts on trade integration within Asia, such as FTAs among some ASEAN+3 countries, have contributed to the business cycle synchronization of member countries by increasing the extent of internal trade integration. If such efforts are pursued further in the future, business cycles of Asian countries are likely to be synchronized further. More synchronized regional business cycles in turn will increase the need for regional macroeconomic policy coordination and decrease the cost of regional monetary integration.

Table 8. Extended results

1		2		
ASEAN+3	ASEAN+7	ASEAN+3	ASEAN+7	
<b>GDP correlations (<math>\rho</math>) equation</b>				
T	0.064(3.18)***	0.032(1.83)*	0.074(3.54)***	0.344(1.69)*
F	-0.290(-3.29)***	-0.165(-2.6)***	-0.328(-3.46)***	-0.165(-2.17)**
EXT	0.039(2.71)***	0.026(2.17)**	5.250(2.46)**	3.040(1.77)*
EXF	0.168(3.61)***	0.106(2.91)***	6.264(3.96)***	3.690(2.71)***
R <sup>2</sup>	-0.766	-0.310	-0.568	0.030
<b>Trade (T) equation</b>				
F	4.034(7.26)***	3.713(5.4)***	4.154(7.48)***	3.869(5.35)***
EXT	-0.318(-1.31)	-0.029(-0.11)	-45.454(-1.47)	-9.926(-0.28)
EXF	-2.00(-5.51)***	-1.988(-5.37)***	-2.057(-5.63)***	-65.298(-5.32)***
R <sup>2</sup>	0.910	0.852	0.906	0.846
<b>Finance (F) equation</b>				
T	0.223(7.44)***	0.241(5.99)***	0.221(7.96)***	0.244(6.09)***
EXT	0.113(1.95)*	0.048(0.75)	14.150(2.05)**	5.010(0.66)
EXF	0.496(4.66)***	0.511(6.29)***	15.808(4.70)***	16.562(6.57)***
R <sup>2</sup>	0.947	0.908	0.947	0.910
3		4		
ASEAN+3	ASEAN+7	ASEAN+3	ASEAN+7	
<b>GDP correlations (<math>\rho</math>) equation</b>				
T	16.720(1.42)	14.708(1.75)*	0.005(0.41)	0.023(1.13)
F	-0.130(-1.41)	-0.140(-2.36)**	-9.324(-0.30)	-64.459(-1.57)
EXT	0.030(1.46)	0.032(2.26)**	0.006(0.48)	0.011(0.80)
EXF	0.096(2.01)**	0.102(3.00)***	0.044(1.24)	0.109(2.05)**
R <sup>2</sup>	0.011	0.005	0.185	0.064
<b>Trade (T) equation</b>				
F	0.007(5.82)***	0.007(4.51)***	1,803.060(5.04)***	2,035.663(3.99)***
EXT	-0.001(-1.91)*	-0.000(-0.78)	0.197(0.81)	0.322(1.11)
EXF	-0.003(-4.22)***	-0.003(-4.34)***	-1.651(-3.65)***	-2.553(-4.0)***
R <sup>2</sup>	0.854	0.828	0.874	0.686
<b>Finance (F) equation</b>				
T	122.318(6.40)***	120.105(5.09)***	0.000(4.34)***	0.000(3.84)***
EXT	0.186(3.19)***	0.129(2.12)**	0.000(1.85)*	-0.000(-0.24)
EXF	0.433(3.41)***	0.472(4.98)***	0.001(2.33)**	0.001(5.34)***
R <sup>2</sup>	0.927	0.877	0.896	0.807
5		6		
ASEAN+3	ASEAN+7	ASEAN+3	ASEAN+7	
<b>GDP correlations (<math>\rho</math>) equation</b>				
T	0.049(2.94)***	0.032(2.81)***	0.050(2.02)**	0.030(1.48)
F	-0.740(-3.08)***	-0.310(-3.31)***	-0.217(-1.99)**	-0.148(-1.99)**
EXT	4.423(1.360)***	0.967(1.29)	0.031(1.8)*	0.026(1.93)*
EXF	1.318(3.36)***	0.843(4.09)***	0.133(2.34)**	0.099(2.36)**
R <sup>2</sup>	-0.472	-0.703	0.106	0.035
<b>Trade (T) equation</b>				
F	16.061(3.88)***	7.204(2.87)***	3.204(11.98)***	3.468(16.27)***
EXT	-74.876(-2.03)***	17.979(0.81)		
EXF	-24.999(-3.91)***	-14.245(-2.94)***	-1.496(-4.66)***	-1.563(-6.88)***
R <sup>2</sup>	0.642	0.371	0.927	0.868
<b>Finance (F) equation</b>				
T	0.069(5.55)***	0.085(3.15)***	0.133(3.59)***	0.084(1.62)
EXT	4.334(3.25)***	1.470(0.56)	0.310(5.19)***	0.324(4.34)***
EXF	1.626(6.28)***	1.690(4.15)***		
R <sup>2</sup>	0.898	0.618	0.896	0.788

**Table 8 (Continued)**

*Note:* (1) shows the results when real GDP in log-difference is used instead of cyclical real GDP.

(2) shows the results when alternative measures for external trade and financial linkages are used.

(3) shows the results when the alternative measure for internal trade linkages is used.

(4) shows the results when the alternative measure for internal financial linkages is used.

(5) shows the results when the integration measures are calculated based on 2001 data, but the business cycle measures are calculated based on 2002–2009 data.

(6) shows the results when EXF is not included in the Trade equation and EXT is not included in the Finance equation.

\*Statistically significant at the 10 percent level. \*\*Statistically significant at the 5 percent level. \*\*\*Statistically significant at the 1 percent level.

On the other hand, the empirical results indicate that regional efforts to improve financial integration within Asia, such as CMIM and ABMI, have affected regional business cycle co-movements negatively. The empirical results also show, however, that regional financial integration has a positive effect on regional trade integration, which in turn has a positive effect on business cycle co-movements. For example, regional efforts like CMIM and ABMI may have a negative direct effect on business cycle co-movements, but they can have a positive indirect effect on business cycle by increasing the trade integration. After taking account of the indirect effect, the overall negative effect is likely to be small.

More importantly, regional financial integration/cooperation provides various other benefits, for example, reducing the possibility of future crisis, enhancing risk sharing, and efficiently allocating savings into investments.<sup>14</sup> When such benefits are considered, further efforts on regional financial cooperation are highly likely to improve welfare of countries in the region. In addition, even regional monetary integration can be more feasible with further efforts on regional financial cooperation. For example, regional financial integration can reduce the cost of monetary union by increasing consumption risk sharing within the region, which can be regarded as a built-in stabilization mechanism in the presence of asymmetric income shocks.<sup>15</sup> Therefore, further regional financial integration/cooperation, especially comprehensive efforts like the Asian Capital Market Initiative that can provide various general benefits to Asian countries, is a crucial task for Asia.

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<sup>14</sup> Refer to Kim and Yang (2012) for various benefits of regional financial cooperation/integration in the context of Asia.

<sup>15</sup> Refer to Kim, Kim, and Wang (2004, 2006) for the measurement of the degree of consumption risk sharing in Asia.

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