Spillovers in ASEAN-5 Equity Markets

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Abstract

   Research into spillovers involving emerging stock markets grew with the increasing openness and growth of emerging market economies (EMEs) as well as the crisis episodes in EMEs in the late 1990s that spread into other markets. This paper investigates which countries' equity markets are more important for the ASEAN-5 equity markets for the period 1990-2016. The findings in this paper show that returns and volatility spillovers are significant for the ASEAN-5 equity markets. In fact, these spillovers can account for more than half of the innovations in the ASEAN-5 national stock markets. Moreover, while the study reveals that innovations from Asian equity markets contribute more to innovations in the ASEAN-5 equity markets; innovations from advanced economies' equity markets remain important and innovations from non-Asian EMEs are not trivial. The results of this paper are robust against different scenarios and crisis episodes.

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1.   Introduction

Spillovers across national stock markets have increased over time. The liberalization of economies, in particular, of their capital markets has contributed to this trend. Advanced computer technology that allowed faster processing and transmission of market information across borders have likewise contributed to increasing spillovers. These developments, in turn, have resulted in greater market contagion and herd behavior in the international context.[2]

The determination of spillovers across national stock market indices is important for portfolio diversification. Increased spillovers within a region and across regions would imply reduction in the benefits gained by investors in their process of international portfolio diversification. This paper investigates the equity market returns and volatility spillovers in the ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, Thailand) coming from equity markets of advanced economies (AEs) and emerging market economies (EMEs) within and outside of Asia to determine regional and non-regional linkages. Particular attention is given to the ASEAN region in light of the region's capital market integration efforts that officially commenced with the implementation of the ASEAN Economic Community in December 2015. While integration provides benefits in terms of ease of capital movement and easier monitoring of financial market information across borders, it may provide lesser opportunities for portfolio diversification.

Generalized variance decompositions from vector autoregression (VAR) models, following Diebold and Yilmaz (2009, 2012, 2014), are used to estimate the contributions coming from equity markets of other countries to changes in the equity markets of ASEAN-5 countries. The results suggest that returns and volatility spillovers are important for the ASEAN-5 equity markets. These spillovers can account for more than half of the innovations in the ASEAN-5 national stock markets. In addition, while the study finds that innovations from Asian equity markets contribute more to innovations in ASEAN-5 equity markets; innovations from advanced economies' equity markets remain important and innovations from non-Asian EMEs are not trivial.

The paper is organized as follows. Section II discusses existing literature on spillovers across equity markets. Section III outlines the data and methodology used to examine spillovers. Section IV

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[2] Natarajan et al. (2014)

presents the estimation results. Section V concludes and provides implications for policy and financial stability.

2.   Review of Related Literature

The literature on financial market spillovers, specifically in equity markets is vast. Early empirical studies typically focused on the relationship among stock markets in advanced countries. For instance, Agmon (1972) investigated the lead-lag relationship in the stock markets of the United Kingdom, USA, Germany and Japan; Panton et al. (1976) studied the co-movements of equity markets in Australia, Austria, Belgium, Canada, France, Italy, Japan, Netherlands, Switzerland, United Kingdom, Germany, and USA; and Hilliard (1979) focused on the degree and causality among stock markets in Germany, France, United Kingdom, USA, Australia, Japan, and Canada.

In addition, many early studies suggest that the correlation in equity markets appear to be causal from the United States to other countries. For instance, Eun and Shim (1989) found that daily variations in US stock market returns were the most influential in terms of the capability of accounting for the error variances in the daily stock market returns of Australia, Canada, France, Germany, Hong Kong, Japan, Switzerland, and United Kingdom, whereas no single foreign market can significantly explain the US stock market movements. Similarly, Hamao et al. (1990) found that changes in price and price volatilities in the US stock market have the most spillover effects in the stock markets of Japan and United Kingdom.[3] Likewise, Janakiramanan and Lamba (1998) and Cha and Cheung (1998) established that the US equity market has a significant influence on Asia-Pacific countries.

Research into spillovers involving emerging stock markets grew with the increasing openness and growth of emerging market economies (EMEs) as well as the crisis episodes in EMEs in the late 1990s that spread into other markets.[4] For instance, Bekaert and Harvey (2000) and Bekaert et al. (2005) analyzed the implications of growing integration with global markets for local returns, volatility, and cross-country correlations, covering a diverse set of EMEs in Africa, Asia, Latin America, and the Mediterranean. Other studies focused on specific regions. Chelley-Steeley (2005), and Yang et al. (2006) investigated the extent and effects of stock market integration in Central and Eastern Europe; Chen et al. (2002) examined the regional linkages among Latin American stock markets, while Floros (2008) focused on the Middle East.

A number of studies that focused on Asian stock markets found mixed results. Ghosh et al. (1999) found that Indonesia, Philippines, and Singapore are closely linked with Japan; while Hong Kong, India, Korea, and Malaysia are more linked with the US. Similarly, Ng (2000) found significant regional shocks from Japan affecting Asia-Pacific stock markets and global shocks from the US. Meanwhile, Sok-Gee et al. (2010) and Worthington and Higgs (2004) concluded that for Asian countries, own country stock market returns and volatility matter more than cross-country spillovers. In contrast, Masih and Masih (1999) found that Asian markets are affected more by each other, rather than by developed markets. Similarly, Chow et al. (2011) found increasing interdependence of stock markets in Asia and the decreasing influence of the US on Asian stock markets.

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[3] Hamao et al. (1990) used daily open and closing price data for the three stock markets to calculate changes in price, and conditional variance to estimate price volatilities.
[4] Beirne et al. (2009)

Aforementioned studies found increasing linkages among emerging stock markets, and between these markets and advanced markets. Nonetheless, some linkages have also declined. Such a finding implies that equity market cross-country relationships vary over time. In fact, the International Monetary Fund (2016) has argued that spillovers from equity markets of EMEs to AEs have become more increasingly important. In particular, unexpected developments in emerging market economies' stock markets as well as news about their macroeconomic fundamentals account for a significantly higher fraction of the variation in advanced economies' stock prices today than they did in the early 1990s.

This paper investigates which countries' equity markets are more important for the ASEAN-5 equity markets from 1990-2016. This study adds to the literature on spillovers by using data that span two crisis periods, which can be considered important for the ASEAN-5 countries, namely, the 1997-1998 Asian Financial Crisis and the 2008-2009 Global Financial Crisis (GFC).[5] Moreover, in contrast to previous research covering Asian economies where sample countries are limited, this study includes a larger set of countries, including China and non-Asian EMEs, in order to account for the latter's impact on the ASEAN-5 stock markets.

The findings in this paper show that returns and volatility spillovers are significant for the ASEAN-5 equity markets. In fact, these spillovers can account for more than half of the innovations in the ASEAN-5 national stock markets. Moreover, while the study reveals that innovations from Asian equity markets contribute more to innovations in the ASEAN-5 equity markets; innovations from AEs' equity markets remain important and innovations from non-Asian EMEs are not trivial.

3. Data and Empirical Methodology

To investigate spillovers in the ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, Thailand) equity markets coming from equity markets of other countries, stock market indices were gathered for the ASEAN-5 countries and 15 countries, which include both advanced and emerging market economies (US, UK, France, Germany, Australia, Japan, Hong Kong, South Korea, Taiwan, China, Argentina, Brazil, Chile, Mexico, and Turkey), for the period 1990-2016.[6]

Following Diebold and Yilmaz (2009), weekly nominal equity market returns were calculated by obtaining the change in log price, Friday-to-Friday. The weekly nominal returns were converted to real weekly returns using the monthly inflation rate, where the weekly inflation was assumed to be constant within the month. Meanwhile, equity market volatility was computed as the annualized standard deviation of the relative price change for the 10 most recent trading days' closing log price. All data were obtained from Bloomberg.

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[5] For the Philippines, prior to September 1994, two stock exchanges existed – the Manila and Makati Stock Exchanges. Data obtained from Bloomberg for the periods prior to September 1994 were based on the Manila Stock Exchange Composite Stock Price Index, as confirmed with Shilling (1996).

[6] Diebold and Yilmaz (2009) was extended to include China in the list of countries and to include the period 2008-2016.

Return and volatility spillovers are calculated from variance decompositions obtained from estimating a generalized N-variable vector autoregression (VAR). Koop et al. (1996) developed the generalized VAR framework to produce variance decompositions that are invariant to the ordering of the variables in the VAR. When one variable is shocked, the effects to the other variables are combined using the historically observed distribution of the errors. Thus, the data themselves reveal the strength of the relationships as they evolve over time.

Diebold and Yilmaz (2012, 2014) used the generalized VAR framework to generate forecast error variance decompositions. From the decompositions, the relative contribution of own variance shares and cross variance shares are obtained, from which a spillover index can be calculated.

The N-variable VAR of order p is given by

$$x_t = \alpha + \sum_{i=1}^{p} \gamma_i x_{t-i} + u_t,$$ (1)

$u_t \sim iid(0, \Sigma_u)$

The set of endogenous variables *X* consists of the weekly equity market real returns (or volatility) from 20 countries. Within this VAR model, a spillover is defined as the ratio of the sum of all cross variance shares ($\sum \sum_{i \neq j}^{n} X_{ij}$) to the sum of all cross and own variance shares ($\sum_{i=1}^{n} \sum_{j=1}^{n} X_{ij}$).

$$SI = \frac{\sum \sum_{i \neq j}^{n} X_{ij}}{\sum_{i=1}^{n} \sum_{j=1}^{n} X_{ij}} \times 100$$ (2)

Returns and volatility spillovers are estimated for the full sample period (February 1990- April 2016) using second-order, 20-variable VARs with 10-step-ahead forecasts.[7] We refer to these estimates as static. To track variations in spillovers over the entire sample, rolling window estimations are implemented. We refer to these estimates as dynamic.

4.   Empirical Results

The results are displayed in Figure 1.[8] Column A shows the static returns and volatility spillovers for the ASEAN-5 countries for the full sample. Column B, meanwhile, shows the dynamic returns and volatility spillovers using 200-week rolling samples. Static estimates (Column A) provide a useful summary of average behavior of spillovers for the entire sample period, however, they are likely to miss important changes in spillovers. Dynamic estimates (Column B) account for the possibility that returns and volatility spillovers vary in dynamics across time, possibly reflecting structural changes in financial markets.[9]

Several observations are apparent. First, the contributions of own country equity market innovations are larger than the contributions of other countries' equity markets when static estimates

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[7] Following the second-order, 19 variable VAR with 10-step-ahead forecasts of Diebold and Yilmaz (2009). We add China to their country list.
[8] Annex 1 provides the variance decompositions for all countries in the sample.
[9] IMF (2016)

are used. However, when dynamic behavior of spillovers are accounted for, the contribution of innovations from a country's own equity market falls, thereby increasing the contribution of other countries' equity markets. For instance, for the Philippines, the contribution of own country innovations to equity market returns declines from 37.4 percent to 21.5 percent, while contribution of own country innovations to equity market volatility drops from 81.7 percent to 48.8 percent over the sample period 1990-2016. The same trend is true for the other ASEAN-5 countries. This implies that it is important to account for the dynamic behavior of spillovers as financial interlinkages across countries change through time.

Second, for both static and dynamic estimates of spillovers, in general, equity market innovations from Asian countries account for larger contribution to ASEAN equity market innovations relative to equity market innovations from AEs and Non-Asian EMEs. The contribution of Asian equity market innovations to the ASEAN-5 equity markets is even more emphasized using the dynamic estimates. Among the ASEAN-5 countries, the Philippines is the most affected by innovations from Asian equity market returns, with the latter accounting for about 40.9 percent of innovations in Philippine equity market returns (column B, row 1). Meanwhile, Singapore, being the top financial center in Asia,[10] is the most affected by innovations in Asian equity market volatility, with the latter accounting for about 38.4 percent of innovations in Singapore equity market volatility (column B, row 4).

Third, while changes in Asian equity markets are more important for ASEAN-5 countries, innovations in equity markets of advanced economies still account for a significant portion of innovations in most ASEAN-5 equity markets. Based on dynamic estimates, the average contribution of innovations in equity market returns and volatility of AEs to the ASEAN-5 equity market returns and volatility is about 21.4 percent and 19.4 percent, respectively.

Fourth, based on static estimates, the contribution of innovations in non-Asian EMEs to the ASEAN-5 equity market returns and volatility appear minimal, averaging only about 4.5 percent and 4.2 percent, respectively. However, based on dynamic estimates, the contribution of non-Asian EMEs to the ASEAN-5 equity market returns and volatility increase to about 15 percent and 15.7 percent, respectively. Again, this highlights the need to recognize the importance of structural changes in financial markets. This likewise lends support to the findings of the IMF (2016) that spillovers from EMEs have increasingly become more important through time. Among the ASEAN-5 countries, notable is the large spillovers in volatility to Indonesia coming from non-Asian EMEs at 29.1 percent. This may be explained by the fact that Indonesia and majority of the non-Asian EMEs in the sample are oil-exporting countries.

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[10] Choudhury, S. R. (2016). "Singapore ranks third globally in the Global Financial Centres Index, beats Hong Kong," CNBC International, 8 April 2016.

Figure 1. Spillovers to Returns and Volatility in ASEAN-5 Equity Markets (1990-2016)
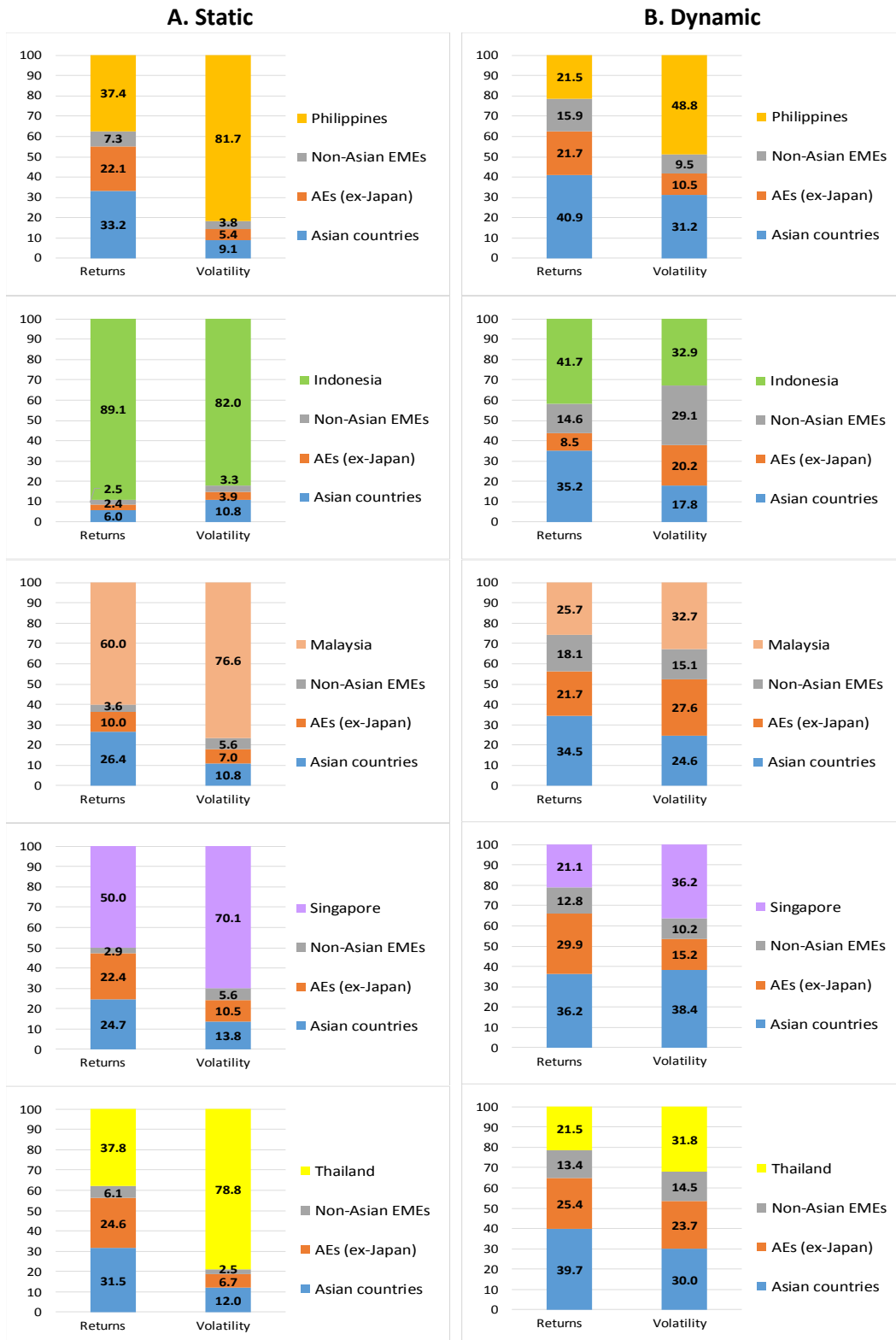
Notes: Asian countries = China, Hong Kong, Japan, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand;

AEs (ex Japan) = US, UK, France, Germany, and Australia; Non-Asian EMEs = Argentina, Brazil, Chile, Mexico, and Turkey

Source: Authors' calculations

The spillover indexes for the entire sample of 20 countries for the period 1990-2016 show that innovations in other countries' equity markets have significant contributions to domestic equity markets (Figure 2). Static spillover indexes for equity market returns and volatility average 48 percent and 31.7 percent, respectively. The spillover indexes increase to 73 percent for returns and 66 percent for volatility when dynamic behavior is accounted for, implying that more than half of the innovations in equity market returns and volatility can be accounted for by dynamic spillovers.

Figure 2. Spillover Indexes, Equity Market Returns and Volatility across Countries
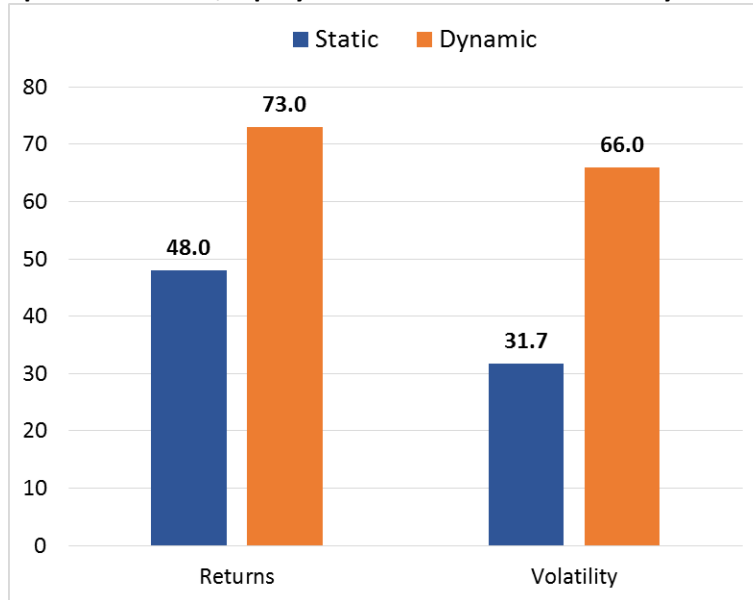
Source: Authors' calculations

Figure 3 plots the evolution of the spillover index for equity market returns for all 20 countries. The spillover plot shows that since the latter half of the 2000s, spillover indexes never decline to their earlier lower range. This suggests that market integration in the 2000s is higher relative to the 1990s. Such a finding is consistent with Diebold and Yilmaz (2009).

Figure 3. Equity Market Returns Spillover Plot
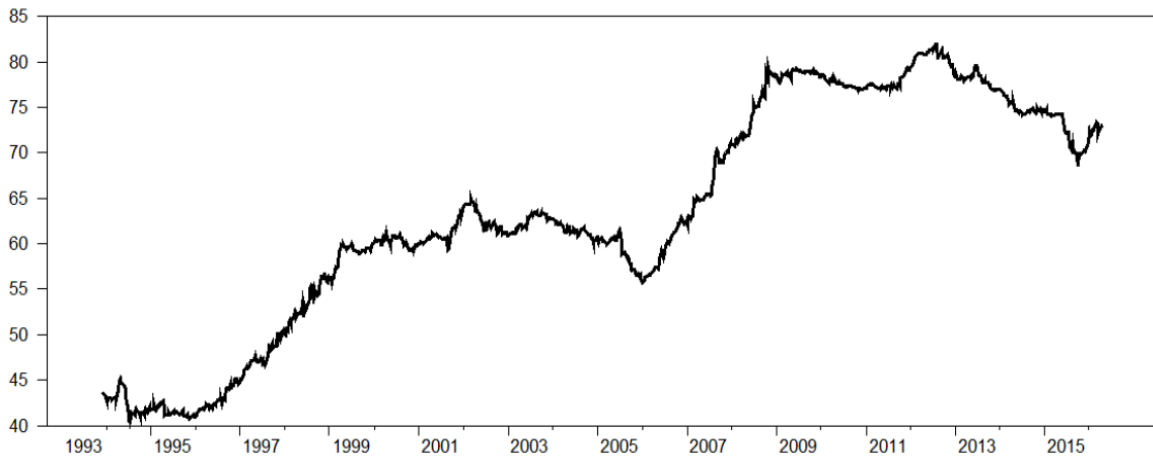
Note: Based on 200-week rolling samples
Source: Authors' calculations

Figure 4 shows the evolution of the spillover index for equity market volatility.[11] The spillover plot shows that during major macroeconomic disturbances, volatility spillovers have spiked. For instance, in the late 1997 to 1998, the volatility spillover index spiked to reflect the Asian Financial Crisis. The index likewise substantially increased in 2007, leading to the 2008-2009 Global Financial Crisis. In 2013, the index spiked anew, reflecting the taper tantrum announcement of the US Federal Reserve. In 2015, the index was again on an upward trend, most likely reflecting the increased volatility stemming from developments in China. To the extent that the volatility spillover plot captures major macroeconomic turning points, this suggests that the spillover index generated by the estimates can be considered robust.

Figure 4. Equity Market Volatility Spillover Plot
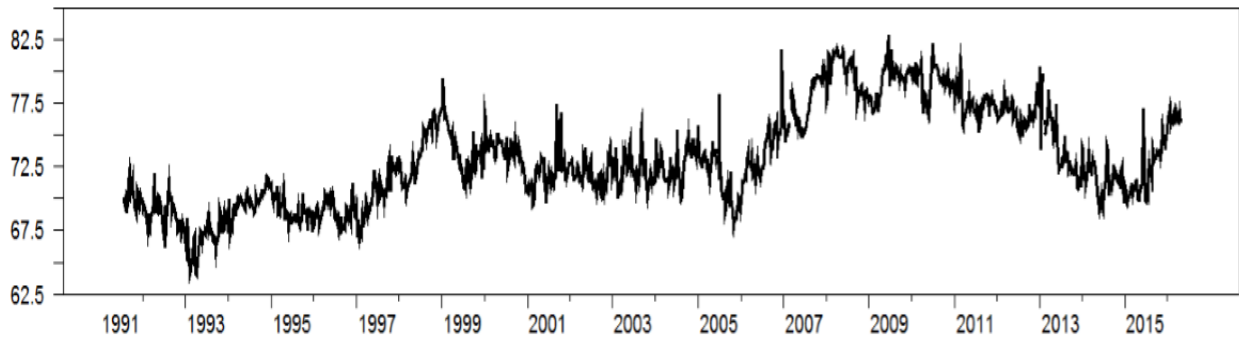
Note: Based on 75-week rolling samples
Source: Authors' calculations

As an additional exercise, the sample period was split into pre- GFC and post-GFC periods. Dynamic estimates show that spillover indexes for both equity market returns and volatility have increased post-GFC (Figure 5).

Figure 5. Spillover Indexes, Pre- and Post-GFC
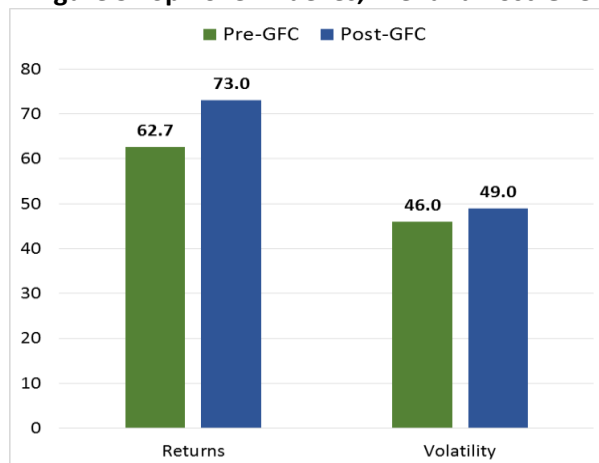
Note: Pre-GFC sample includes 1990-2006, while post-GFC sample includes 2010-2016.
Source: Authors' calculations

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[11] The shorter window width, that is, 75-week rolling samples instead of 200-week rolling samples, allow tracking of volatility spillovers with greater resolution or less smoothing.

For robustness check, we reduced the number of countries from 20 to 6, namely the ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) and US. [12] From 73 percent, the spillover index was reduced to 49.5 percent, which implies that, on average, about half of the variations in the equity market returns can be accounted for by spillovers from countries in this sample. On average, 10 percent of the variations in equity market returns in ASEAN countries is accounted for by variations in US equity market returns. Singapore is affected most by US at 16 percent, while Indonesia is affected the least at 3 percent. The spillover plot (Figure 6) shows the evolution of the spillover index for equity market returns for the 6 countries. Similar to the spillover plot for the 20 countries, this plot shows that since the latter half of the 2000s, spillover indexes never declined to their previous lower range, suggesting that market integration in the 2000s is higher relative to the 1990s. The ASEAN Economic Community could help explain this.

Figure 6. Equity Market Returns Spillover Plot (ASEAN-5 and US)
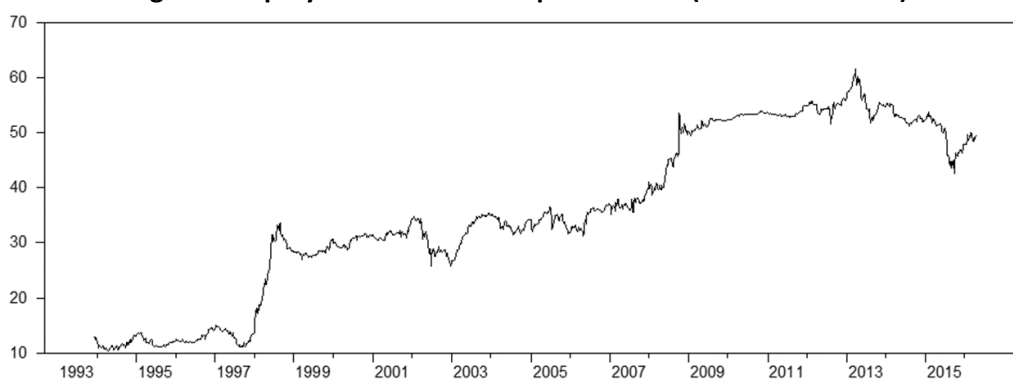
Note: Based on 200-week rolling samples
Source: Authors' calculations

5.   Conclusion and Policy Implications

This study shows that spillovers are important for the ASEAN-5 equity markets both in terms of returns and volatility. In particular, estimates find that innovations from other countries' equity markets contribute to more than half of the innovations in the ASEAN-5 national stock markets. The ASEAN-5 equity markets have also been affected more by innovations in Asian equity markets than by equity market innovations in AEs and Non-Asian EMEs. The results confirm earlier findings of Chow et al. (2011) that stock markets in Asia behave regionally. Nonetheless, innovations from advanced economies' equity markets remain important and innovations from non-Asian EMEs are not trivial. Moreover, this study finds that, in general, equity market returns and volatility spillovers have increased post-GFC.

The higher contribution to the ASEAN-5 equity markets of innovations coming from Asian countries relative to non-Asian countries imply that diversification of risk within the Asian stock markets may be limited by the increasing spillover effects within the region, especially in periods of

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[12] This section benefitted from the comments of Assistant Governor Dr. Johnny Noe E. Ravalo, Co-Chair of the Financial Stability Committee (FSC), and members of the FSC Technical Committee during the discussions in the Technical Committee meetings held on 6 and 13 July 2016.

heightened market stress. For instance, the devaluation of the Renminbi and the stock market crisis in China in the second half of 2015 have resulted in increased bouts of volatility and decline in stock market indices across many Asian equity markets.   In such instances, the benefits of portfolio diversification within the affected markets will be limited. Meanwhile, the finding that spillovers have increased since the second half of the 2000s across all countries in the sample implies that, in general, portfolio diversification has become more challenging. This suggests that investors and portfolio managers should have improved risk management strategies. The uncertainties brought by recent developments in the European Union, specifically the so-called "Brexit", can again bring episodes of volatilities and market stress, and can be a subject of future research.

Nonetheless, this study only examined the spillovers in a single asset market. While the increasing spillovers across equity markets decrease portfolio diversification within the equity market, it is highly likely that investors diversify across asset markets; that is, across equity, bond, foreign exchange and even commodity markets. We take these areas as subject for future research.   Another useful extension is to account for the direction of spillovers across markets.

Finally, while this study confirms the findings of earlier research of increasing financial spillovers across countries, the more important issue is the impact of heightened financial spillovers on the vulnerability of the domestic financial system. If vulnerability increases with greater financial spillovers, the next important step would be to consider policies that would enhance resilience of the domestic financial system. Likewise, it may be useful to consider that not all spillovers may have adverse effects on the domestic financial system. Answers to these issues will be important for the ASEAN countries as their financial and economic integration moves forward. Again, we take these areas as subject for future research.

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Annex 1-A. Spillover Table – Equity Market Returns, Static Estimates

TO	FROM																				Contribution from others	From others including own
	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR	CHI		
US	31.0	11.2	10.7	9.9	3.0	3.4	6.5	0.1	2.0	0.4	2.1	2.1	3.3	3.7	0.1	0.0	6.1	3.9	0.3	0.1	**68.9**	100
UK	11.4	26.4	12.7	10.8	5.2	3.9	7.8	0.2	3.0	0.3	1.6	3.2	1.3	2.9	0.1	0.1	5.4	3.0	0.5	0.1	**73.5**	100
FRA	12.0	14.0	22.6	14.9	4.3	4.8	6.4	0.1	3.4	0.6	1.6	2.4	2.1	2.8	0.0	0.0	3.8	3.5	0.5	0.2	**77.4**	100
GER	11.5	12.7	15.8	24.9	4.5	3.9	5.2	0.0	3.5	0.4	1.9	2.4	2.1	2.2	0.1	0.2	4.3	3.8	0.4	0.1	**75.0**	100
HKG	3.8	6.2	4.2	4.1	42.3	3.8	5.1	0.2	3.8	0.6	2.8	3.3	3.5	6.1	0.0	0.1	4.7	2.5	0.2	2.6	**57.6**	100
JPN	6.5	6.3	7.1	5.8	6.7	35.2	6.9	0.4	4.4	1.0	2.3	3.5	3.2	2.9	0.1	0.1	4.9	1.6	0.6	0.4	**64.7**	100
AUS	9.6	8.8	7.0	5.2	5.0	4.6	36.6	0.2	2.7	0.5	3.0	2.7	2.5	3.1	0.0	0.1	5.6	2.2	0.3	0.2	**63.3**	100
IDN	0.5	0.6	0.3	0.2	0.8	1.1	0.8	88.9	0.3	0.3	0.6	0.5	0.4	0.5	0.0	0.1	1.1	0.3	1.0	1.5	**10.9**	100
KOR	4.7	6.6	6.1	5.9	6.5	4.8	4.9	0.5	36.1	0.8	2.4	3.4	2.9	7.7	0.0	0.0	3.3	2.3	0.9	0.1	**63.8**	100
MYS	3.1	2.1	2.0	1.1	3.6	3.0	1.7	0.2	2.4	60.0	5.5	4.8	0.9	5.7	0.1	0.2	1.9	0.9	0.5	0.3	**40.0**	100
PHL	6.4	3.9	3.4	3.5	5.0	3.3	4.9	0.3	3.4	3.7	37.3	5.5	2.8	9.1	0.1	0.3	2.4	3.8	0.7	0.1	**62.6**	100
SGP	4.6	6.4	4.1	3.6	5.0	3.1	3.7	0.4	2.7	1.8	3.5	49.9	3.0	4.8	0.2	0.1	0.7	1.4	0.5	0.4	**50.0**	100
TAI	6.9	3.4	4.8	4.6	6.2	3.7	3.5	0.1	3.3	0.4	2.8	2.9	43.8	4.3	0.1	0.1	3.4	3.9	0.4	1.2	**56.0**	100
THA	7.7	5.3	4.5	3.1	8.0	2.6	4.0	0.2	6.9	2.2	6.0	2.9	2.6	37.7	0.1	0.1	2.4	1.9	1.6	0.1	**62.2**	100
ARG	0.2	0.3	0.1	0.4	0.0	0.1	0.1	0.0	0.1	0.4	0.0	0.1	0.3	0.5	96.4	0.3	0.2	0.1	0.1	0.2	**3.5**	100
BRA	0.0	0.3	0.4	0.7	0.2	1.0	0.2	0.3	0.1	0.6	1.5	0.2	0.3	0.1	1.6	90.9	0.0	0.6	0.1	0.9	**9.1**	100
CHL	8.1	6.3	3.6	4.1	4.7	3.4	5.0	0.4	1.8	0.3	1.1	0.8	3.1	2.0	0.1	0.8	47.6	6.3	0.4	0.2	**52.5**	100
MEX	3.8	3.8	3.1	2.7	3.9	0.9	2.8	0.1	1.8	0.5	0.9	0.8	2.3	0.7	0.1	0.4	6.6	64.3	0.3	0.3	**35.8**	100
TUR	0.7	0.4	0.6	0.4	0.4	0.9	0.2	0.6	0.4	0.1	1.5	0.4	0.2	1.3	0.2	0.1	0.7	0.2	88.3	2.3	**11.6**	100
CHI	1.5	0.4	1.8	1.1	6.5	0.4	0.4	1.1	0.1	0.4	0.3	1.0	2.2	0.1	0.0	1.5	0.3	0.7	0.8	79.4	**20.6**	100
Total																					**959.0**	2000
Spillover Index																						**48.0%**

Annex 1-B. Spillover Table – Equity Market Volatility, Static Estimates

TO	FROM																			Contribution from others	From others including own
	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR	CHI		
US	58.1	7.1	6.7	7.0	2.6	1.8	3.0	0.8	1.4	0.5	0.6	1.3	0.4	1.1	1.3	2.4	0.1	3.4	0.4	0.1	**42.0**	100
UK	5.3	43.0	16.5	12.7	3.0	2.7	3.6	0.7	1.2	0.7	0.9	1.2	0.7	0.5	1.1	2.3	0.1	2.8	0.9	0.0	**56.9**	100
FRA	4.8	15.8	40.7	17.7	2.3	2.4	3.2	0.7	1.2	0.8	0.6	1.3	0.8	0.5	1.8	2.1	0.1	2.4	0.8	0.2	**59.5**	100
GER	4.8	12.8	19.4	44.7	2.7	2.7	3.1	0.2	1.0	0.6	0.4	0.8	0.8	0.5	1.1	1.2	0.0	1.5	1.5	0.1	**55.2**	100
HKG	2.4	4.1	3.3	3.5	59.3	2.3	5.3	1.5	2.7	1.9	1.3	3.5	1.8	1.6	1.2	1.8	0.2	1.7	0.5	0.2	**40.8**	100
JPN	2.8	4.2	3.6	4.1	2.6	65.6	3.2	0.7	3.2	0.9	0.5	1.8	1.4	0.9	1.3	1.4	0.2	1.2	0.3	0.1	**34.4**	100
AUS	3.3	5.0	4.6	4.1	5.0	3.1	58.9	0.4	2.3	1.2	0.6	1.8	1.4	0.6	2.3	1.9	0.0	2.8	0.4	0.2	**41.0**	100
IDN	0.8	1.1	1.1	0.3	1.8	0.8	0.6	82.1	2.2	1.4	1.1	0.9	0.2	2.3	0.3	0.7	1.2	0.2	0.9	0.1	**18.0**	100
KOR	1.1	1.9	2.1	1.7	3.1	3.6	2.8	1.2	69.5	0.8	0.1	1.8	2.3	1.7	1.6	2.0	0.3	1.6	0.5	0.2	**30.4**	100
MYS	0.8	1.4	2.2	1.5	2.5	1.2	1.1	1.1	0.9	76.4	1.0	0.9	1.3	1.8	0.5	2.5	0.1	1.3	1.2	0.1	**23.4**	100
PHL	1.2	1.4	1.1	0.8	1.9	0.6	0.9	1.3	0.3	1.3	81.5	1.0	0.4	2.1	0.7	1.1	0.2	1.6	0.2	0.2	**18.3**	100
SGP	1.5	2.3	2.7	1.3	4.4	1.9	2.7	1.0	2.1	0.8	0.9	70.2	1.3	1.1	0.8	1.5	0.1	2.4	0.8	0.3	**29.9**	100
TAI	0.6	1.2	1.6	1.6	2.5	1.1	1.7	0.1	2.8	1.5	0.3	1.4	77.8	0.9	1.5	1.2	0.1	1.3	0.7	0.2	**22.3**	100
THA	1.6	1.7	1.3	1.4	1.8	1.3	0.7	1.4	1.9	1.9	1.7	0.9	0.9	78.9	0.4	0.4	0.1	0.8	0.8	0.2	**21.2**	100
ARG	1.5	1.9	3.0	1.7	1.3	0.9	2.5	0.2	1.5	1.1	0.8	1.0	1.0	0.4	70.5	4.6	0.2	4.0	1.8	0.1	**29.5**	100
BRA	2.4	3.5	3.0	1.9	1.8	0.7	1.5	0.6	1.7	1.8	0.9	1.4	1.0	0.5	4.6	64.1	0.1	7.1	1.2	0.0	**35.7**	100
CHL	0.2	0.0	0.5	0.1	0.2	0.3	0.0	0.5	1.5	0.6	0.2	0.3	0.1	0.1	0.3	0.2	90.9	0.4	0.2	3.4	**9.1**	100
MEX	3.8	4.1	3.5	2.0	1.9	1.5	2.8	0.2	1.5	1.1	1.2	2.4	1.1	0.8	3.5	7.2	0.2	60.0	1.0	0.2	**40.0**	100
TUR	0.7	2.1	1.7	2.3	0.8	0.2	0.5	1.7	0.9	1.2	0.9	0.9	0.8	0.3	1.9	1.5	0.1	1.2	79.8	0.4	**20.1**	100
CHI	0.0	0.1	0.1	0.5	0.7	0.4	0.2	0.4	0.2	0.3	0.3	0.2	0.3	0.2	0.1	0.0	1.2	0.0	0.4	94.4	**5.6**	100
Total																					**633.3**	2000
Spillover Index																						31.7%

Annex 1-C. Spillover Table – Equity Market Returns, Dynamic Estimates

TO	FROM																				Contribution from others	From others including own
	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR	CHI		
US	16.7	9.9	8.6	8.5	3.5	4.2	6.6	0.7	4.4	3.0	3.8	5.6	5.3	4.3	0.5	2.6	3.1	5.1	2.6	0.9	**83.2**	100
UK	10.4	16.2	10.5	9.8	3.8	4.0	5.8	1.0	4.8	2.3	2.6	4.5	4.9	4.3	0.9	3.3	3.9	4.0	2.0	0.9	**83.7**	100
FRA	9.0	10.3	15.8	12.9	3.0	4.8	4.2	0.8	5.1	2.4	2.4	4.4	4.4	3.8	0.7	3.4	4.0	5.1	2.7	0.8	**84.2**	100
GER	9.8	10.6	14.2	17.3	2.8	4.0	4.2	0.9	4.1	2.0	2.4	4.2	3.9	3.9	0.4	2.9	3.9	5.0	2.6	0.7	**82.5**	100
HKG	4.5	4.7	3.9	3.3	25.4	4.1	5.4	2.1	5.3	3.4	4.9	5.9	4.6	3.4	0.6	2.7	5.4	4.5	3.4	2.5	**74.6**	100
JPN	6.1	5.3	5.9	4.6	5.3	22.8	9.1	1.3	5.2	3.2	6.2	6.6	3.3	3.6	0.5	1.3	3.5	2.1	3.4	0.6	**77.1**	100
AUS	7.1	6.8	5.1	4.7	4.6	6.0	20.5	1.5	5.6	5.6	5.6	5.9	4.3	4.4	0.3	2.0	4.1	3.9	1.6	0.5	**79.6**	100
IDN	1.2	1.7	1.9	1.4	4.2	0.9	2.3	41.6	3.3	8.2	4.8	5.0	2.9	5.8	0.4	1.1	5.0	2.9	5.2	0.1	**58.3**	100
KOR	5.1	6.4	6.6	4.8	5.2	5.0	6.1	2.3	20.3	3.8	3.7	4.6	6.6	5.4	0.7	2.6	4.6	3.8	1.9	0.5	**79.7**	100
MYS	4.8	3.2	3.7	3.3	3.0	1.7	6.7	5.8	3.7	25.9	5.4	5.0	3.9	4.9	0.6	3.4	4.6	5.8	3.7	1.1	**74.3**	100
PHL	5.0	3.4	3.4	2.8	4.6	7.8	7.1	2.9	3.4	4.9	21.7	6.6	4.1	6.1	0.4	2.9	4.0	4.3	4.3	0.5	**78.5**	100
SGP	8.0	6.5	5.7	4.6	5.0	5.3	5.1	3.1	3.8	4.8	4.1	21.3	4.8	4.5	0.6	3.6	3.8	2.1	2.7	0.8	**78.9**	100
TAI	6.8	6.3	6.7	4.9	5.3	3.5	4.9	3.2	6.9	4.4	3.9	4.2	24.4	2.8	0.2	1.7	3.4	3.8	1.6	1.0	**75.5**	100
THA	5.3	5.7	5.1	4.7	4.0	3.7	4.6	4.7	5.7	4.6	6.7	6.0	4.0	21.7	0.4	3.3	3.1	3.5	3.1	0.3	**78.5**	100
ARG	1.8	1.7	2.1	1.6	1.3	3.9	1.4	2.0	1.0	0.8	2.0	0.8	1.3	0.9	67.3	2.4	2.0	1.7	1.6	2.5	**32.8**	100
BRA	5.3	4.5	5.5	4.4	4.0	1.9	3.7	2.1	3.8	3.3	3.4	3.3	3.0	2.3	0.8	34.4	5.6	4.7	3.1	0.6	**94.5**	100
CHL	4.3	3.3	6.0	4.5	5.3	5.7	6.1	2.6	4.6	5.1	3.8	3.1	2.9	2.0	1.0	5.2	25.3	4.3	4.7	0.4	**74.9**	100
MEX	7.3	5.3	7.1	6.5	4.0	2.6	4.7	2.0	4.4	5.2	4.3	2.8	4.3	3.4	0.7	4.5	5.0	22.8	2.4	0.7	**77.2**	100
TUR	5.5	3.9	5.0	4.0	3.4	5.0	3.8	4.2	2.5	4.0	5.6	4.3	1.6	4.1	0.5	3.4	3.8	3.2	31.1	0.9	**68.7**	100
CHI	5.6	5.0	3.6	3.3	6.5	1.6	1.8	1.2	2.5	1.9	1.5	3.1	3.2	1.0	1.1	2.5	1.8	3.4	2.8	46.7	**53.4**	100
Total																					**1460.9**	2000
Spillover Index																					73.0%	

Annex 1-D. Spillover Table – Equity Market Volatility, Dynamic Estimates

TO	FROM																				Contribution from others	From others including own
	US	UK	FRA	GER	HKG	JPN	AUS	IDN	KOR	MYS	PHL	SGP	TAI	THA	ARG	BRA	CHL	MEX	TUR	CHI		
US	28.7	16.3	5.4	5.2	1.4	0.5	2.5	1.4	3.6	7.7	0.7	0.3	1.9	1.4	2.6	3.7	2.1	6.6	0.2	7.9	**71.4**	100
UK	12.1	21.5	10.7	11.1	1.6	1.6	0.9	1.7	5.9	8.2	2.0	1.0	2.5	1.4	3.6	4.1	0.6	4.6	0.1	4.9	**78.6**	100
FRA	5.0	13.2	23.2	18.9	1.5	0.5	0.4	2.2	10.7	4.0	1.0	3.2	1.7	2.7	0.7	3.2	1.5	1.3	0.5	4.6	**76.8**	100
GER	5.3	14.1	19.9	24.5	1.8	1.6	0.6	2.3	6.9	6.3	0.5	4.7	0.3	1.8	1.5	3.6	0.5	0.5	0.1	3.3	**75.6**	100
HKG	0.2	2.8	1.8	2.1	32.2	2.3	8.2	0.5	4.5	4.7	6.3	11.8	9.3	3.1	3.6	2.1	1.0	0.6	0.4	2.7	**68.0**	100
JPN	2.1	2.3	0.9	3.3	1.0	53.2	1.2	1.1	0.2	7.1	1.4	1.8	5.6	1.1	1.0	5.0	0.2	3.6	0.8	7.2	**46.9**	100
AUS	3.6	7.2	5.7	7.2	7.7	3.1	23.2	2.1	5.3	12.0	0.7	5.1	3.4	0.2	0.1	5.6	0.4	3.2	0.2	4.1	**76.9**	100
IDN	3.6	3.9	3.2	4.0	0.6	0.2	5.5	33.0	2.2	5.4	1.2	0.2	0.9	5.6	5.9	6.2	9.9	6.8	0.3	1.5	**67.1**	100
KOR	5.0	9.1	13.5	8.6	4.0	0.1	4.3	0.3	27.4	0.7	2.1	4.0	4.0	1.7	0.1	3.3	0.4	1.2	3.8	6.4	**72.6**	100
MYS	5.0	8.9	4.4	7.0	5.7	4.2	2.3	1.9	0.8	33.0	1.3	2.8	2.3	1.2	0.1	4.9	4.0	5.6	0.5	4.4	**67.3**	100
PHL	1.2	5.2	1.0	1.6	6.8	1.5	1.5	1.9	0.6	4.0	48.8	0.3	2.1	6.4	0.4	3.4	3.3	2.3	0.1	7.6	**51.2**	100
SGP	0.4	1.7	4.0	2.9	11.6	1.5	6.2	0.0	4.3	2.7	0.8	36.0	8.1	5.6	2.7	2.0	1.7	2.6	1.2	3.8	**63.8**	100
TAI	2.1	4.3	0.6	0.6	11.3	1.0	2.5	3.2	4.7	3.1	0.1	9.3	39.0	0.7	0.7	6.9	3.5	2.7	0.6	2.1	**60.0**	99
THA	4.8	8.0	4.9	4.6	2.3	0.6	1.4	5.2	4.0	4.1	4.5	5.4	0.5	31.8	1.1	1.4	6.8	4.4	0.8	3.4	**68.2**	100
ARG	4.0	5.5	1.4	1.4	4.3	0.7	0.6	7.8	4.6	0.3	4.7	3.2	2.5	3.4	39.0	0.8	3.2	1.9	9.1	1.6	**61.0**	100
BRA	4.0	7.4	4.3	4.8	2.0	0.2	0.2	4.9	1.6	4.3	2.9	2.3	5.6	2.3	0.6	31.1	3.9	8.6	0.4	8.3	**68.6**	100
CHL	3.0	5.7	1.3	0.8	5.0	0.5	3.1	7.2	2.9	5.9	6.0	1.6	2.4	5.6	0.7	3.0	36.8	4.7	0.4	3.4	**63.2**	100
MEX	7.8	6.3	1.6	1.1	0.7	6.2	1.6	5.0	1.2	6.2	0.8	3.4	2.4	3.2	1.3	8.4	0.4	34.5	0.3	7.6	**65.5**	100
TUR	1.5	0.6	0.7	0.3	0.5	0.8	0.7	0.7	4.8	0.5	7.8	0.5	4.3	3.5	12.2	1.3	1.2	2.6	54.6	0.9	**45.4**	100
CHI	5.0	4.9	5.7	3.1	2.3	6.0	2.3	0.6	3.1	3.5	4.1	3.2	1.5	2.8	0.1	9.8	2.5	7.8	3.7	28.1	**72.0**	100
Total																					1320.1	2000
Spillover Index																					66.0%	

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