The Benefits of Further Financial Integration in Asia[†]

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Abstract

This paper studies the degree as well as the implications of financial integration for Asia, using both quantity- and price-based methods. We develop a measure of financial integration from cross-border financial activities, and show that Asia's degree of financial integration, both with the world and within the region, is low. Evidence is presented to show that financial integration has a meaningful effect on economic rebalancing in Asia. Next, the paper explores the notion that more financial integration involves a tradeoff, by contrasting its benefit in terms of risk sharing versus its cost in terms of financial contagion. Price-based measures of risk sharing and contagion are proposed. It is shown that a tradeoff exists, although for Asia, the tradeoff lies below the global frontier, suggesting that Asia's quality of financial integration has scope for improvement.

JEL Classification: E29, E44, F36, G00, G12

Keywords: financial integration, financial development, rebalancing, risk sharing, contagion, affine term structure model, Asia

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I. INTRODUCTION

The recent global financial crisis and episodes of volatile capital flows to emerging Asia have revived the debate about deeper financial integration in the region. On the one hand, financial integration can deepen regional financial markets, strengthen regional sources of funding and so allow more risk sharing. It can also improve access to financial services and help rebalance growth by strengthening domestic demand. On the other hand, greater financial integration may lead to larger risk of contagion within the region that can be very costly.

In addressing these themes, this paper adopts both quantity-based and price-based approaches to study the degree as well as the implications of financial integration for Asia. We develop a z-score measure of financial integration from cross-border financial activities, and show that Asias degree of financial integration, both with the world and within the region, is low, in contrast to its high degree of trade integration. Empirical evidence is presented to show that financial integration has a meaningful effect on economic rebalancing in Asia, suggesting that there is potential rebalancing gain to further financial integration.

The paper then explores the notion that more financial integration involves a tradeoff, by contrasting its benefit in terms of risk sharing versus its cost of financial contagion risk. A new measure of risk-sharing is introduced, based on a term structure model and asset pricing theory. Contagion is measured by a proxy for negative tail-event correlation in the stock market. A tradeoff exists, although for Asia, the tradeoff lies below the global frontier, suggesting that Asias quality of financial integration has a scope for improvement. That is, for the same level of contagion risks, Asian economies are currently benefiting less from risk sharing compared with advanced economies.

II. FINANCIAL INTEGRATION AND REBALANCING

A formal assessment of the degree of financial integration should capture not only the progress across time but also a country's position relative to the rest of the world. Given that both global and country-specific factors come into play in determining the degree of financial integration, we control for common factors that help explain global trends, and then construct measures that assess the extent to which countries deviate from normal levels of financial integration with the world. Two alternative measures of financial integration are explored: the Z score and trade-financial relative intensity.

A. Z Score

The Z score measures how many standard deviations an individual countrys observation is from the global mean. Each individual countrys observation is compared against the global mean and the dispersion from the mean is scaled by the global standard deviation. The observations reflect measures of financial integration, such as the ratio of cross-border portfolio investment assets to GDP. Z score calculations implicitly take into account common global factors, such as a favorable global and financial environment, which may increase the overall cross-border financial activities of all countries. If the impact of a common global factor is symmetric across countries, the Z score will not change for an individual country. The Z score is defined as follows:

$$z_{f,it} = \frac{(x_{f,it} - \bar{x}_{f,t})}{\sigma_{f,t}} \quad (1)$$

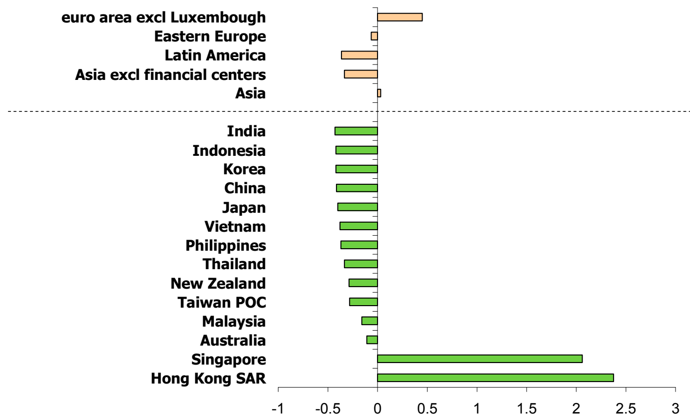
where $z_{f,it}$ refers to a Z score for financial activity type f of country i at time t; $x_{f,it}$ is a ratio of cross-border financial activity f to GDP of country i at time t. $\bar{x}_{f,t}$ and $\sigma_{f,t}$ refer to the mean and standard deviation across countries. The average global score for each type of cross-border financial activity is equal to zero by construction. A positive Z score indicates that an individual countrys ratio of cross-border financial activity to GDP is higher than the global average. The opposite is true for the negative score. To aggregate over different types of cross-border financial activities, we calculate the overall Z score for country i by simply averaging $z_{f,it}$ across the six types of cross-border financial activities, namely: portfolio investment liabilities, portfolio investment assets, FDI inflows, FDI outflows, banking liabilities and banking assets to GDP. The average Z score for Asia is close to the world average and that of Eastern European countries but well below that of the euro area (Figure 1). However, excluding the financial centers of Hong Kong SAR and Singapore, the average Z score for Asia is well below the world average and closer to that of Latin America.

B. Role of Trade Integration

Asian economies are highly integrated through trade. As trade in goods and cross-border financial activities are found to have strong complementarities (Shin and Yang, 2006) one would also expect Asian economies to be also highly financially integrated. To account for this important country characteristic of Asian economies, we compare Asian economies trade intensity with the intensity of their cross-border financial transactions [3]. Specifically, the

[3] See Leung and Unteroberdoerster (2008)

Figure 1: Z Score for Financial Integration (average 2004-07)



Source: Authors' calculations.

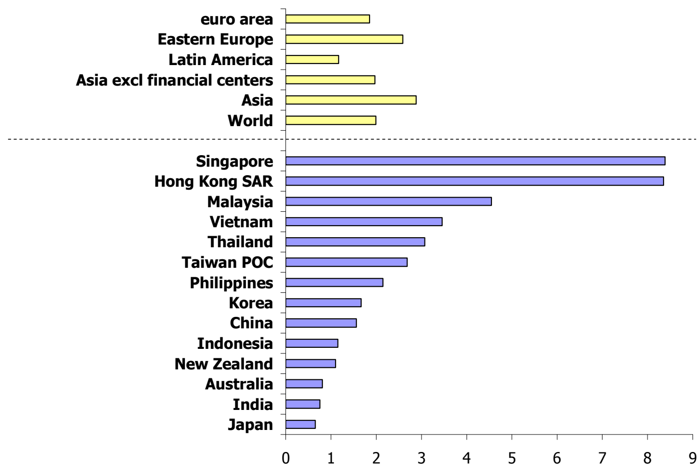
intensity measure is calculated as follows:

$$Intensity_{f,it} = \frac{\left(\frac{f_{it}}{\sum_{i=1}^{n} f_{it}}\right)}{\left(\frac{GDP_{it}}{\sum_{i=1}^{n} GDP_{it}}\right)} \tag{2}$$

where $Intensity_{f,it}$ refers to intensity of trade or cross-border financial transactions of country i at time t. n is the number of economies in the sample and f_{it} is the sum of exports and imports or of cross-border financial assets and liabilities (or flows) of country i at time t. GDP_{it} refers to Gross Domestic Product of country i at time t in U.S. dollars. In simple terms, the intensity measures a countrys footprint in global trade or finance, relative to its weight in the global economy. While trade intensity in Asia (especially emerging Asia) has been relatively high compared with other regions (Figure 2), financial intensity is much lower. In fact, an observation similar to that of Z score emerges. Asia on average (excluding Hong Kong SAR and Singapore) appears to have lower financial intensity compared to the world average and the euro zone.

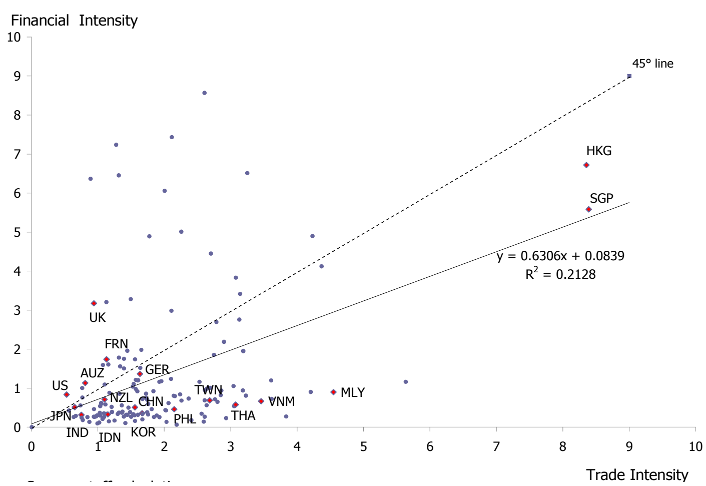
Aggregating the different types of cross border financial activities, Figure 3 captures the lack of Asian economies' overall financial integration with the world relative to their role in global trade. On average across the world, a country's financial intensity tends to increase with its trade intensity. But this does not seem to be the case in the same way for Asian economies. Compared to the world norm, most Asian economies rapid expansion into global trade (position on the x-axis measuring trade intensity) has not been matched by their role in international

Figure 2: Trade Intensity (average 2004-07)



Source: Authors' calculations.

Figure 3: Trade and Financial Intensity



Source: Authors' calculations.

finance (position on the y-axis measuring cross-border financial intensity). This appears to hold in particular for the emerging economies of South East Asia, including Malaysia, Thailand, the Philippines, and Indonesia.

C. Role of Cyclical and Structural Factors

To identify the cyclical and structural factors that may influence cross-border activities and hence the measurement of financial integration, we draw on the literature of asset gravity models. We will first discuss the role of country-specific and structural factors in a multilateral context and then assess the degree of intraregional financial integration in a bilateral gravity model setup.

Our multilateral model of financial integration (as measured by overall z score) uses a panel Generalized Methods of Moments (GMM). The model allows us to separate country-specific effects (fixed effects) on financial integration from the effects of other drivers—in this case, relative growth rates, trade openness, interest rate differentials, exchange rate movements, and volatility. A high relative growth rate could either induce accumulation of financial assets (by acting as a push factor) or attract financial liabilities (a pull factor). As discussed above, trade openness, as captured by the sum of imports and exports to overall GDP, is also an important factor driving financial flows (e.g., Lane and Milesi-Ferretti, 2008). Interest rate differentials and exchange rate movement are included to capture differences in returns on (short-term) financial assets which may trigger cross-border financial flows.[4] Exchange rate volatility accounts for exchange rate risks associated with cross-border holding of assets. The specification adopted is therefore:

$$\begin{aligned} z_{it} = \beta_0 &+ \text{fixed effects}_i + \beta_1(\text{g diff}_{it}) + \beta_2(\text{int diff}_{it}) + \beta_3(\text{trade op}_{it}) \\ &+ \beta_4(\Delta \log(er_{it})) + \beta_5 Vol_{it} + \varepsilon_{it} \end{aligned} \tag{3}$$

where g diff_{it} is the difference between GDP growth of country i at time t and the rest of the world, int diff_{it} is the difference between short-term (money market) rate of country i and the rest of the world at time t, trade op_{it} is the ratio of the sum of exports and imports to GDP of country i at time t, er_{it} is bilateral exchange rate of country i vis--vis the U.S. dollar (an increase in er_{it} means depreciation in country i's currency), and Vol_{it} is the standard deviation of the monthly return of country is bilateral exchange rate over year t. The estimation results

[4]Multilateral trade is the sum of total exports and imports. Multilateral relative returns are calculated as the difference between domestic short-term interest rate and GDP-weighted short-term rates for the rest of the world.

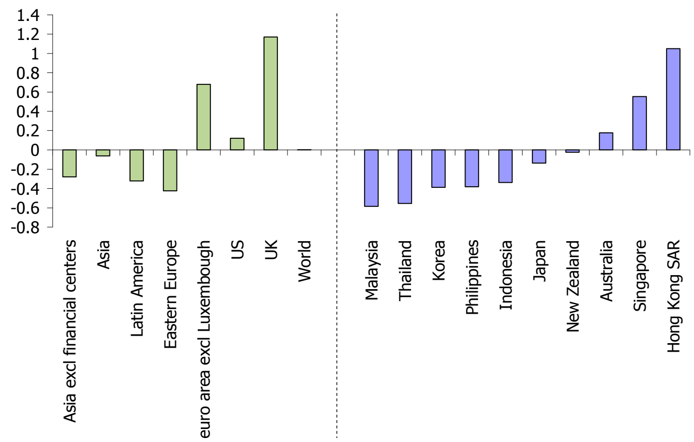
Table 1: Estimation of Financial Integration

Estimation of Financial Integration	
Dependent variable: financial integration score (z)	
Variable	Coefficient
Constant	-0.176
	(-2.324)
Δ ln(exchange rate)	-0.303
	(-2.260)
Trade to GDP ratio	0.324
	(2.706)
Relative GDP growth	0.036
	(2.048)
Relative short term interest rate	-0.018
	(-0.935)
Exchange rate volatility	-1.846
	(-6.386)
Number of observations	266
Adjusted R^2	0.95
Note: t-statistic in brackets	

Source: Authors' calculations.

are presented in Table 1. The results suggest important contributions from all factors, with expected signs except for the short-term interest rate, which is found to be insignificant. Having constructed a normal degree of financial integration, the country-specific effects (fixed effects) can be viewed as a measure of a country's deviation from the "norm" or, if they are negative, of a lack of financial integration. Figure 4 illustrates Asias country specific (fixed) effects and the averages across the regions and the world. The results suggest that Asia's (excluding Hong Kong SAR and Singapore) degree of financial integration is significantly lower than the world average, but in line with Latin America. Eastern European countries are now performing much worse than the world average and appear to be less financially integrated than Asia, while the euro zone appears more financially integrated. Taking a closer look at the relative performance across Asian economies, we find again, as is the case when controlling for trade alone, that the degree of financial integration is particularly low in emerging Asia.

Figure 4: Country-specific Factors (Fixed Effects) of Financial Integration Equation



Source: Authors' calculations.

D. Is Asia's Regional Integration Abnormally Low?

In our second model, we examine determinants of bilateral portfolio financial integration based on CPIS data over 2004-07. The following form of financial gravity model is estimated for 1,809 country pairs, covering all regions:

$$port_{ijt} = \mu_0 + \mu_1 dist_{ij} + \mu_2 lang_{ij} + \mu_3 colony_{ij} + \mu_4 trade_{ijt} + \mu_5(\text{g diff}_{ijt}) + \mu_6(\text{int diff}_{ijt}) + \mu_7(\Delta \log(er_{ijt})) + \mu_8 Vol_{ijt} + \mu_{9,k}\sum_{k=1}^{4} region_k + \mu_{10,k}\sum_{k=1}^{4} global_k + \varepsilon_{it} \quad (4)$$

where $port_{ijt}$ is the ratio (in percent) of total portfolio assets between countries i and j to countries i and j's total GDP at time t (source: CPIS), μ are coefficients, $dist_{ij}$ is the log of distance between countries i and j, $lang_{ij}$ and $colony_{ij}$ are dummy variables indicating common language and colonial relation respectively (Rose and Spiegel, 2004), g diff$_{ijt}$ is the absolute value of the difference between GDP growth of countries i and j at time t, int diff$_{ijt}$ is the absolute value of the difference between short-term (money market) rate of countries i and j at time t (source: IFS), $trade_{ijt}$ is the ratio (in percent) of total exports between countries i and j to countries i and j's total GDP at time t (source: DOTS), er_{ijt} is bilateral exchange rate of country i vis--vis country j, Vol_{ijt} is the standard deviation of the monthly return of country i and j's bilateral exchange rate over year t (source: IFS), $region_k$ are dummy variables capturing intraregional portfolio transaction for each regionsAsia, euro area, Latin America and Eastern Europe, and $global_k$ are dummy variables capturing interregional portfolio transactions between the four regions and the rest of the world.

The results in Table 2 confirm our earlier simple evidence on portfolio transactions that Asia is less integrated than the euro area both on intraregional and interregional fronts, but that the level of regional integration is also low compared with other emerging market regions. The estimation follows a general-to-specific approach, consequently, a few variables were dropped due to their statistical insignificance and/or incorrect signs. The result suggests an important contribution from noneconomic regional factors—the distance between countries, common languages as well as colonial relation. In line with the global model estimated earlier, trade integration and volatility in exchange rate play an important role in determining portfolio transactions. Moreover, the estimated coefficients on regional and global dummies allow us to rank the degree of portfolio integration by region—both on intraregional and interregional dimensions. Based on the Wald test of coefficient restriction, we are able to rank the degree of portfolio integration across regions and compare the degree of intra and interregional integration. All regions except the euro area tend to be more integrated globally than regionally. In comparison to other emerging market regions, Asia fares relatively well in global integration but less so in regional integration. In fact, anything else being equal, for any intra-Asian country pair, financial integration tends to be 0.8 percentage points of GDP lower than the world average, a measure of underperformance that is worse than for the Latin America region, but comparable to the case of emerging Eastern European economies.

E. The Link Between Financial Integration and Rebalancing

Growth in Asia depends on external demand more than in other advanced economies and emerging market regions (Mohommad, NDiaye, and Unteroberdoerster, 2010). This dependence has led to an unbalanced production structure that is heavily tilted towards industry. From a demand side-perspective, only a few economies seem to have excessively low consumption, most notably China, while several others may well need to increase their investment-to-GDP ratios from current levels. However, in many economies strengthening domestic sources of growth will require boosting productivity of the services sector. Overall, economic rebalancing will mean different things for different countries and encompass comprehensive policy packages that foster investment in domestic demand oriented sectors such as services, in infrastructure which would enhance productivity and crowd in private investment, and mea-

Table 2: Estimation of Portfolio Gravity Model

Estimation of Portfolio Gravity Model	
Dependent variable: *portfolio assets to GDP (port)*	
Variable	Coefficient
Constant	0.311
	(5.530)
Lang	0.262
	(5.804)
Colony	0.716
	(26.002)
Dist	-0.003
	(-2.141)
Trade	0.654
	(24.553)
Vol	-3.068
	(-4.045)
Asia-global	-0.070
	(-6.104)
Euro-global	0.119
	(18.037)
LatAm-global	-0.168
	(-3.704)
EEur-global	-0.278
	(-5.251)
Asia-regional	-0.805
	(-18.208)
Euro-regional	2.878
	(20.811)
LatAm-regional	-0.603
	(-6.301)
EEur-regional	-0.863
	(-9.857)
Number of observations	5,292
Adjusted R^2	0.41
Note: t-statistic in brackets	

Source: Authors' calculations.

sures to boost consumption.

Greater financial integration in Asia can play an important role in strengthening the domestic source of growth. For example, by inducing more competition in sheltered banking systems it could provide access of underserved households and firms thereby reducing financing constraints hampering consumption and investment. In a similar vein, by providing greater liquidity, foreign participation in local currency bond markets is found to lower yields (Peiris, 2010). Moreover, by facilitating the transfer of financial know-how it fosters financial innovation which could lessen the motives for precautionary savings, for instance by providing households with a broader range of savings and insurance instruments, or result in more suitable forms to finance investment. Greater financial openness also tends to be conducive to improved corporate governance by exposing firms to a broader range of investors and investor classes. Similarly, pressure for greater transparency exerted by foreign investors reduces price volatility of financial assets because it improves the quality and frequency of information (Prasad and Rajan, 2008).

The Asian Bond Market Initiative is a specific example how greater financial integration is used to promote deeper and more resilient local financial markets. Through coordinated efforts between national policy makers to strengthen and harmonize institutional and legal frameworks and the setting up of pooled bond funds the initiative sets out to promote the development of local bond markets and create a spare tire in the event of disruptions to still bank-dominated funding channels or global finance. With foreign investors in advanced economies set to increase the share of emerging market assets in their portfolio (in line with their weight in global trade and production), the additional demand is likely to improve liquidity, lowering the volatility and cost of funding, thereby encouraging domestic firms to issue bonds. Foreign participation could thus trigger a virtuous cycle of bond market development allowing Asia to become less bank dominated and develop a twin engine financial system (Felman and others, 2010).

To quantify the link between financial integration and rebalancing, we start from the macroeconomic balance approach. On a macro scale, the need for rebalancing in Asia means a redress to savings-investment imbalances and thus can be captured by relative size of overall current account surplus to GDP. As discussed above, a wide spectrum of structural factors related to the financial system and the degree of financial integration can play an important role in affecting savings-investment norms. And these factors are found to be economically meaningful.

Using the standard macroeconomic balance approach, we therefore test the hypothesis whether financial integration is among the set of important structural determinants of cross-country variations in the current account balance. Based on this approach, structural determinants of the current account balance include old age dependency ratio, population growth, income, income growth and fiscal balanceall relative to an individual countrys major trading partnersalong with oil-trade balance and initial net foreign assets (as ratios to GDP). We augment the model to include our measures of financial integration developed in section II as an additional explanatory variable and follow a general-to-specific approach. A panel regression model of 105 countries is estimated by the generalized method of moments (GMM) and also accounts for heteroscedasticity.

Table 3 presents the estimation results comparing the model with z-score measure against that with trade-financial intensity measure of financial integration. Both models confirm the significance of financial integration as determinants of the savings-investment norm. Compared to the original model, these two augmented models fit the data better. The results clearly indicate an important role played by financial integration in rebalancing.

Based on the model estimates, we find that if the degree of financial integration in Asia were to be at the world norm, on average across emerging Asia (excluding Hong Kong SAR and Singapore), the current account surplus will be reduced by around 1 percent of GDP (Figure 5). The extent of current account adjustment does not depend on the size of the overall current account surplus (or imbalances) since a number of other structural factors besides the degree of financial integration also come into play in determining current account imbalances. Consequently, countries with larger current account imbalances, such as China, are not necessarily the ones that would benefit most in terms of rebalancing from further financial integration due to overwhelming impact of other structural determinants at work. On the other hand, despite relatively lower current account imbalances, Thailand, Korea, Indonesia, and Malaysia may stand to rebalance in a more significant way by moving towards the norm of financial integration.

III. Is There a Tradeoff to Financial Integration?

Financial integration holds a great promise in theory. It is expected to be a catalyst for (i) transferring resources from less productive to more productive regions, (ii) allowing countries to diversify and insure against idiosyncratic shocks via risk sharing, and (iii) fostering financial market development, and hence growth and macroeconomic stability, among others. Evidence

Table 3: Estimation of Augmented Macroeconomic Balance Approach

Estimation of Augmented Macroeconomic Balance Approach

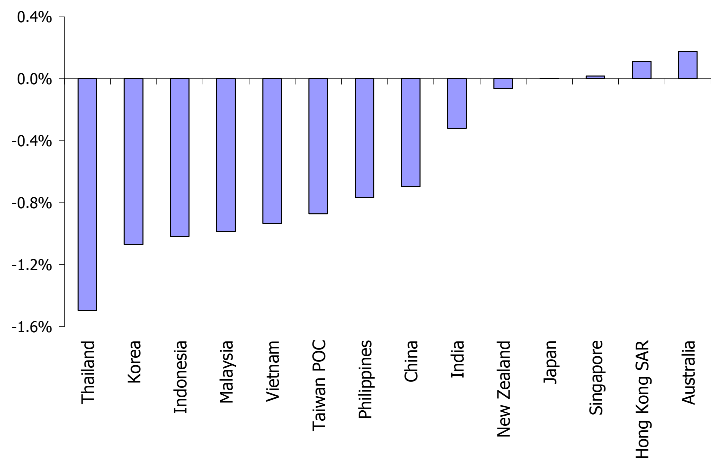
Dependent variable: current account to GDP			
Variable	Original Macrobalance Model[1]	*Z* score Model	Trade-Financial Intensity Model
Constant	-0.001	0.002	-0.006
	(-0.159)	(0.252)	(-0.880)
Relative old age dependency	-0.108	-0.106	-0.008
	(-1.197)	(-1.376)	(-0.108)
Relative population growth	-0.613		
	(-1.324)		
Relative income growth	-0.719	-0.546	-0.733
	(-2.030)	(-1.599)	(-2.498)
Oil trade balance	0.383	0.406	0.398
	(5.303)	(6.262)	(6.158)
Relative fiscal balance	0.265	0.166	0.266
	(1.590)	(1.545)	(2.162)
Initial net foreign assets	0.051	0.060	0.053
	(4.791)	(4.854)	(4.472)
Z score		-0.014	
		(-1.698)	
Trade to financial intensity ratio			0.004
			(2.005)
Number of observations	795	488	698
Adjusted R^2	0.451	0.467	0.473

Note: t-statistic in brackets

[1] Vitek (2010).

Source: Authors' calculations.

Figure 5: Change in CA to GDP due to Increase in Financial Integration to Global Norm



Source: Authors' calculations.

of how much these benefits have materialized in practice is at best mixed in the last two cases (Kose et al. (2009) and Nicolo and Juvenal (2010)), but near absent in the first (Lucas (1990)). Meanwhile, the opposing view that financial integration brings with it costly financial crises, amplified by contagion and spillover effects, has recently gained ground, propelled not least by the global financial crisis. There is a growing discomfort that financial integration is not only a double-edged sword, but may be integral to how financial crises arise and are exacerbated internationally (Stiglitz (2004, 2010), and Devereux and Yetman (2010b)).

The lack of clarity about the extent of benefits from financial integration and the potential cost involved pose a dilemma to policy makers, especially in emerging market countries. Asian economies have stepped up efforts to foster more intra-regional financial integration after the 1997 financial crisis, in a bid to reduce reliance on bank and foreign funding with a conviction that the integration will fortify the regional financial system and bring net economic benefits to the region. Should the policy makers continue to promote more regional financial integration to accelerate the benefit, or should these efforts now be put in reverse to curb the risks of financial contagion and preempt systemic disruption emanating from closer and more complex financial linkages?

This section contributes to the debate by focusing on the risk management function of financial integration where the tension is most distinct: the benefit is enjoyed if financial integration allows risks to be shared across borders, while the cost is incurred when risks spill over from one country to another. We quantify the extent of risk sharing and contagion risks using an asset price approach which offers a number of advantages. These are self-evident in the assessment of financial contagion which is fundamentally an asset-pricing concept, e.g., even a large coordinated portfolio investment outflow can hardly be termed a financial contagion in the absence of a disruptive fall in asset prices. On the other hand, the degree of international risk sharing is traditionally measured by the cross-country correlation of consumption growth, a quantity-based approach (the seminal paper being Lewis (1996)). Our asset-price approach is rooted on the same theoretical foundation as Lewis (1996), but by looking at asset prices directly, we do not have to make any specific assumption about the utility function, which is needed in Lewis (1996) to justify consumption growth as the proxy for the marginal rate of substitution. More importantly, our approach can take advantage of the higher frequency financial market data, hence can yield more insights on both the degree and time evolution of risk sharing (the latter of which is driven by interactions between the amount of risks and prices of risks).

A. Risk Sharing

There is perfect risk sharing between countries i and j if and only if the stochastic discount factors for the two countries are equalized[5]:

$$M_{t+1}^{i} = M_{t+1}^{j} \tag{5}$$

To the extent that there is less than perfect risk sharing, the distance between the two stochastic discount factors indicates the degree of constrained risk sharing. It is natural then that a statistical measure of risk sharing should be based on this distance. Brandt et al. (2006) defines a metric:

$$BCS_{i,j} = 1 - \frac{\text{var}(\log M_{t+1}^{i} - \log M_{t+1}^{j})}{\text{var}(\log M_{t+1}^{i}) + \text{var}(\log M_{t+1}^{j})} \tag{6}$$

which ranges from -1 to 1, with a higher number indicating better risk sharing. We shall refer to this metric as the Brandt-Cochrane-SantaClara (BCS) index.

The stochastic discount factors M_{t+1}^{i} and M_{t+1}^{j} are of course unobserved, prompting many researchers to resort to an indirect inference approach. For example, Brandt et al. (2006)

[5]The stochastic discount factors intuitively measure the marginal rates of substitution in the two countries, which, if equalized, imply perfect risk sharing because all country-specific shocks are shared equally. See Cochrane (2001).

assumes a cross-border no-arbitrage condition which implies that

$$\log M^i_{t+1} = \log M^j_{t+1} + \log \frac{e_{t+1}}{e_t} \tag{7}$$

where e_t is the spot price of j's currency per one unit of i's currency.[6] They then substitute the numerator of the BCS index by var$(\log(e_{t+1}/e_t))$. Since the stochastic discount factors are known to be much more volatile than the exchange rates, the BCS index should be close to 1 and they conclude that the degree of risk sharing must be high (or the exchange rates are too smooth).

An alternative and more direct way to test the hypothesis of perfect risk sharing is to estimate the stochastic discount factor directly. Various attempts in the literature have focused on some moments of the discount factors, however. For instance, Flood and Rose (2005) and Hanhardt and Ansotegui (2009) start by expanding the fundamental asset pricing equation:

$$P^i_t = E_t(M^i_{t+1} X^i_{t+1}) \tag{8}$$

$$= E_t(M^i_{t+1}) E_t(X^i_{t+1}) + Cov_t(M^i_{t+1} X^i_{t+1}) \tag{9}$$

where P^i_t is the asset's price and X^i_{t+1} the payoff of the asset. Their strategy then consists of writing down a factor model for $Cov_t(M^i_{t+1} X^i_{t+1})$ and using stock prices to back out $E_t(M^i_{t+1})$.

There is no known method for extracting the realized stochastic discount factors from the stock market data, as there is simply not enough information contained in a univariate variable such as a stock index. We propose a new approach, drawing on government bond term structure which is a much richer source of information. We retain the assumption that there is no-arbitrage within any given country i, so that there exists a positive random variable M^i_{t+1} pricing all domestic assets, and attempt to estimate it directly using suitable identifying restrictions. These restrictions derive from the no-arbitrage conditions set in the context of an affine term structure model. The market is assumed to be complete within each country, so that the estimated stochastic discount factor is indeed the unique one.[7] We do not assume cross-border no-arbitrage, therefore equation 7 needs not hold. Instead, the estimated time-series of

[6] Equation 7 is based on the premise that asset j, when denominated in i's currency, must also be priced by M^i_{t+1} and vice versa. Thus the condition can be interpreted as a parity condition. See detailed derivation in Backus et al. (2001).

[7] With incomplete markets, there is no unique stochastic discount factor, and the estimate of M^i_{t+1} represents the pricing kernel projected on the space of bond returns. In this case, the discount factor and the measure of risk sharing are specific to the bond market. It is notable, however, that the estimate of M_{t+1} obtained below for the case of US has moments that are similar to prior estimates based on the stock market.

M^i_{t+1} can be used to construct the BCS index directly.

A.1. Affine Term Structure Model

We briefly review the key ingredients of the affine term structure model.[8] Assume that there is a state vector X_t which evolves as a VAR process of order 1:

$$X_t = \mu + KX_{t-1} + \Sigma\varepsilon_t \tag{10}$$

where $\varepsilon_t \sim N(0, I)$. The choice of X_t throughout this paper will be the first three principal components of the term structure, which are known to be flexible enough in describing any shape of yield curve. The risk-free one-period interest rate is assumed to be an affine function of the state variable:

$$r_t = \delta_0 + \delta_1' X_t \tag{11}$$

Under no-arbitrage assumption, the fundamental asset pricing applied to bonds is given by

$$P_{n,t} = E_t(M_{t+1}P_{n-1,t+1}) \tag{12}$$

where $P_{n,t}$ is the price of n-period zero-coupon bond at time t, and M_{t+1} is the stochastic discount factor. We adopt a typical assumption that M_{t+1} is lognormal, taking the form

$$M_{t+1} = exp\left[-r_t - \frac{1}{2}\lambda_t'\lambda_t - \lambda_t'\varepsilon_{t+1}\right] \tag{13}$$

where the λ_t, the price of risk, is also affine in the state variable:

$$\lambda_t = \Lambda_0 + \Lambda_1 X_t \tag{14}$$

The system of equations 10-14 describes the elements of an affine term structure model. Solving the pricing kernel equation 12 recursively backwards, using as a terminal condition $P_{0,t+1} = 1$, and substitute for r_t and λ_t, the solution for the log bond price, $p_{n,t} \equiv \log P_{n,t}$, can

[8]See Dai and Singleton (2000), Duffee (2002) and Ang and Piazzesi (2003) among others for details on how an affine model is specified and solved.

be shown to be affine in the state as well

$$p_{n,t} = A_n + B_n' X_t \tag{15}$$

where A_n and B_n are solutions to the following system of difference equations

$$\begin{aligned} A_n &= A_{n-1} - \delta_0 + B_{n-1}'(\mu - \Sigma\Lambda_0) + \frac{1}{2}B_{n-1}'\Sigma\Sigma' B_{n-1} \\ B_n' &= B_{n-1}'(K - \Sigma\Lambda_1) - \delta_1' \end{aligned} \tag{16}$$

with initial conditions $A_1 = -\delta_0$ and $B_1' = -\delta_1'$. Given these solutions, the log gross yield $y_{n,t} \equiv \log(1 + Y_{n,t}) = -p_{n,t}/n$ is clearly also affine in the state

$$y_{n,t} = -\frac{A_n}{n} - \frac{B_n'}{n} X_t \tag{17}$$

A.2. Estimation

The data set consists of monthly time-series of zero-coupon government bond yields obtained from Bloomberg which covers 13 countries including Japan, Hong Kong SAR, Korea, Singapore, Taiwan Province of China, Indonesia, Malaysia, the Philippines, Thailand, China, India, US and EU (approximated by the German Bund). The series start from January 2000 to May 2011 for all countries except Indonesia (starting from February 2003) and China (starting from September 2003). The available maturities are 3-month, 1-year, 2-year, 5-year, 10-year and 15-year.

The empirical objective is to obtain an estimate of M_{t+1} which is most consistent with the time-series of observed zero-coupon yields while respecting the restrictions imposed by no-arbitrage affine model. Since the functional form of M_{t+1} is assumed, the problem is simply that of parametric estimation. The general approach is to assume that yields are observed with gaussian errors and estimate the parameters $\theta = \{\mu, K, \Sigma, \delta_0, \delta_1, \Lambda_0, \Lambda_1\}$ using the maximum likelihood method which effectively minimizes the sum of squared error between observed yields and the fitted values, $\sum_{n=1}^{N}\sum_{t=1}^{T}(y_{n,t} - \hat{y}_{n,t})^2$. To improve the time efficiency of the estimation, we first implement an asymptotically consistent procedure proposed by Adrian and Moench (2010), based on multi-step cross-sectional linear regressions along the line of Fama and Macbeth (1973).[9] Specifically, for each country we perform the following set of

[9]Their basic insight is to express the model in the space of excess returns instead of yields, which makes

computations:

1. Interpolate the yield curve in each time period, using piecewise cubic Hermite polynomial.[10] Use the interpolated yields to compute the first three principal components, log prices, and excess returns over 1-month holding period. The 1-month yield serves as the short-term interest rate r_t.

2. Estimate a VAR in the three principal components, to get estimates for μ, K, Σ and the associated residual ε_t. Regress the short-term interest rate r_t on the state variables to obtain δ_0 and δ_1. These estimates are treated as fixed.

3. Implement the Adrian-Moench procedure to obtain $\hat{\Lambda}_0$ and $\hat{\Lambda}_1$ (see Appendix A).

4. Refine the estimates via a maximum likelihood routine, by choosing Λ_0 and Λ_1 to minimize the sum of squared yield fit errors, $\sum_{n=1}^{10}\sum_{t=1}^{T}(y_{n,t} - \hat{y}_{n,t})^2$, setting the initial conditions for Λ_0 and Λ_1 equal to $\hat{\Lambda}_0$ and $\hat{\Lambda}_1$ obtained from the previous step.

5. Recover the log stochastic discount factor $\log M_{t+1} \equiv m_{t+1} = -r_t - \lambda_t'\lambda_t - \lambda_t'\varepsilon_{t+1}$.

A.3. Risk Sharing Measures

Figure 6 plots the time-series of m_{t+1} for selected countries. Figure 6a plots the discount factor for the US together with that of EU. The two series are similar in levels and tend to co-move closely over time, particularly so during the so-called great moderation period of 2002-2007, and again after the global financial crisis. Such close relationship between the discount factors is much less visible for the Asian countries, whether among the newly industrialized economies (NIEs) consisting of Hong Kong SAR, Korea, Singapore and Taiwan Province of China (Figure 6b), or ASEAN3 including Malaysia, the Philippines and Thailand (Figure 6c). The discount factors for these countries are both more volatile and less correlated with each other, lending little evidence of intra-regional risk sharing whether among NIEs or ASEAN.

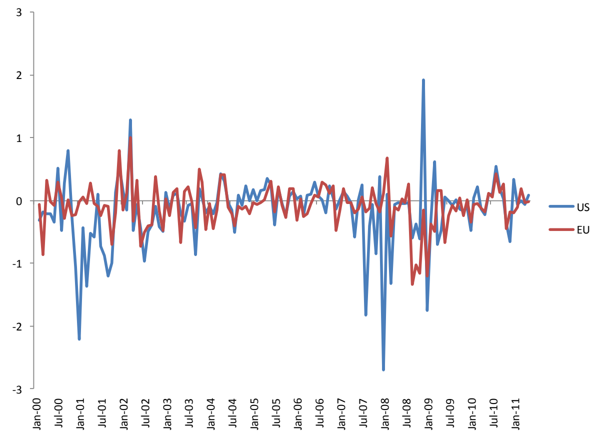
To evaluate the degree of risk sharing more objectively, we compute the BCS index (equation 6) for all pairs of 13 countries. The results are shown in Table 4a. Broadly speaking,

the model tenable to linear estimation. See appendix A for a brief overview of the steps and rationale for this procedure.

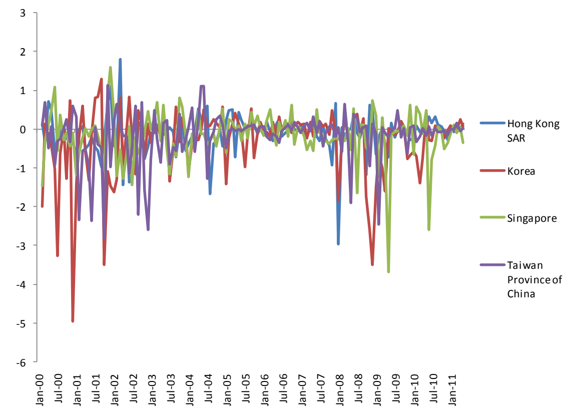
[10] We choose this method over cubic spline to avoid excessive oscillation that otherwise would arise intermittently in the sample.

Figure 6: Log Stochastic Discount Factors

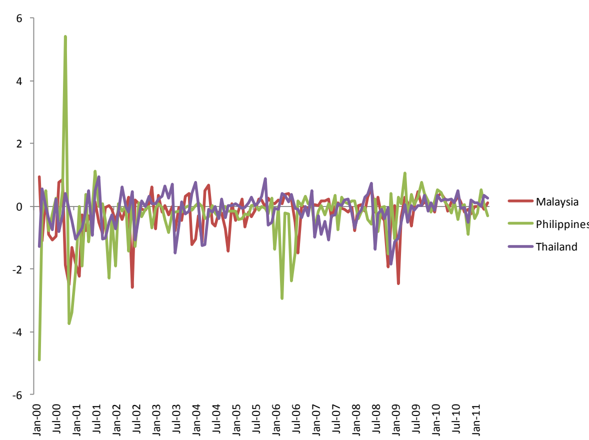
(a) US and EU



(b) NIEs



(c) ASEAN3



Source: Authors' calculations.

the degree of risk sharing between the 13 countries is moderate at best: the BCS indices average at 0.10, significantly below the full risk-sharing benchmark of 1. At the same time, behind this average number lies much heterogeneity, with certain pairs of countries sharing risks more successfully than others. Those with above average risk sharing are marked with light color, while those with BCS higher than one standard deviation from the mean (0.22) are in dark color.

Notable cases include the risk sharing between the US and Hong Kong SAR, whose BCS index is the highest at 0.587. A very close financial integration together with a common monetary policy between the two economies mean that risks in the UK and Hong Kong SAR

Table 4: Brandt Cochrane Santa-Clara (BCS) Indices

(a) By countries

	Japan	*Hong Kong SAR*	*Korea*	*Singapore*	*Taiwan Province of China*	*Indonesia*	*Malaysia*	*Philippines*	*Thailand*	*China*	*India*	*US*
Hong Kong SAR	0.182											
Korea	0.193	0.078										
Singapore	0.076	0.208	0.054									
Taiwan Province of China	-0.076	0.059	0.072	0.095								
Indonesia	0.102	-0.023	0.198	0.067	-0.022							
Malaysia	0.186	0.206	0.146	0.116	0.221	0.176						
Philippines	-0.123	-0.043	0.157	0.060	0.007	0.180	-0.022					
Thailand	0.173	0.090	0.269	0.156	0.098	-0.021	0.086	0.166				
China	-0.099	-0.111	0.167	0.131	0.304	0.009	0.222	-0.108	0.007			
India	-0.029	0.055	0.251	-0.004	-0.062	0.012	0.034	0.204	0.254	0.049		
US	0.025	0.587	0.059	0.226	0.127	-0.041	0.137	0.201	0.131	-0.054	0.166	
EU	0.011	0.297	0.086	0.034	0.101	0.025	0.177	0.063	0.049	0.037	0.212	0.338

(b) Summary by regions

	NIEs	ASEAN 4	US & EU
NIEs	0.095		
ASEAN 4	0.107	0.094	
US & EU	0.190	0.093	0.338

Source: Authors' calculations.

are similarly priced, evidence of significant risk sharing. Meanwhile the US and EU share a significant amount of risks relative to others, reaffirming our earlier observation. The result may again not be surprising given the high degree of financial development and integration between the two economies. In contrast, however, Japan does not share risks meaningfully with the US or EU despite having a well-developed financial market, suggesting that risk sharing is a function of more than financial integration.

Intra-regional risk sharing in Asia remains low, for both NIEs and ASEAN4 groups (ASEAN4 includes Indonesia, Malaysia, the Philippines and Thailand). In Table 4a, the corresponding BCS indices are boxed and labelled A and B respectively. Among NIEs, only Hong Kong SAR and Singapore are sharing risks above one standard deviation from average. Meanwhile, the extent of risk sharing between NIEs and ASEAN4 is more noticeable, with Korea and Malaysia acting as core members of their groups in sharing risks with the other faction (Table 4a, box C). The US shares risks significantly with most NIEs, and to a

Table 5: BCS Over Sub Periods

(a) Great Moderation

	NIEs	ASEAN 4	US & EU
NIEs	0.095		
ASEAN 4	0.107	0.094	
US & EU	0.190	0.093	0.338

(b) Global Financial Crisis

	NIEs	ASEAN 4	US&EU
NIEs	0.044	0.125	0.074
ASEAN 4	0.125	0.151	0.066
US&EU	0.074	0.066	0.153

(c) Recovery

	NIEs	ASEAN 4	US&EU
NIEs	0.021	0.044	0.197
ASEAN 4	0.044	0.173	0.293
US&EU	0.197	0.293	0.613

Source: Authors' calculations.

lesser extent with ASEAN4 (Table 4a, boxes D and E). These results can be summarized in Table 4b, which aggregate the BCS indices across the regions. Our price-based measures are consistent with findings based on quantity-based measures that Asian countries are more financially integrated with major economies outside the region than with those within Asia (see Borensztein and Loungani (2011), Pongsaparn and Unteroberdoerster (2011) and Cowen et al. (2006) for example).

As Figure 6 suggests, the extent of risk sharing may potentially vary over time, possibly driven by both cyclical and structural shifts. To shed light on the nature of these changes over the past decade, the BCS indices are computed over three subperiods: (1) the Great Moderation period of January 2002 to June 2007, (2) the Global Financial Crisis from July 2007 to June 2009 , and (3) the recovery period from July 2009 to May 2011.[11] Table 5 show the evolution of risk sharing over the past decade.

[11]These subsamples are used for the computation of the BCS indices, holding fixed the full-sample estimates of the stochastic discount factors. The subperiod division is inevitably arbitrary. While the Great Moderation for advanced economies may have started as early as the 80's, we exclude the period before 2002 because Asia remained weighed down by legacies from the Asian crisis. Also we adopt mid 2007 as the starting point of the Global Financial Crisis, even though for many the bankruptcy of Lehman Brothers in September 2008 may be the watershed. Our view is that many signs and forms of market stresses have emerged long before Lehman's demise, and the amount of risks to be shared probably have already risen. As Figure 6 shows, the pattern of risk sharing may have undergone a structure shift as early as the mid 2007.

Risk sharing among the US, EU and NIEs intensified during the Great Moderation, weakened markedly during the crisis, and resumed strongly since the recovery. The benefits of financial integration for these economies have been reaped slowly over the period when shocks and risks were relatively modest. Risks associated with events as severe as the Global Financial Crisis however were little shared between the major economies, and the economies at the center of the crisis, particularly the US, were under-insured by other economies. As a result, the stochastic discount factor of the US became highly volatile and little correlated with other countries' discount factors during the crisis.

Meanwhile, the intra-regional risk sharing within the ASEAN4 steadily climbed over the periods, while for NIEs the opposite is the case. Behind this evolution, both cyclical and structural forces are likely at work. During the Global Financial Crisis, Indonesia, Malaysia and Thailand were jointly sharing a lot of risks, with BCS indices in the range of 0.26-0.35. The discount factors in all three economies became more volatile, but remained close to and highly correlated with each other. In other words, as core members of emerging Asian economies, the group underwent an episode of abrupt shift in prices of risks during the crisis, but was able to share risks efficiently. After the recovery took hold, the discount factors stabilized for all ASEAN4, but the BCS indices between the Philippines versus Indonesia, Malaysia and Thailand began to increase. The BCS indices for Thailand versus Malaysia and Indonesia also stay high, in contrast to the pre-crisis period. These recent developments provides tentative evidence that the recent increase in intra-regional risk sharing may at least partly be structural.

B. Contagion

We apply a simple statistical measure of 'CoVaR' (Conditional Value-at-Risk) due to Adrian and Brunnermeier (2010) to equity markets.[12] Intuitively, the CoVaR concept measures the extent to which a tail event in one market can spill over and create or worsen a tail event in another market. This measure is computed by performing quantile regressions of one asset returns conditional on another, thus the attention is squarely on tail correlation. The estimated coefficient or 'beta' then describes the degree of exposure to the financial contagion risk. Aggregating the magnitude of spillovers stemming from different countries gives a measure of one country's exposure as desired. We draw on returns of stocks rather than bonds when

[12] A number of alternative measures are available: Diebold and Yilmaz (2009) construct a measure of spillover based on variance decomposition of VARs in return and volatilities, while Engle et al. (2009) proposed a class of Multiplicative Error Model (MEM), a GARCH-based measure of volatility spillovers. As Section **??** will show, our results are broadly consistent with these studies.

computing CoVaR, because of the close association between the stock market and financial crises as well as times of stress in general.

The data are weekly returns in the primary equity indices of the same set of countries. The baseline estimation period conforms to that used to estimate risk sharing, covering the week ending January 7th, 2000 to June 10th, 2011. Weekly rather than monthly data are used primarily to harvest more information at the tails (the same frequency is used in Adrian and Brunnermeier (2010)).

The tail event is defined to be the threshold value on the domain of return distribution, below which the realized return will fall with probability 5%. The tail event for market i is therefore the value-at-risk (VaR) for the weekly return at 5% confidence level, which can be estimated by fitting a quantile regression (Koenker and Bassett (1978)) to the weekly return of market-i stock:

$$ret_t^i = a + b\, ret_{t-1}^i + e_t \tag{18}$$

In the restricted model of $b = 0$, the fitted value $\hat{a}$ is a sample point estimate of the 5% VaR. However we consider a general model and estimate b, as a simply way to model autoregressive time-varying tail risk:

$$VaR_t^i = \hat{a} + \hat{b}\, ret_{t-1}^i \tag{19}$$

To capture contagion, we estimate a similar quantile regression of market i, but this time conditional on concurrent information received from market j:

$$ret_t^i = \alpha + \beta\, ret_{t-1}^i + \gamma\, ret_t^j + \epsilon_t \tag{20}$$

The fitted value of regression 20, when evaluated at $ret_t^j = VaR_t^j$, defines the notion of conditional VaR, or 'CoVaR' in the terminology of Adrian and Brunnermeier (2010):

$$CoVaR_t^{i,j} = \hat{\alpha} + \hat{\beta}\, ret_{t-1}^i + \hat{\gamma}\, VaR_t^j \tag{21}$$

In other words, $CoVaR_t^{i,j}$ measures the size of the potential tail event at market i conditional on the news that a 5% tail event has already occurred in market j. A large and negative $CoVaR_t^{i,j}$ indicates a significant financial contagion from market j to market i. Clearly $CoVaR$ as so defined is one-sided, directed (since $CoVaR_t^{i,j} \neq CoVaR_t^{j,i}$ in general) and aims to capture 'tail' risk spillover.

It is useful for interpretation to express $CoVaR$ in a relative rather than absolute scale, namely how much additional tail risk is generated for market i as conditions in market j deteriorate from the median return to the 5% value-at-risk. Thus, we define our contagion index from market j to market i as

$$Contag_t^{i,j} = \hat{\gamma}\left(VaR_t^j - Median^j\right) \tag{22}$$

where $Median^j$ is the median weekly return, computed as the fitted value of regression 18 with $b = 0$ and confidence level 50%. Large and negative $Contag_t^{i,j}$ means there is a significant degree of downside contagion from market j to i, or equivalently that market i is exposed to systemic risk stemming from stress in market j. We use this $Contag$ measure as a gauge of costs accrued to market i, arising from being financially integrated to market j.

Table 6: Contagion Matrix: $Contag^{i,j}$

j \ i	Japan	Hong Kong SAR	Korea	Singapore	Taiwan Province of China	Indonesia	Malaysia	Philippines	Thailand	China	India	US	EU	NIEs	ASEAN	US&EU	Average
Japan		-3.046	-4.511	-2.812	-2.863	-3.339	-1.570	-2.375	-2.452	-1.552	-3.289	-2.730	-3.454	-3.308	-2.434	-3.092	-2.833
Hong Kong SAR	-3.341		-4.473	-3.862	-3.247	-3.107	-1.842	-1.859	-2.942	-1.702	-3.283	-2.162	-4.011	-3.861	-2.438	-3.087	-2.986
Korea	-2.850	-3.118		-3.301	-3.734	-2.261	-1.571	-1.574	-2.903	-1.632	-2.947	-2.513	-3.761	-3.384	-2.077	-3.137	-2.680
Singapore	-3.443	-4.147	-4.482		-3.989	-3.094	-1.947	-2.039	-2.736	-1.924	-3.875	-2.644	-3.858	-4.206	-2.454	-3.251	-3.181
Taiwan Province of China	-2.699	-2.408	-4.599	-2.807		-2.813	-2.092	-1.395	-2.915	-1.478	-2.940	-1.692	-2.791	-3.271	-2.304	-2.241	-2.552
Indonesia	-2.547	-2.785	-3.154	-2.632	-2.154		-1.865	-2.677	-2.849	-1.306	-3.437	-2.097	-2.685	-2.681	-2.464	-2.391	-2.516
Malaysia	-2.166	-1.755	-2.588	-2.200	-2.289	-2.743		-1.554	-2.700	-1.041	-2.452	-1.082	-2.436	-2.208	-2.332	-1.759	-2.084
Philippines	-1.919	-1.962	-2.107	-1.716	-1.936	-2.845	-1.428		-2.328	-0.528	-2.510	-1.195	-2.187	-1.930	-2.201	-1.691	-1.888
Thailand	-2.510	-2.417	-3.019	-2.482	-2.269	-2.916	-1.583	-2.693		-1.133	-2.866	-1.639	-2.782	-2.547	-2.397	-2.211	-2.359
China	-1.198	-0.915	-1.083	-0.292	-1.463	-0.992	-0.561	-0.210	0.094		-0.506	0.010	-0.479	-0.938	-0.417	-0.234	-0.633
India	-3.238	-3.052	-3.487	-3.263	-3.282	-2.537	-1.687	-1.879	-2.377	-0.834		-1.828	-3.569	-3.271	-2.120	-2.698	-2.586
US	-2.891	-2.576	-2.450	-2.116	-1.559	-2.037	-0.980	-1.899	-2.348	-0.720	-2.325		-4.707	-2.176	-1.816	-4.707	-2.217
EU	-3.064	-3.274	-3.270	-2.920	-2.917	-2.708	-1.425	-1.940	-2.787	-0.394	-3.062	-4.219		-3.095	-2.215	-4.219	-2.665
NIEs	-3.083	-3.225	-4.518	-3.324	-3.657	-2.819	-1.863	-1.717	-2.874	-1.684	-3.261	-2.253	-3.605	-3.681	-2.318	-2.929	-2.914
ASEAN	-2.286	-2.229	-2.717	-2.258	-2.162	-2.834	-1.625	-2.308	-2.626	-1.002	-2.816	-1.503	-2.523	-2.342	-2.348	-2.013	-2.222
US&EU	-2.977	-2.925	-2.860	-2.518	-2.238	-2.372	-1.203	-1.919	-2.568	-0.557	-2.693	-4.219	-4.707	-2.635	-2.016	-4.463	-2.597
Average	-2.656	-2.621	-3.269	-2.534	-2.642	-2.616	-1.546	-1.841	-2.437	-1.187	-2.791	-1.983	-3.060	-2.837	-2.128	-2.671	-2.435

Note: Maximum value among aggregates of each row or column is highlighted.

Source: Authors' calculations.

Averaging $Contag_t^{i,j}$ across time t gives a mean exposure of market i to market j, denoted $Contag^{i,j}$. The average contagion matrix is presented in Table 6, where the sources of contagion (country j) are listed in rows, while the recipient countries i are on columns. For example, as the stock market return in Singapore deteriorates from its median level to its stressed case of 5% value-at-risk level, our estimate implies that the repercussion on Hong Kong SAR would be equivalent to a 4.147% downward adjustment in the worst case scenario facing Hong Kong SAR.

The spillover risks stemming from the financial centre countries, i.e. Hong Kong SAR and Singapore, to others appear to be among the highest according to the estimates. Averaging $Contag^{i,j}$ across i (to get $Contag^j$), highlights Singapore as the most systemic equity market with average $Contag^j$ of -3.181, followed by Hong Kong SAR with $Contag^j$ of -2.986. On the other hand, the most 'exposed' market is Korea, whose $Contag^i = \sum_{\forall j} Contag^{i,j}/12$ is 3.269.

Table 6 also shows averages of $Contag^i$ and $Contag^j$ within sub-groups NIEs, ASEAN4 and US-EU. Collectively as a region, NIEs is the most important source of risks for most Asian economies, especially other members in NIEs, and it is also the region that is most exposed to contagion originating within Asia (note the shaded areas, which mark the region with the highest $Contag$). While the US and EU are mutually exerting contagion risk onto each other, the degree of spillover to Asia is more moderate. Thus, the contagion risk appears in general to be transmitted mainly intra-regionally.[13] This is in contrast to the international risk-sharing pattern observed earlier.

The result that NIEs, rather than the US and EU, are the main source of contagion risk for Asia is robust within various subsamples over the past decade - both $\hat{\gamma}$ and $Contag$ are stable for different samples.[14] The only notable breakpoint is during the Global Financial Crisis, when ASEAN4 became the main source of tail risk for the region itself, which reinforces the extent of intra-regional spillover further. On the contrary, when we repeated the calculation over the previous decade of 1987-1999, we found that the US and EU were the main sources of tail risk for Asia during that episode. It seems to be the case that progresses over the last decade in both financial and trade integration within Asia have already shifted the source of financial contagion for Asia from external to internal.

[13]Gebka and Serwa (2007) also found some evidence from GARCH-type analysis that intra-regional spillovers are more significant, although their sample only includes emerging equity markets.

[14]The result echoes the findings of Diebold and Yilmaz (2009) that Hong Kong SAR and Singapore are the major economies that exert return and volatility spillovers to other Asian economies.

The overall results suggest that the degree to which contagion risks rise with the extent of financial integration may be shaped by a number of other factors. Closer integration between real sectors via trade channel for example can increase the tail event correlation. The relative stability of the size and pattern of these spillovers suggests that the determinant of financial contagion is largely structural and owes to an accumulative progress of globalization both in real and financial terms over a long period of time. Stalling or reversing the process of financial integration will probably do little to contain the contagion risk in the medium-term. Rather, efforts should be invested in enhancing the risk-sharing benefits obtained from financial integration.

C. Is There Tradeoff to Financial Integration?

The BCS and $Contag$ indices are explicit measures of the benefits and costs of financial integration. The natural question is whether there exists a cost-benefit tradeoff to financial integration in the sense that reaping more benefits from integration necessarily entails greater costs in terms of higher contagion risks. In principles, a tradeoff is expected if both risk sharing and contagion risks increase with the degree of financial integration: if $BCS = f(integration)$ and $Contag = g(integration)$ where f and g are both increasing functions, then

$$BCS = f(g^{-1}(Contag)) \equiv F(Contag) \tag{23}$$

where F is a decreasing function, hence a tradeoff.[15]

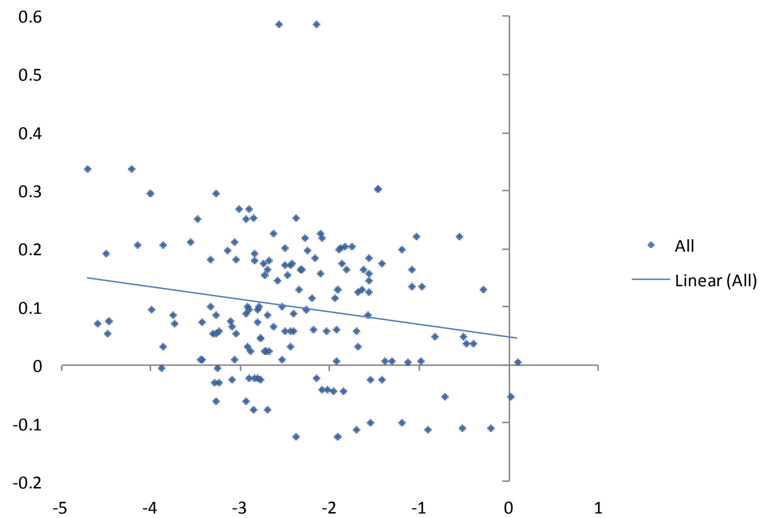
To explore this issue, we show a scatter plot of BCS on the y-axis against $Contag$ on the x-axis together with a fitted line, in Figure 7a. There is a discernible tradeoff as indicated by the negatively sloped fitted line. The goodness of fit is not high ($R^2 = 0.03$), but the negative slope of -0.02 is significant with t-statistic of -2.21. Higher risk-sharing benefit, on average, comes about at a higher cost in terms of contagion risk.

An inspection of the terms of tradeoff for each individual case reveals a much more subtle pattern. In particular, consider Figure 7b which overlays the original scatter plot with highlighted dots representing the US case together with an associated fitted line. This term of

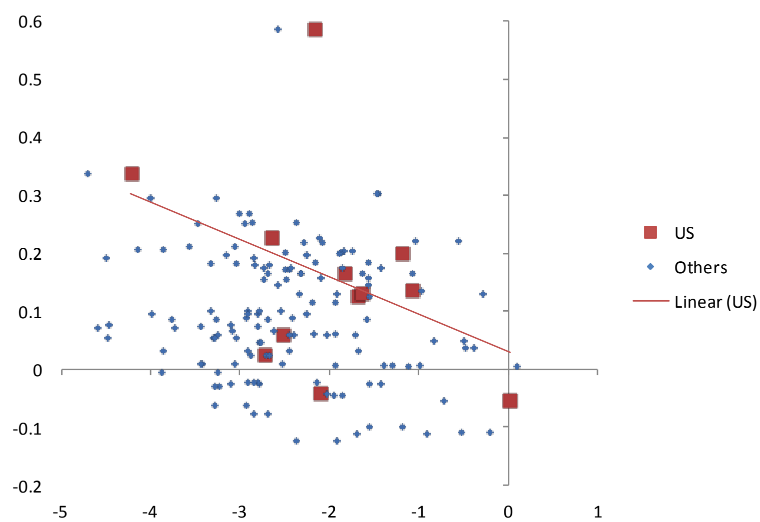
[15]Recent examples of a full-fledged theoretical foundation for a tradeoff between risk sharing and financial contagion include Battiston et al. (2009) which highlights the 'connectivity' aspect of integration, and Devereux and Yetman (2010a) which establishes the cost-benefit tension in a macro model with financial frictions in the form of a leverage constraint.

Figure 7: Risk-Return Tradeoff to Financial Integration

(a) Overall



(b) US



Source: Authors' calculations.

tradeoff lies close to the north-east bound of the scatter, suggesting that the US more or less defines the efficient cost-benefit frontier to integration for Asia. The majority of countries, in other words, are less successful than the US in taking advantage of risk-sharing opportunities, given the contagion costs incurred.

The next set of figures compare the scatter plots of other countries to the US tradeoff to highlight the differences. Figure 8 shows that neither the EU nor Japan enjoys the same degree of risk-return efficiency of the US. Hong Kong SAR, whose risk sharing with the US is the highest, has a tradeoff frontier that is close but still inferior to that of the US. Meanwhile, for other members of NIEs, the tradeoff lines are upward-sloping, an indication that these countries have room to benefit from integration without incurring higher costs and may have yet to reach their own efficient frontiers in integrating with the rest of Asia. Figure 9 paints a broadly similar picture for ASEAN4, China and India, where there is also a significant potential gain from increasing risk-sharing benefits without increasing the contagion costs.

The apparent heterogeneity in the terms of tradeoffs points towards differences in the 'quality' of financial integration in Asia. When this quality differs significantly, variations in the degree of integration will not necessarily imply a positive and uniform correlation between contagion risks and risk sharing. Instead, the cost-benefit tradeoff is contextualized by the additional quality factors, or $Context$:

$$BCS = F(Contag, Context) \tag{24}$$

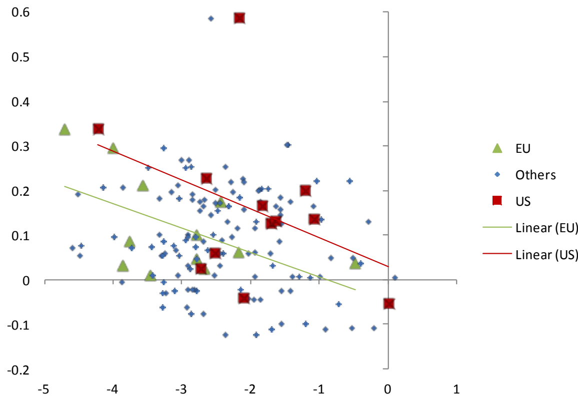
In other words, while there may be an underlying positive relationship between BCS and $Contag$, with movements along the relationship explained by variations in the degree of financial integration, there is also a shift variable $Context$ at work and obscuring the reduced-form relationship. What is clear from Figures 8 and 9 is that the latent factors $Context$ play a role in suppressing risk sharing for some countries. One policy option to unlock the potential benefit of risk sharing is to relax these $Context$-related constraints.[16]

Our discussion will focus on four potential $Context$ factors: (i) the extent of financial integration (namely, a greater quantity also leads to a higher quality of integration), (ii) the degree of financial market developments, (iii) size of economic shocks, and (iv) general macroeconomic backdrop, which are now discussed in turn.

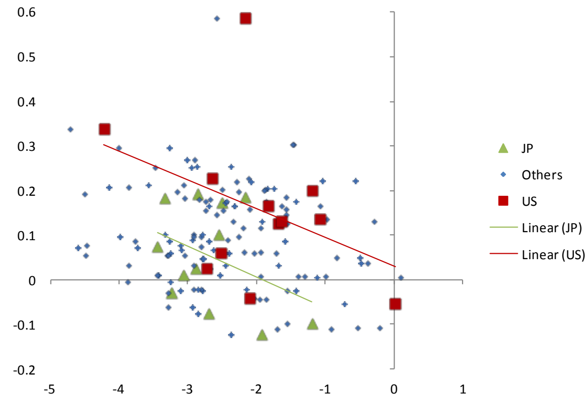
[16]A number of studies have stressed the importance of context as an important determinant of the beneficial effects of financial integration. See Prasad et al. (2003) and Masten et al. (2008).

Figure 8: Cost-Benefit Tradeoffs: EU, Japan and NIEs

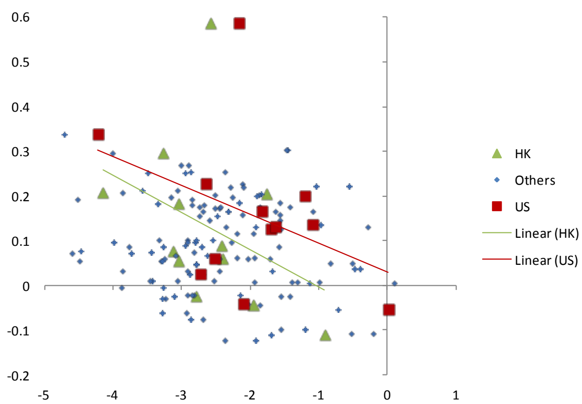
(a) EU



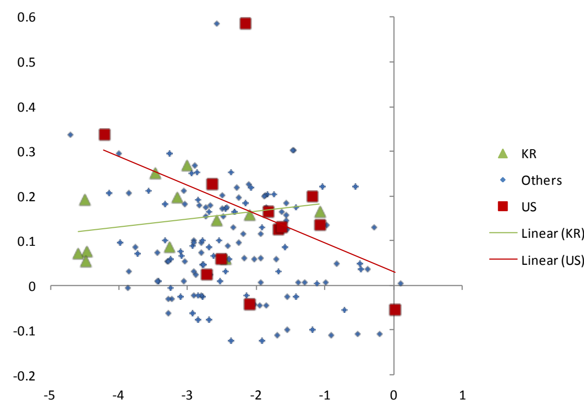
(b) Japan



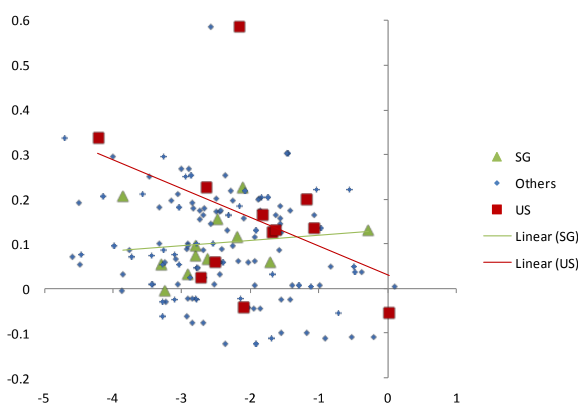
(c) Hong Kong SAR



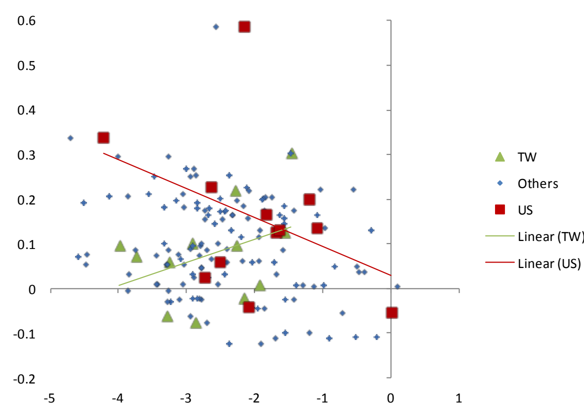
(d) Korea



(e) Singapore

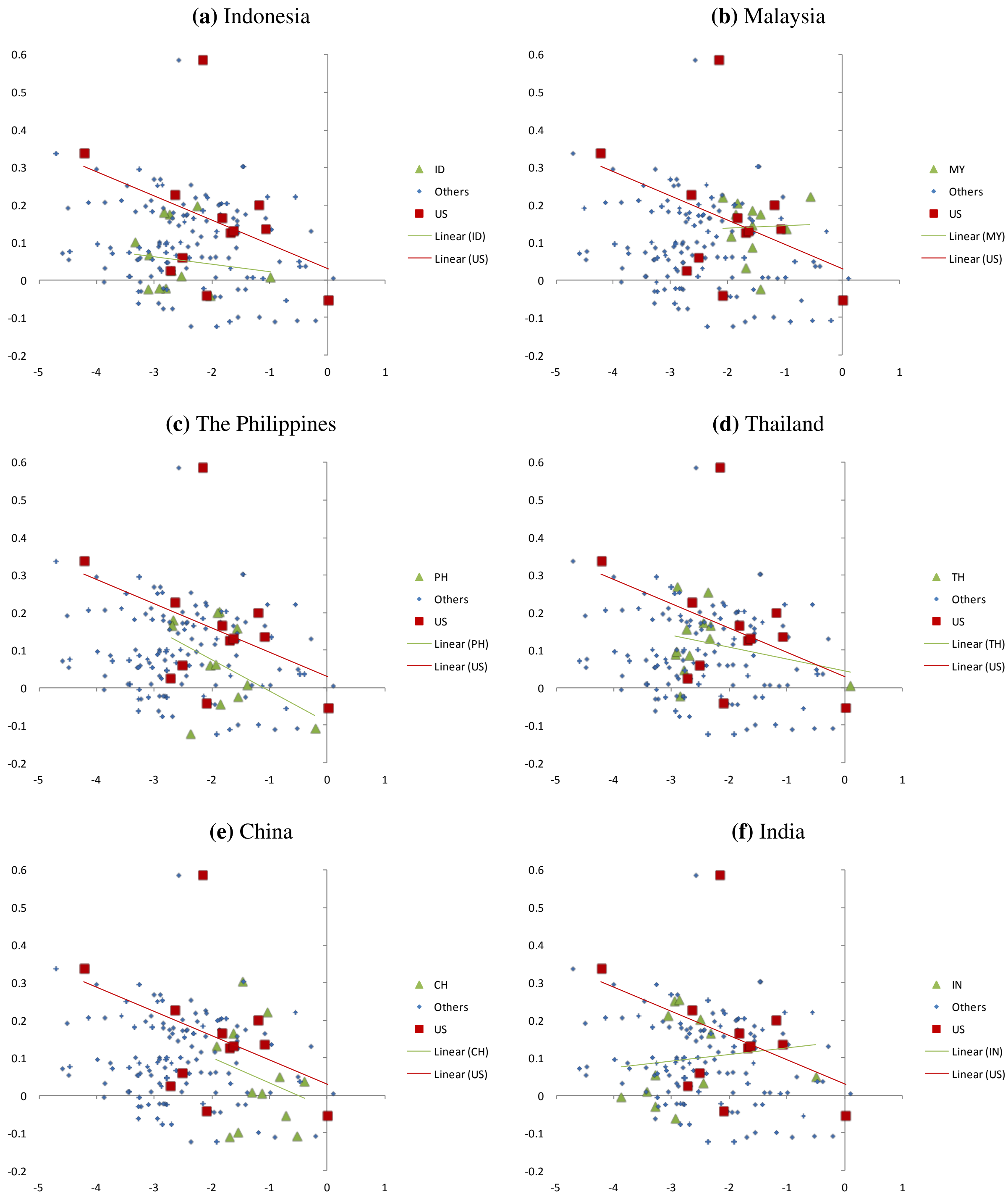


(f) Taiwan Province of China



Source: Authors' calculations.

Figure 9: Cost-Benefit Tradeoffs: ASEAN4, China and India



Source: Authors' calculations.

The first factor captures the idea of a threshold effect: as countries become more financially integrated, the risk-sharing benefits increase nonlinearly. Many $Context$ variables, like $Contag$, are endogenous to the extent of financial integration. Closer integration fosters development of financial products to manage and share new risks, for example there will be less need for a foreign exchange derivative market with little financial integration. Better private risk management is also encouraged by greater integration, through better liquidity as well as learning-by-doing. As a result, risk-sharing benefit may depend outright on the degree of integration, and not just through $Contag$. This linkage, if significant, lends support for further financial integration as a means to break away from the 'low integration equilibrium' and unlock the benefits of international risk sharing.[17]

Countries whose financial markets are more developed, whose access to advanced instruments such as derivatives is readily available, and whose market participants are better informed as well as more plentiful, are better equipped in dealing with idiosyncratic risks and hence should be more likely to benefit from risk sharing. But sharing risks requires a counterpart, thus an uneven development in financial market is another possible explanation for limited risk sharing in some groups of countries. To the extent that this is a binding constraint, policy efforts should focus on harmonizing market rules and practices, fostering financial market developments at a multilateral platform and developing institutions more generally. Many recent policy recommendations by the IMF and others fall within this category (see Cowen et al. (2006), FSAP reports for Asian economies, and more recently Gray et al. (2011) which discusses the progress and future directions for bond market development in ASEAN5).

As the total amount of risks depends on the volatility of shocks, more volatility will lower BCS if the amount of risks being shared does not rise proportionately. As previously documented, there are instances in which the estimated degree of risk sharing as measured by BCS dropped in the period of extreme economic turbulence. We consider a stronger hypothesis, however, that a larger amount of total risks may reduce the absolute degree of risk sharing (i.e. 'Risks shared' depends negatively on shock volatility), particularly as shocks endogenously impair the ability of financial markets to allocate risks efficiently.[18] In this case, countries should step up their efforts to cooperatively smooth out shocks within the region, recognizing the limitations of financial markets in insuring against extremely large risks.

[17] A related argument is that more open and integrated economies can better withstand economic volatility and may even be able to generate more productivity gains. See Kose et al. (2009) and references therein.

[18] In models with strong financial accelerator or cascade mechanisms, this negative dependence is not only theoretically possible but is likely. See Stiglitz (2010).

The macroeconomic environment in general may also help explain the differentiated degrees of risk sharing. Different macroeconomic backdrops imply unbalanced dynamics and propagation of shocks, with in turn can affect the financial market's ability to allocate risks across economies. Choices of monetary policy frameworks, degrees of openness, and competitiveness all contribute to heterogeneous macroeconomic conditions. There is again little scope for unilateral policy in this case. A multilateral approach to promoting risk sharing, on the other hand, involves steps to harmonize the policy frameworks, ranging from a common recognition of broad policy priority to a stronger form culminating in an adoption of a common currency area as suggested by Mundell (1973) for example.[19]

C.1. Explaining the tradeoffs

How quantitatively relevant are these four factors? One feature of the BCS estimates obtained is the pattern of intra-regional risk sharing which varies across different groups and periods. We leverage on this variation to identify the relative importance of all the factors. For example, if financial market development was an important determinant of risk sharing, then those regions with more uneven financial development in certain period should have less intra-regional risk sharing over that particular period. Similarly, more uneven shocks or greater differences in macroeconomic environments in the cross-section should help explain more limited intra-regional risk sharing in any period. Meanwhile, a higher degree of intra-regional integration should lead to more risk sharing within the region, other things being equal.

To test these hypotheses, we consider three groups of countries: NIEs, ASEAN4 and US&EU. The dependent variable is the degree of intra-regional risk sharing within each of these three regions. BCS unfortunately must be defined over some time interval, which reduces the availability of time-series data. We therefore introduce an alternative definition of intra-regional risk sharing. For each group $j \in \{NIEs, ASEAN4, US\&EU\}$, we define $\sigma_{jt}(m)$ to be the $\log$ of cross-sectional standard deviation of $\log M_t^i$ across $i \in j$ for fixed t. $\sigma_{jt}(m)$ is a measure of intra-regional risk sharing within region j, and is different from BCS since it is an absolute measure and a complete time series (hence more data points for estimation).

[19]Mundell (1973) argued that one important benefit of a common currency area is better international risk sharing, since having a common price level will *"...allow the country* [hit by a negative income shock] *to run down its currency holdings and cushion the impact of the loss, drawing on the resources of the other country until the cost of adjustment has been efficiently spread over the future."*

The measure of intra-regional financial integration is taken from the Coordinated Portfolio Investment Survey (CPIS) dataset and defined to be the average proportion of portfolio investment liabilities corresponding to creditors within the same region. A larger ratio therefore indicates closer intra-regional financial integration. The data are annual, and we use quadratic interpolation to convert the data into monthly frequency. Denote these ratios by int_{jt}.

The extent of unbalanced financial developments is captured by the $\log$ of cross-sectional standard deviations in the ratios of stock market capitalization to nominal GDP at each date t, denoted by $\sigma_{jt}(st\_gdp)$. According to our hypothesis, $\sigma_{jt}(st\_gdp)$ should have a positive impact on $\sigma_{jt}(m)$, as more uneven development puts a drag on the ability of financial market to insure risks. There are admittedly many other measures of financial development, but their data availability is a limitation and interpretation is not necessarily less problematic.

As a proxy for size of shocks, we define $\sigma_{jt}(ip)$ to be the $\log$ of cross-sectional standard deviations at each date t of HP-filtered year-on-year growth in industrial production across each i in j. Larger $\sigma_{jt}(ip)$ indicates a larger amount of real risks within region j that can potentially be shared.

The differences in general macroeconomic conditions is measured by the $\log$ of cross-sectional standard deviations in the year-on-year core inflation, denoted by $\sigma_{jt}(\pi)$. This variable captures in a simple way the effects of monetary policy regimes, sensitivity to commodity prices and imported inflation, as well as relative position on the Phillips curve among others.

The specification to be estimated is

$$\sigma_{jt}(m) = \alpha + \beta_1 int_{jt} + \beta_2 \sigma_{jt}(st\_gdp) + \beta_3 \sigma_{jt}(ip) + \beta_4 \sigma_{jt}(\pi) + \eta_j + \varepsilon_{jt} \tag{25}$$

where η_j denotes unobserved region-specific time-invariant effect. Note that the specification does not explicitly condition on contagion risks, because a time-series measure of contagion is not available. The implicit dependence on contagion risks will instead be picked up by int_{jt} and η_j, which in turn will affect the interpretation of β_1. We estimate OLS (ignoring η_j), fixed effects and random effects respectively. The results are reported in Table 7.

Except for $\sigma_{jt}(st\_gdp)$, the effects of all variables are statistically significant with signs that conform with the hypotheses for all three estimation methods. Risk sharing benefits are greater in periods and regions with tighter financial integration, less uneven economic shocks and more similar inflation rates.

Table 7: Determinants of Intra-Regional Risk Sharing

	OLS	Fixed effects	Random effects
int_{jt}	-0.023	-0.156	-0.041
	(0.008)***	(0.052)***	(0.018)***
$\sigma_{jt}(st\_gdp)$	0.029	0.042	-0.062
	(0.055)	(0.139)	(0.101)
$\sigma_{jt}(ip)$	0.224	0.217	0.216
	(0.066)***	(0.066)***	(0.066)***
$\sigma_{jt}(\pi)$	0.142	0.145	0.138
	(0.074)**	(0.073)***	(0.074)**
Constant	-1.275	0.316	-1.114
	(0.152)***	(0.660)	(0.286)***
R^2	0.26	0.27	0.07
N	408	408	408

Source: Authors' calculations.

[a] Standard errors are in parentheses. ***,** and * indicate statistical significance at 1%, 5% and 10% respectively. Random effects estimation uses Wallace-Hussain method to compute component variances.

More financial integration raises the risk sharing benefit, but this effect can arise both directly and indirectly through higher contagion risks. Differentiating the right hand side of equation 24, the total impact of integration on risk sharing can be decomposed into two parts:

$$F_1 \frac{\mathrm{d}\, Contag}{\mathrm{d}\, int} + \frac{\mathrm{d}\, F}{\mathrm{d}\, int} \tag{26}$$

The first term is the 'movement-along-the-curve' effect of financial integration, where risk sharing is increased at the expense of higher contagion risks. The second term is the 'shift' effect, where integration improves the terms of tradeoff via the aforementioned threshold effect. The first term has a negative sign, given our assumption that contagion risks rise with financial integration ($\mathrm{d}\, Contag/\,\mathrm{d}\, int > 0$) and that there exists an efficient cost-benefit tradeoff ($F_1 < 0$). Therefore our estimate of β_1, which measures the net effect of integration on risk sharing, indicates that the second term dominates in size. Controlling for fixed effects, which pick up the exogenous parts of contagion risks not explained by the degree of integration, the dominance of the shift effect is even more evident (0.156 compared to 0.023 in the OLS case). The results therefore show that there are both movement and shift effects taking place as the degree of integration rises, but there are net increases in risk sharing. Despite this sizable net gain in risk sharing benefit associated with an outward shift in the tradeoff line, the welfare implications remain unclear however, because contagion risks are forced to go up along with risk sharing. It is still possible for welfare to decrease with the degree of integration, if the welfare function is highly sensitive to financial contagion.

The importance of macroeconomic context is confirmed by the estimates. Both cyclical shocks and inflation differentials have the potential to affect the degree of international risk sharing, for any given level of contagion risks. It is worth noting that, since the dependent variable is an absolute measure of risk sharing, the dispersion in economic activity has an impact on risk sharing in absolute terms (i.e. it affects the amount of risks being shared) and not just in relative terms (percentage of risks shared, as in BCS). This result is consistent with the hypothesis that more volatile economic shocks can impair the risk-sharing mechanism. An implication is that risk sharing should not be thought of as an insurance mechanism against catastrophic events. Its benefit is reaped only slowly over time in an environment with relatively moderate volatility.

Another policy implication is that the role of macroeconomic policy management should go beyond the traditional one of unilateral discretion, since there is an element of externalities: when a country follows a certain path of stabilization policy or adopts a certain level of inflation target, the decisions affect the risk-sharing benefits enjoyed not only by itself but also by its neighbors. Continuing policy dialogue and coordination can help internalize these externalities and improve the sharing of risks. For example, an acknowledgement of common shocks to the region and a broad agreement of appropriate policy response to address the shocks can have beneficial indirect effects on international risk sharing.

The effect of $\sigma_{jt}(st\_gdp)$ is found to be insignificant, which may owe in part to the sample size being to small to pin down the effect of a relatively stable structural variable. $\sigma_{jt}(st\_gdp)$ varies relatively little over time in the sample, making the identification of its effect over business cycle frequency difficult. Meanwhile the cross-sectional variation of $\sigma_{jt}(st\_gdp)$ alone can only contribute so much in a very small panel such as ours. There are also many dimensions to financial development than captured by stock market capitalization to GDP. It may therefore be premature to reject the role of financial development in fostering risk sharing, in light of both estimation and measurement issues. Estimates of other parameters are robust to dropping $\sigma_{jt}(st\_gdp)$ from the specification, however.

Overall, the results show that there are indeed contextual factors capable of explaining the heterogeneous tradeoffs between risk sharing and contagion risks. Policies aimed at influencing these factors can help to enhance the quality of regional financial integration and improve the terms of tradeoffs for Asia. The fact that one significant factor, real shocks, fluctuates at the business cycle frequency points towards the role of shorter-term policy in supporting risk sharing, in addition to structural infrastructure-based development policy that is often proposed. The significance of inflation differentials suggests that more uniform policy framework can help improve risk sharing by inducing more similar macroeconomic dynamics and conditions. Meanwhile, the threshold effect of financial integration is found to be important, hence *more* integration can lead to *better* quality of integration. The net effect on welfare is however made ambiguous by endogenous contagion, rendering the policy implications less clear-cut.

IV. Conclusion

Further financial integration of Asian economies, in particular at the regional level, would strengthen Asia's domestic sources of growth and improve economic resilience. In particular, policymakers should focus on ways to harmonize legal, institutional, and macroeconomic policy objectives and reduce discrepancies in the stage of development across different financial markets in the region. Such efforts would enhance risk sharing among regional economies at minimal cost of financial contagion, which is an inevitable by-product of greater financial integration. Deeper financial integration with better access of consumers and investors to financial services is also likely to support further economic rebalancing.

APPENDIX

A. ADRIAN-MOENCH PROCEDURE

This appendix provides a brief overview of Adrian and Moench (2010) to motivate the implementation of their 3-step regression procedure. Note that the log excess return of holding an n-period bond for one period accrued at time $t+1$ can be expanded as

$$\begin{aligned} exret_{t+1}^{n-1} &\equiv p_{t+1}^{n-1} - p_t^n + p_t^1 \\ &= A_{n-1} + B'_{n-1} X_{t+1} - A_n - B'_n X_t + A_1 + B'_1 X_t \\ &= A_{n-1} + B'_{n-1}(\mu + K X_t + \Sigma \varepsilon_{t+1}) - A_n - B'_n X_t + A_1 + B'_1 X_t \\ &= (-A_n + A_{n-1} + B'_{n-1}\mu + A_1) + (B'_{n-1}K - B'_n + B'_1) X_t \\ &\quad + B'_{n-1} \Sigma \varepsilon_{t+1} \end{aligned} \tag{27}$$

where we assume that p_t^n is affine in X_t as in equation 15. Conjecture the solution for $exret_{t+1}^{n-1}$ of the form

$$exret_{t+1}^{n-1} = B'_{n-1} \Sigma \left[\Lambda_0 + \Lambda_1 X_t + \varepsilon_{t+1} \right] \tag{28}$$

Equating the right hand side of equation 28 to that of equation 27 and matching terms, it can easily be verified that the set of implied solutions for A_n and B'_n is identical to that of equations 16 up to the convexity terms.

This equivalence implies that the prices of risk parameters, Λ_0 and Λ_1, can be estimated by performing a 3-step regression on equation 28. First, the state equation 10 is estimated using OLS to get estimates for μ, K, Σ as well as the residual $\hat{\varepsilon}_{t+1}$. The second step involves performing a series of cross-sectional OLS on

$$exret_{t+1}^{n-1} = a_{n-1} + b'_{n-1} X_t + c'_{n-1} \hat{\varepsilon}_{t+1} + error \tag{29}$$

for all n and stacking the estimated coefficients to get $\hat{a} = [\hat{a}_1, ..., \hat{a}_N]$, $\hat{b} = [\hat{b}'_1, ..., \hat{b}'_N]'$, and $\hat{c} = [\hat{c}'_1, ..., \hat{c}'_N]'$. Finally, in view of equations 28 and 29, estimates for Λ_0 and Λ_1 can be obtained by regressing $\hat{a}$ on $\hat{c}$ and $\hat{b}$ on $\hat{c}$ respectively

$$\hat{\Lambda}_0 = (\hat{c}'\hat{c})^{-1} \hat{c}' \hat{a} \tag{30}$$

$$\hat{\Lambda}_1 = (\hat{c}'\hat{c})^{-1} \hat{c}' \hat{b} \tag{31}$$

In actual implementation, the last step is modified slightly to correct for the convexity term:

$$\hat{\Lambda}_0 = (\hat{c}'\hat{c})^{-1}\hat{c}'\left(\hat{a} + \frac{1}{2}b^* vec(\Sigma)\right) \tag{32}$$

where b^* is an $N \times K$ matrix with n-th row filled by $\hat{b}'_n \otimes \hat{b}'_n$, and $vec(\Sigma)$ is the vectorized Σ.

References

Adrian, T. and M. K. Brunnermeier (2010): "CoVaR," *Federal Reserve Bank of New York Staff Reports*.

Adrian, T. and E. Moench (2010): "Pricing the term structure with linear regressions," Staff reports, Federal Reserve Bank of New York.

Ang, A. and M. Piazzesi (2003): "A no-arbitrage vector autoregression of term structure dynamics with macroeconomic and latent variables," *Journal of Monetary Economics*, 50, 745–787.

Backus, D. K., S. Foresi, and C. I. Telmer (2001): "Affine term structure models and the forward premium anomaly," *Journal of Finance*, 56.

Battiston, S., D. D. Gatti, M. Gallegati, B. C. Greenwald, and J. E. Stiglitz (2009): "Liaisons dangereuses: Increasing connectivity, risk sharing and systemic risk," *NBER Working Paper*.

Borensztein, E. and P. Loungani (2011): "Asian financial integration: Trends and interruptions," *IMF Working Paper*.

Brandt, M. W., J. H. Cochrane, and P. Santa-Clara (2006): "International risk sharing is better than you think, or exchange rates are too smooth," *Journal of Monetary Economics*, 53, 671–698.

Cochrane, J. H. (2001): *Asset pricing*, Princeton University Press.

Cowen, D., R. Salgado, H. Shah, L. Teo, and A. Zanello (2006): "Financial integration in Asia: Recent developments and next steps," *IMF Working Paper*.

Dai, Q. and K. J. Singleton (2000): "Specification analysis of affine term structure models," *Journal of Finance*, 55, 1943–1978.

Devereux, M. B. and J. Yetman (2010a): "Financial contagion and vulnerability of Asian financial markets," Mimeo.

——— (2010b): "Leverage constraints and the international transmission of shocks," *Journal of Money, Credit and Banking*, 42, 71–105.

Diebold, F. X. and K. Yilmaz (2009): "Measuring financial asset return and volatility spillovers, with application to global equity," *The Economic Journal*, 119, 158–171.

Duffee, G. R. (2002): "Term premia and interest rate forecasts in affine models," *Journal of Finance*, 57.

Engle, R. F., G. M. Gallo, and M. Velucchi (2009): "A MEM-based analysis of volatility spillovers in East Asian financial markets," *Econometrics Working Papers Archive, Universita' degli Studi di Firenze*.

FAMA, E. F. AND J. D. MACBETH (1973): "Risk, return, and equilibrium: empirical tests," *Journal of Political Economy*, 81, 607–636.

FLOOD, R. P., N. P. MARION, AND A. MATSUMOTO (2009): "International risk sharing during the globalization era," *IMF Working Paper*.

FLOOD, R. P. AND A. K. ROSE (2005): "Financial integration: A new methodology and an illustration," *Journal of the European Economic Association*, 3, 1349–1359.

GEBKA, B. AND D. SERWA (2007): "Intra- and inter-regional spillovers between emerging capital markets around the world," *Research in International Business and Finance*, 21, 203–221.

GRAY, S., J. FELMAN, A. CARVAJAL, AND A. JOBST (2011): "Developing ASEAN5 bond markets: What still needs to be done?" *IMF Working Paper*.

HANHARDT, A. AND C. ANSOTEGUI (2009): "Measuring european stock market integration via a stochastic discount factor approach," .

KOENKER, R. AND G. BASSETT (1978): "Regression Quantiles," *Econometrica*, 46.

KOSE, M. A., E. S. PRASAD, K. ROGOFF, AND S.-J. WEI (2009): "Financial globalization: A reappraisal," *IMF Staff Papers*, 56.

LEWIS, K. K. (1996): "What can explain the apparent lack of international consumption risk sharing?" *Journal of Political Economy*, 104, 267–297.

LUCAS, R. E. (1990): "Why doesn't capital flow from rich to poor countries," *American Economic Review*, 80, 92–96.

MASTEN, A. B., F. CORICELLI, AND I. MASTEN (2008): "Non-linear growth effects of financial development: Does financial integration matter?" *Journal of International Money and Finance*, 27, 295–313.

MUNDELL, R. A. (1973): "Uncommon arguments for common currencies," in *The economics of common currencies - proceedings of the Madrid conference on optimum currency areas*, ed. by H. G. Johnson and A. K. Swoboda, George Allen & Unwin.

NICOLO, G. D. AND L. JUVENAL (2010): "Financial integration, globalization, growth and systemic real risks," *Federal Reserve Bank of St. Louis Working Paper Series*.

PONGSAPARN, R. AND O. UNTEROBERDOERSTER (2011): "Financial integration and rebalancing in Asia," *IMF Working Paper*.

PRASAD, E. S., K. ROGOFF, S.-J. WEI, AND M. A. KOSE (2003): "Effects of financial globalization on developing countries: Some empirical evidence," *IMF Working Paper*.

RUNGCHAROENKITKUL, P. (2011): "Risk sharing and financial contagion in Asia: An asset price perspective," *IMF Working Paper*.

STIGLITZ, J. E. (2004): "Capital-market liberalization, globalization, and the IMF," *Oxford Review of Economic Policy*, 20, 57–71.

——— (2010): "Risk and global economic architecture: Why full financial integration may be undesirable," *American Economic Review: Papers & Proceedings*, 100, 388–392.