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Has Regional Integration Led to Greater Risk-Sharing in Asia?

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HAS REGIONAL INTEGRATION LED TO GREATER RISK-SHARING IN ASIA?

Thiam Hee Ng and Damaris Lee Yarcia

NO. 135

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July 2014

**ADB WORKING PAPER SERIES ON
REGIONAL ECONOMIC INTEGRATION**

ADB Working Paper Series on Regional Economic Integration

Has Regional Integration Led to Greater Risk-Sharing in Asia?

Thiam Hee Ng* and Damaris Lee Yarcia**
No. 135 | July 2014

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Abstract

The 1997–1998 Asian financial crisis revealed the latent risks present in an increasingly integrated global economy and how virulent these risks can be when roused from dormancy. Given the inevitability of integration, the challenge is how to maximize its benefits while minimizing its costs. One benefit of greater integration, particularly financial integration, is that countries can diversify their risks, thus allowing them to smooth out their consumption. This paper analyzes whether the degree of risk-sharing in East Asia has improved along with the observed rise in integration in the region. Higher risk-sharing is expected to result in (i) higher intraregional correlation of consumption across time and relative to output, and (ii) a higher residual in the panel regression of consumption on output. The results show that risk-sharing continues to be low in Asia. The increase in cross-economy correlation in consumption coincided with an even higher cross-economy correlation in output. Furthermore, the correlation between domestic consumption and domestic output growth remains high. And finally, correlation within the region is lower than correlation with the global economy. These findings suggest that higher consumption correlation is the result of stronger economic ties rather than greater risk-sharing.

Keywords: risk-sharing, ASEAN, integration

JEL Classification: F36, F51, F65

1. Introduction

The 1997–1998 Asian financial crisis and the 2008–2009 global financial crisis showcased how much contagion can be a real risk in an increasingly integrating global economy. While greater integration has brought considerable benefits, there is a need to ensure that integration's benefits outweigh its costs. This is the motivation behind the renewed efforts of the Association of Southeast Asian Nations (ASEAN) to increase the degree of intra- and inter-regional integration over the past 2 decades. For example, ASEAN+3 was created in 1997 to improve cooperation between Southeast Asian economies and the People's Republic of China (PRC), Japan, and the Republic of Korea. This relationship was further reinforced with the establishment of the Chiang Mai Initiative Multilateralization (CMIM) in 2010, which was designed to manage one of the main channels of regional contagion—short-term liquidity—in member countries.

Over the past decade or so, Asia's financial sector has grown considerably. For example, local currency (LCY) bond markets have grown from less than US\$600 million in 2000 to US\$7.1 trillion in September 2013. As of 2013Q13, the most rapidly growing markets in the region—Viet Nam, Indonesia, the People's Republic of China, the Philippines, and the Republic of Korea—were expanding at double-digit annual rates (ADB 2013a, ADB 2013b). Since the 1997–1998 Asian financial crisis, governments across Asia have liberalized their financial sectors, while at the same time strengthening the financial regulatory environment. This helped the region's financial system to recover quickly from the Asian financial crisis and avoid the full impact of the 2007–2008 global financial crisis. The increase in the degree of financial integration in Asia is also evident in the rising degree of co-movement in asset prices and the increased share of intraregional financial assets to total assets.

Ongoing financial development and integration in the region offers an opportunity for greater risk-sharing as well. Kose et al. (2006) provide a unified conceptual framework on the benefits and costs of integration, particularly the macroeconomic effects of financial liberalization, in terms of both growth and volatility. The authors find that developing countries can benefit from financial globalization, but their conclusion contains many nuances. Kose, Prasad, and Terrones (2007) argue that one of the main benefits of financial globalization is that it can allow for more efficient international risk-sharing. Thus, Asians should have greater opportunities to invest in other regional economies and diversify their risks. And, in return, they should have greater access to a larger pool of financial assets that will enable other investors to tap and exploit gains from trading in financial assets.

There are several expected benefits from greater integration of the financial sector (Barro and Lee 2011). First, excess savings in one country can be channeled into investment in another country, thereby promoting growth. Another benefit of increased integration is that it can help investors diversify their risks and smooth out their consumption profiles. Greater financial integration enables individuals and firms to hold foreign assets, reducing the volatility of a country's income and allowing countries to share risk. When an economy is hit by an idiosyncratic country-specific shock, returns on financial assets held in other countries will help cushion some of the impact. The ability to share risks is particularly important during

volatile times when economies experiencing sudden downturns need insurance against such events.

This paper aims to examine the extent to which financial development and greater regional integration have contributed to a higher level of risk-sharing in Asia. The analysis includes an examination of the correlations between consumption and output among Asian economies to analyze if there has been a trend toward greater risk-sharing over time. With greater risk-sharing, one would expect to see consumption being less correlated with domestic output and more correlated with regional or global output. A panel regression is also estimated in order to gauge progress in risk-sharing in the region.

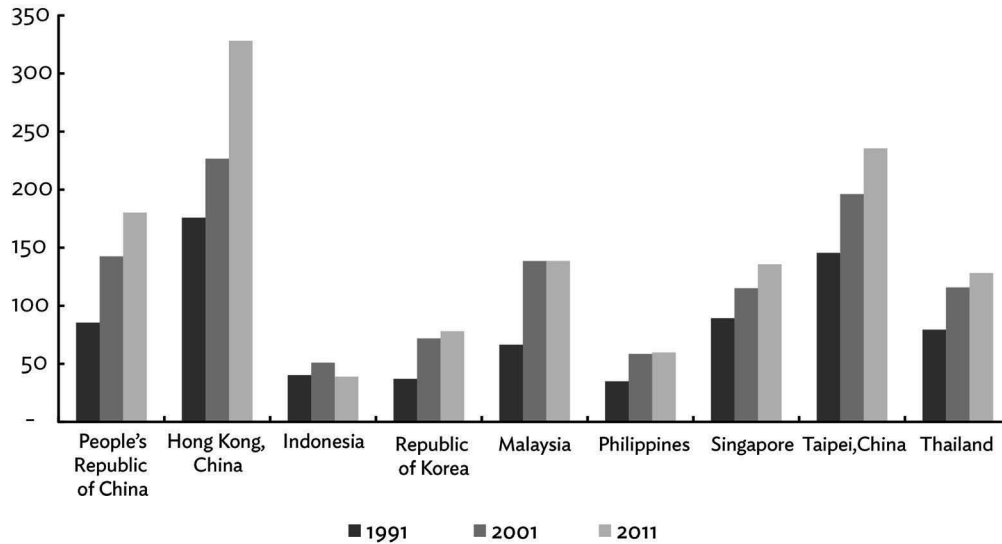
This paper is organized as follows. Section II discusses recent achievements in financial market development and integration in Asia. Section III presents a short survey of the literature on risk-sharing in the region. Section IV discusses the methodology and results of the correlation analysis and panel regression. Concluding remarks and recommendations follow in Section V.

2. Trends in Financial Development and Integration

A common measure of financial sector development is the ratio of total bank deposits, usually measured by M2, to gross domestic product (GDP). Between 1991 and 2011, there has been substantial progress made in deepening the region's banking sector (Figure 1). Among the region's economies, the People's Republic of China; Hong Kong, China; Malaysia; Singapore; and Thailand have the most developed banking sectors, with M2 surpassing GDP in each of these economies by the end of the 1990s. Meanwhile, Indonesia, the Republic of Korea, and the Philippines lag behind other economies in the region in terms of banking sector development.

Given its more liberal, market-driven approach to integration, Asia's progress in terms of financial integration is much less evident than Europe's based on key measures of integration like the co-movement of asset prices and the relative share of cross-border assets to total assets. Capannelli, Lee, and Petri (2009) provide additional discussion on key indicators of integration. ADB (2013) shows that while there have been significant strides in financial integration in Asia in the past decade, the gains pale in comparison to trade integration. Further, the region's financial markets are found to be more closely integrated with global financial markets than with other Asian markets.

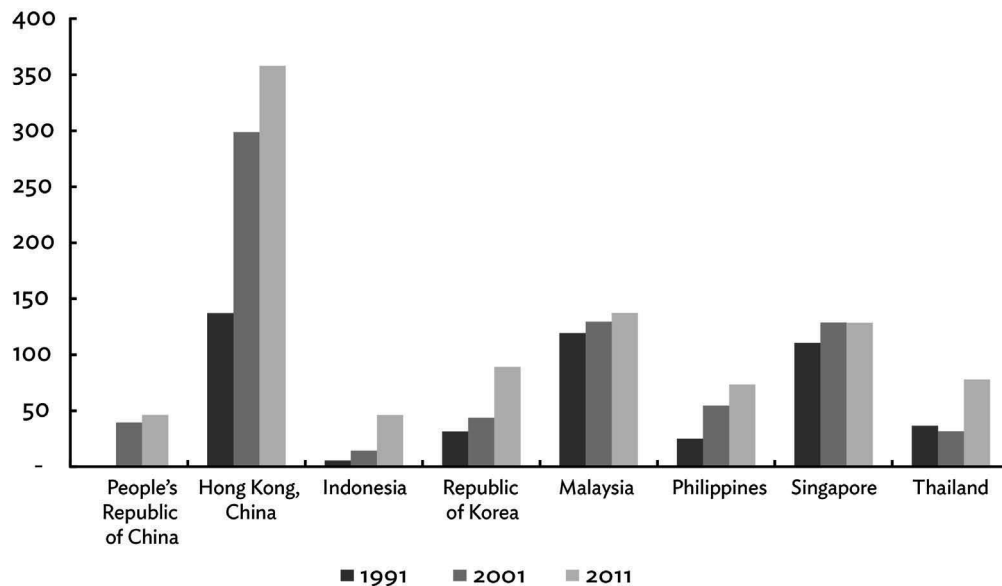
Figure 1: M2 Money Supply (% of GDP)



Note: Money and quasi money comprise the sum of currency outside banks, demand other than those of the government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply is frequently called M2; it corresponds to line 34 and 35 in the International Monetary Fund's (IMF) International Financial Statistics (IFS).

Source: World Bank. World Bank Development Indicator. CEIC for raw data on Taipei, China.

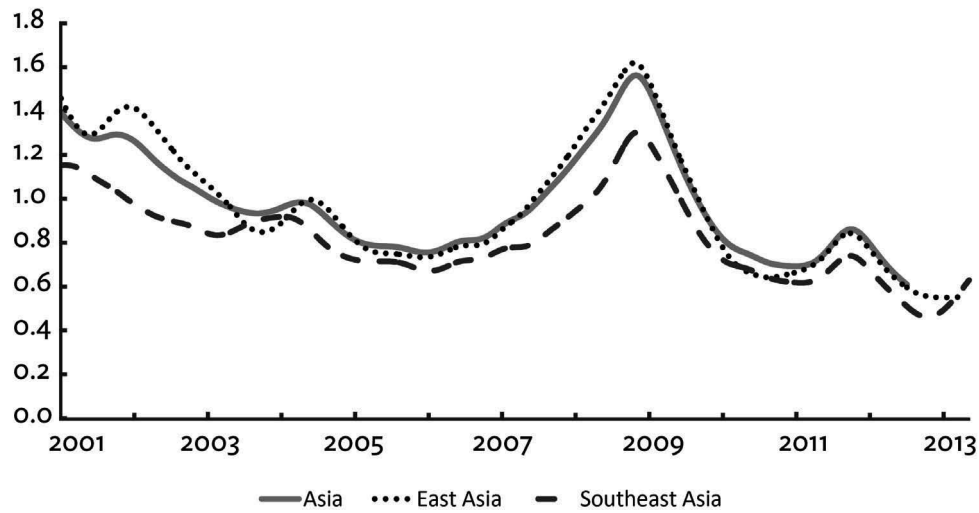
Figure 2: Market Capitalization of Listed Companies (% of GDP)



Note: Market capitalization (also known as market value) is the share price times the number of shares outstanding. Listed domestic companies are the domestically incorporated companies listed on the country's stock exchanges at the end of the year. Listed companies does not include investment companies, mutual funds, or other collective investment vehicles Taipei, China not included due to unavailable data.

Source: World Bank. World Development Indicator.

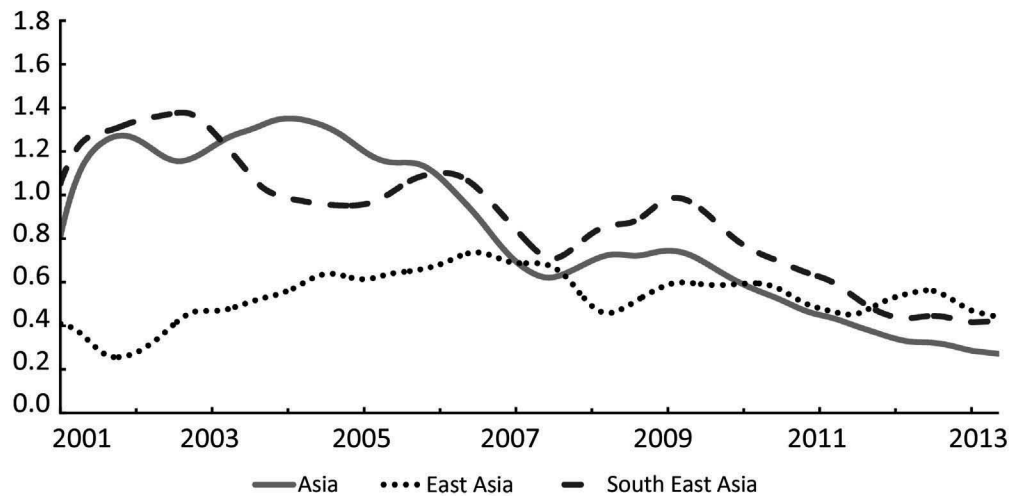
Figure 3: Cross-Market Dispersion of Equity Returns (%)



Note: Cross-market standard deviation of daily stock market returns, de-trended using Hodrick-Prescott (HP) filter. Asia includes East Asia includes the People's Republic of China; Hong Kong, China; Japan; the Republic of Korea; Mongolia; and Taipei,China. Southeast Asia includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Data until 7 May 2013.

Source: Bloomberg.

Figure 4: Coefficient of Variation of 10-Year Bond Yield Spreads



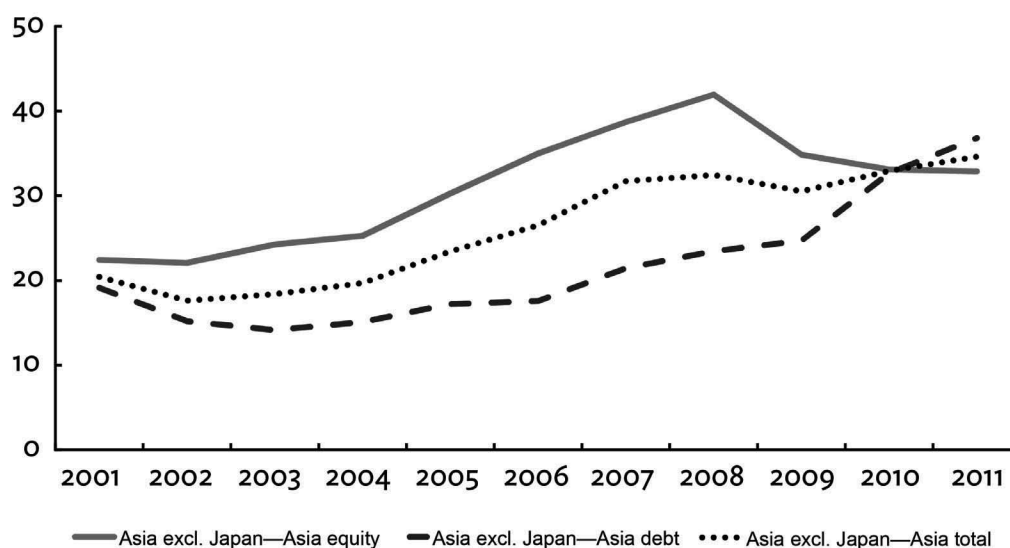
Note: Coefficient of variation of 10-years government bond yield spreads over benchmark United States Treasuries, de-trended using Hodrick-Prescott (HP) Filter. Asia includes East Asia and Southeast Asia. East Asia includes the People's Republic of China, Hong Kong, China; the Republic of Korea; and Taipei,China. Southeast Asia includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Data until 7 May 2013.

Source: Bloomberg.

One indicator of greater financial integration in Asia has been closer co-movements in Asian equities prices since the early 2000s. During the 2008–2009 global financial crisis, there was an increase in these co-movements as the region’s stock markets were affected by global financial shocks. Recently, there has also been a convergence in Asian daily stock market returns. The cross-market dispersion of equity returns across Asia was narrower in 2012 than in 2001. The downward trend in standard deviation in equity returns across markets was briefly interrupted during the height of the global financial crisis and the Eurozone debt crisis, but eventually returned to a downward path (Figure 3). The increase in co-movements could have been in response to global financial shocks.

In terms of bond markets, the evidence of increased integration is even clearer. Co-movements in bond yield spreads have not changed much since 2000 in East Asia, but there have been substantial changes in Southeast Asia and Asia as a whole. This suggests that there may be a common factor driving both markets in the region. After converging until mid-2007, Asia’s bond yield spreads diverged momentarily following the 2008–2009 global financial crisis before resuming their downward trajectory (Figure 4). This is in contrast with equity markets, where returns show a converging trend after the global financial crisis.

Figure 5: Intra-Asian Portfolio Holdings (% of total)



Note: Asia excl. Japan—Asia total refers to the portfolio holdings (equity and debt securities) in Asia (excluding Japan) divided by the global portfolio holdings of Asia. Asia includes East Asia, Central Asia, Southeast Asia, South Asia, and the Pacific. Australia and New Zealand are excluded as source and destination due to differences in the structure of their economies with the rest of Asia. Countries included in Asia as recipient differ from that of Asia as source due to data unavailability. In particular, data for the People’s Republic of China as source is unavailable.

Source: ADB calculations using data from *Coordinated Portfolio Investment Survey*, International Monetary Fund. Accessed 19 December 2012.

Another measure of financial integration in the region involves cross-border holdings of financial assets in Asia. The share of Asian assets held by Asian investors as a share of total external assets has been climbing steadily. This is the case despite a drop in 2008 as the global financial crisis caused investors to flee in search of safe haven assets in the United States (US). However, as financial markets calmed in the aftermath of the crisis, Asian investors continued to accumulate regional financial assets. Intra-Asian bond holdings rose to 9.4% in 2011, up from 5.9% in 2007. However, intra-Asian equity holdings fell from a peak of 27.6% in 2007 to 22.7% in 2011. This represents a substantial decline caused partly by the underperformance of some Asian stock markets. If Japan (with its large holdings of non-regional financial assets) is excluded, intra-Asian bond holdings increased from 21.4% in 2007 to 36.8% in 2011. Thus, excluding Japan, the level of intra-Asian debt holdings actually exceeded that of intraregional equity holdings in 2011.

Other studies also find some evidence of greater integration in Asia. Borensztein and Loungani (2011) have shown convergence in equity premia and interest rates among Asian countries, suggesting that there has been progress in financial integration. They also concur that cross-border holdings among Asian countries are significant in many cases and have increased over the last decade. Comparing the extent of financial integration in Asia with other regional groups, they further find that convergence has tended to be faster in Eastern Europe than in Asia. While in all regions, crises interrupt the process of convergence. Meanwhile, several Asian economies display a departure from regional home bias that is comparable to investor behavior in Latin America, but still less than in Eastern Europe and the industrialized countries.

Another comparison between European and Asian integration is provided by Calvi (2010). Using co-integration and Granger causality techniques on data for seven European and 11 East Asian financial markets, she shows that in Europe financial integration is significantly more advanced than in East Asia. In addition, the author finds that financial integration in Asia is still in its infancy, although an increase in equity market integration over the last 10 years can be observed. Furthermore, the level of bond market integration in Europe is higher than in equity markets. However, in East Asia, equity markets are more integrated than bond markets.

The strength of Asia's integration with the global economy relative to the regional economy has been observed in other studies. Kim, Lee, and Park (2009) explored the nature and evolution of macroeconomic interdependence between emerging Asian and G7 economies and found evidence of "re-coupling," or a bi-directional relationship between East Asia and G7 economies, which may be the reason why global integration is stronger than intra-regional integration.

It is safe to conclude that Asian regional financial integration is increasing. Nevertheless, Asian economies remain more integrated with global financial markets than with the markets of their regional neighbors. While there is still a great deal further to go, it is undeniable that financial integration has progressed over the last decade in Asia. However, financial integration is not an end in itself. It is merely a process toward a desired outcome. One of the most important of which is greater risk-sharing among countries.

3. Risk-sharing in Asia

Several studies have suggested that there have been some improvements in risk-sharing among Asian economies in recent decades. Hoffman (2011) looks at emerging Asian economies and finds that, even after controlling for changes in business cycle patterns (to control for the effect of rising bilateral trade within the region), risk-sharing in Asia started to increase as the region recovered from the 1997–1998 financial crisis. However, while the degree of risk-sharing may have risen, it may not have risen substantially, as pointed out by some studies.

Kose, Prasad, and Terrones (2007) find little empirical evidence that international risk-sharing is at levels predicted by theory. In addition, they find that only industrial countries have attained better risk-sharing outcomes during the recent period of globalization. Developing countries have, by and large, been shut out from this benefit. The most interesting result is that even emerging market economies, which have experienced large increases in cross-border capital flows, have seen little change in their ability to share risk. Kose, Prasad, and Terrones (2007) suggest that this is partly explained by the composition of flows. In particular, portfolio debt, which has dominated the external liability stocks of most emerging markets until recently, is not conducive to risk-sharing.

In another study, Rungcharoenkitkul (2011) compares the risk-sharing benefits with the contagion costs associated with financial integration in Asia. Using a new measure of risk-sharing based on a structural and an asset price approach, he finds the degree of intraregional risk-sharing in Asia lower than in either the European Union (EU) or the US, while also varying across time and countries. In contrast, intraregional contagion risks are more significant, and have been relatively stable over the past decade. An overall tradeoff exists between risk-sharing and contagion, but the terms of the tradeoff vary across countries, depending on relative economic fluctuations and inflation differentials. He concludes that Asia still has room to benefit from risk-sharing without necessarily raising the cost of contagion risks.

Similarly, Kim, Kim, and Wang (2006) also found that most of the fluctuations in output were not smoothed out in Asian economies. This suggests that there has not been much risk-sharing. Financial markets do not seem to have much of a role in smoothing out GDP shocks. The degree of risk-sharing in Asia was also found to be lower than in Organisation for Economic Co-operation and Development (OECD) countries.

4. Empirical Analysis

Economic models predict that in a world without trade and financial integration, consumption will be highly correlated with domestic output (Kim et al. 2006). However, when markets become integrated, it allows for the possibility of risk-sharing. This can help countries sever the link between movements in output and consumption. In a world with perfect risk-sharing, domestic consumption should be affected only by global or regional output shocks whose risks cannot be diversified away. As a result, there should be little or no link between domestic

consumption and domestic output. Instead, high levels of co-movement of consumption across countries are expected, driven by a common regional or global shock. Further, fluctuations in consumption are expected to be more highly correlated with global or regional output than with domestic output.

In the correlation analysis, the outcome of greater risk-sharing, as reflected in the behavior of consumption and output, will be analyzed. Given the general trend toward greater financial integration in the region, greater risk-sharing in the region is also expected. Therefore, if there has been an increase in risk-sharing, the following can be expected:

- (i) cross-country correlations of consumption increase over time;

$$\rho_{t_2}(c_i, c_j) > \rho_{t_1}(c_i, c_j)$$

- (ii) cross-country correlations of consumption are higher than cross-country output correlations;

$$\rho_t(c_i, c_j) > \rho_t(y_i, y_j)$$

- (iii) domestic consumption co-movements with domestic output decrease over time;

$$\rho_{t_2}(c_i, y_i) < \rho_{t_1}(c_i, y_i)$$

- (iv) domestic consumption is more highly correlated with regional or global output than with domestic output;

$$\rho_t(c_i, y_{world}) \geq \rho_t(c_i, y_{reg_i}) > \rho_t(c_i, y_i)$$

where,

$$y_{reg_i} = \left(\sum_{reg} y \right) - y_i, \quad reg = \{East\ Asia, Southeast\ Asia, Asia\}$$

$y = output\ of\ country\ i\ or\ j, \quad i \neq j$

$c = consumption\ (total\ or\ private)\ of\ country\ i\ or\ j, \quad i \neq j$

The impact of major shocks to the region's economies is taken into account and the sample period is thus divided into four sub-periods: 1993Q1–1996Q4 and 2000Q1–2007Q2 are “calm” periods without major shocks, while 1997Q1–1999Q4 and 2007Q3–2011Q4 are “crisis” periods when the region was affected by the Asian financial crisis and global financial crisis, respectively. To test differences in dynamics within both Asia and the global economy as a whole, world output or consumption growth is proxied by that of the G7 countries (Canada, France, Germany, Italy, Japan, the United Kingdom, and the US).

4.1 Data

For the empirical analysis, the paper uses a sample of nine economies from East Asia and Southeast Asia for the period 1993–2011. These include the People's Republic of China; Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore;

Taipei,China; and Thailand. The sample economies were selected based on availability of data on GDP and total consumption.

Data on total population came from the World Bank's *World Development Indicators (WDI)* based on mid-year estimates. Quarterly population data is interpolated by evenly dividing the year-on-year change in mid-year population in the second quarter across the four quarters in between.

The quarterly data on GDP, private final consumption expenditure, and public final consumption expenditure were taken from the International Monetary Fund's (IMF) *International Financial Statistics* and converted to per capita levels using the interpolated quarterly population data. Quarterly consumption data for the People's Republic of China was estimated based on annual data by assuming constant household consumption expenditure-to-GDP and public consumption expenditure-to-GDP ratios within a year, and then applying these ratios to the quarterly GDP figures. This is considered a safe assumption given that seasonally adjusted GDP is used in the analysis and that the rate of consumption is not expected to change substantially in a year.

Whenever available, data series in 2005 US dollars (seasonally adjusted) were used. Otherwise, nominal values were converted to real terms using the 2005-based GDP deflator and seasonally adjusted using Census X12. Data for all Asian countries, except for Taipei,China, which was already seasonally adjusted from official statistics, needed seasonal adjustment. The raw data series are all in LCY units converted to constant 2005 US dollars using the IFS exchange rate from 2005. Exchange rates for the European G7 members were converted to euros for 1998 and prior years using LCY rates of growth during those periods. Data for Taipei,China comes from official statistical sources.

The final dataset is used to calculate quarter-on-quarter (q-o-q) growth rates in consumption and output, which were the basis of the analysis. Hence, unless otherwise stated, when output and consumption are mentioned throughout the paper, it is in terms of q-o-q growth rates.

A look into some summary statistics (Table 1, Table 2) reveals a huge increase in real terms in average consumption and output in the third period (2000–2007). Prior to the Asian financial crisis, the People's Republic of China had the lowest level of per capita consumption (US\$417) and output (US\$710) among surveyed economies. By 2007–11, these figures more than tripled for the People's Republic of China and the lowest per capita consumption belonged to Indonesia (US\$1,022) and the lowest per capita output to the Philippines (US\$1,384). There is also a huge dispersion of consumption and output levels across the region.

Table 1: Average Annual Per Capita Consumption, 1993–2011 (\$)

	1993Q1–1996Q4	1997Q1–1999Q4	2000Q1–2007Q2	2007Q3–2011Q4
People’s Republic of China	417	570	842	1,317
Hong Kong, China	13,985	14,418	16,467	21,440
Indonesia	743	821	862	1,022
Republic of Korea	7,339	8,164	11,114	13,889
Malaysia	2,408	2,368	2,844	3,531
Philippines	846	902	987	1,142
Singapore	10,205	10,889	14,093	15,291
Taipei,China	8,278	9,855	11,154	12,160
Thailand	1,381	1,419	1,682	1,993

Source: Authors’ calculations using data from World Bank’s World Development Indicators (WDI) and the IMF’s *International Financial Statistics*.

Table 2: Average Annual Per Capita Output, 1993–2011 (\$)

	1993Q1–1996Q4	1997Q1–1999Q4	2000Q1–2007Q2	2007Q3–2011Q4
People’s Republic of China	710	952	1,514	2,718
Hong Kong, China	20,418	20,606	24,097	30,191
Indonesia	1,081	1,104	1,188	1,525
Republic of Korea	11,504	12,844	16,490	20,111
Malaysia	4,190	4,591	5,182	6,180
Philippines	989	1,044	1,224	1,384
Singapore	20,588	22,565	26,978	32,309
Taipei,China	10,757	12,540	15,016	18,575
Thailand	2,164	2,158	2,471	2,967

Source: Authors’ calculations using data from World Bank’s World Development Indicators (WDI) and the IMF’s *International Financial Statistics*.

4.2 Results of Correlation Analysis

In this section, the behavior of consumption patterns will be analyzed across the region’s economies to detect if there has been a trend toward greater co-movement of consumption. One of the expected benefits from greater financial integration over the past 2 decades is greater leeway for more efficient risk-sharing across the region. When countries have the opportunity to invest in each other’s financial assets, they can more easily diversify their risks, and consumption is smoothed.

In this section, the results of the pairwise correlation analysis are reported. Median correlation (ρ_{med}) is computed as follows:

$$\rho_{med} = \begin{cases} \rho_{\frac{n+1}{2}} & , \text{ if } n=\text{odd} \\ \rho_{\left(\frac{\frac{n}{2} + \left(\frac{n+1}{2}\right)}{2}\right)} & , \text{ if } n=\text{even} \end{cases}$$

- (i) Bilateral correlation of private consumption growth is rising; but bilateral correlation of output growth is rising faster.

$$\rho_{t_2}(c_i, c_j) > \rho_{t_1}(c_i, c_j) \quad \text{but} \quad \dot{\rho}_t(y_i, y_j) > \dot{\rho}_t(c_i, c_j)$$

In terms of correlation of consumption, results show that cross-country correlation of private consumption¹ growth across the sample of Asian countries increased between 1993Q1–1996Q4 and 2007Q3–2011Q4 (Table 3). At first glance, this would seem to provide support for greater risk-sharing in the region. However, private consumption correlations tend to increase during periods of crisis (e.g., 1997Q1–1999Q4 and 2007Q3–2011Q4) in line with the rise in output growth correlations, suggesting that the latter is the likely source of rising consumption correlation, not risk-sharing. This is consistent with non-crisis periods, 1993Q1–1996Q4 was low and 2000Q1–2007Q2 saw a significant decline from the previous period of 1997Q1–1999Q4. However, there were two exceptions—the People’s Republic of China and Taipei,China—which showed an increase in private consumption correlation with other economies in 2000Q1–2007Q2.

Table 3: Median Pairwise Correlation of Private Consumption Growth, 1993–2011

	Full sample	1993Q1– 1996Q4	1997Q1– 1999Q4	2000Q1– 2007Q2	2007Q3 –2011Q4
People’s Republic of China	0.05	0.03	–0.06	0.16	0.20
Hong Kong, China	0.24	0.09	0.36	0.12	0.25
Indonesia	0.04	0.03	0.14	–0.09	–0.01
Republic of Korea	0.25	0.06	0.52	0.12	0.19
Malaysia	0.21	0.13	0.49	0.10	–0.20
Philippines	–0.01	–0.13	0.16	0.03	–0.09
Singapore	0.27	0.01	0.41	0.17	0.23
Taipei,China	0.07	–0.08	–0.16	0.22	0.21
Thailand	0.16	0.02	0.40	–0.09	0.18
MEDIAN	0.16	0.03	0.36	0.12	0.19

Note: Figures are calculated as the median of pairwise correlations across a balanced panel of nine economies.
Source: Authors’ calculations using data from the IMF’s *International Financial Statistics*, and national sources for Taipei,China.

¹ Results for private and total consumption are presented to separate out the effect of public consumption.

One of the factors causing higher consumption correlations could be that output correlations have been increasing in the region with the increase in trade integration (Table 4).² The results show that there has been an increase in correlation in output since the start of the sample period. In particular, correlations of output tend to be much higher during the crisis periods (1997Q1–1999Q4 and 2007Q3–2011Q4). But even comparing the two non-crisis periods (1993Q1–1996Q4 and 2000Q1–2007Q2), there was a significant increase in the correlation of output. Thus, some of the observed increases in consumption correlations could be due to higher output correlations. Interestingly, the increase in correlation in output tended to be higher than the correlation in consumption. This suggests there has been limited progress in risk-sharing. And this pattern was even more pronounced during the 1997–1998 Asian financial crisis. Some of the rise in output correlations in the most recent sub-period (2007Q3–2011Q4) is due to the effects of the 2008–2009 global financial crisis, which were transmitted worldwide (Table 5).

- (ii) The correlation of domestic consumption growth with domestic output growth remains high. $\rho_{t_2}(c_i, y_i) > \rho_{t_1}(c_i, y_i)$

Correlations between output growth and consumption growth in each East and Southeast Asian economy are examined to show the correlations of total consumption and private consumption with domestic GDP for the full sample period (Table 6). Then, the cross-sectional medians for the correlations for each group of economies were determined. The result shows that the median correlation between both total consumption and private consumption with domestic output in Asia became statistically significant after the 1997–1998 Asian financial crisis. For G7 countries, it was more prominent during the more recent global financial crisis. There is a clear trend of increasing correlations over time for Asian economies, with a spike in 1997Q1–1999Q4. Correlations tend to fall during non-crisis periods and increase during crisis periods. This effect is stronger for the 1997–1998 Asian financial crisis than the 2008–2009 global financial crisis. For G7 economies, there was a decline in correlations after 1993Q1–1996Q4, which returned to previous levels only in 2007Q3–2011Q4. These results show the continued link between output and consumption in Asia.

² The decline in investment rates across many of the region's economies following the 1997–1998 Asian financial crisis may also have contributed to the increase in consumption correlations.

Table 4: Median Pairwise Correlation of Output Growth, 1993–2011

	Full sample	1993Q1– 1996Q4	1997Q1– 1999Q4	2000Q1– 2007Q2	2007Q3– 2011Q4
People's Republic of China	0.10	0.00	−0.09	0.22	0.09
Hong Kong, China	0.43	0.08	0.65	0.33	0.52
Indonesia	0.30	−0.08	0.67	0.22	0.29
Republic of Korea	0.43	0.17	0.69	0.17	0.52
Malaysia	0.51	0.03	0.79	0.24	0.60
Philippines	0.18	−0.10	0.67	0.07	0.11
Singapore	0.38	−0.02	0.72	0.34	0.38
Taipei,China	0.34	0.22	0.30	0.21	0.58
Thailand	0.38	−0.02	0.63	0.28	0.37
MEDIAN	0.38	0.00	0.67	0.22	0.38

Note: Figures are calculated as the median of pairwise correlations across a balanced panel of nine economies.

Source: Authors' calculations using data from the IMF's *International Financial Statistics*, and national sources for Taipei,China.

Table 5: Differences between the Pairwise Correlations of Consumption and Output, 1993–2011

	Full sample	1993Q1– 1996Q4	1997Q1– 1999Q4	2000Q1– 2007Q2	2007Q3– 2011Q4
People's Republic of China	−0.05	0.03	0.03	−0.06	0.11
Hong Kong, China	−0.20	0.01	−0.29	−0.20	−0.27
Indonesia	−0.26	0.12	−0.54	−0.31	−0.30
Republic of Korea	−0.18	−0.11	−0.17	−0.05	−0.33
Malaysia	−0.30	0.10	−0.31	−0.14	−0.80
Philippines	−0.18	−0.03	−0.51	−0.04	−0.19
Singapore	−0.11	0.03	−0.31	−0.16	−0.15
Taipei,China	−0.28	−0.30	−0.46	0.01	−0.38
Thailand	−0.21	0.04	−0.23	−0.37	−0.18
MEDIAN	−0.20	0.03	−0.31	−0.14	−0.27

Note: Figures are calculated as the median of the pairwise correlation of consumption growth minus the median of the pairwise correlation of output growth across a balanced panel of nine countries.

Source: Authors' calculations using data from the IMF's *International Financial Statistics*, and national sources for Taipei,China.

Table 6: Correlations of Consumption with Domestic Output, 1993–2011

	Full Sample	Asia	East Asia	Southeast Asia	G7
Total Consumption					
Full Sample	0.70 (0.00)	0.55 (0.00)	0.74 (0.00)	0.44 (0.00)	0.72 (0.00)
1993Q1–1996Q4	0.48 (0.07)	0.19 (0.49)	0.50 (0.12)	0.18 (0.52)	0.70 (0.00)
1997Q1–1999Q4	0.71 (0.01)	0.76 (0.00)	0.84 (0.00)	0.62 (0.03)	0.71 (0.01)
2000Q1–2007Q2	0.44 (0.01)	0.46 (0.01)	0.63 (0.00)	0.17 (0.36)	0.43 (0.02)
2007Q3–2011Q4	0.60 (0.01)	0.53 (0.02)	0.62 (0.01)	0.47 (0.05)	0.81 (0.00)
Private Consumption					
Full Sample	0.66 (0.00)	0.58 (0.00)	0.76 (0.00)	0.52 (0.00)	0.74 (0.00)
1993Q1–1996Q4	0.54 (0.04)	0.29 (0.30)	0.45 (0.16)	0.27 (0.34)	0.72 (0.00)
1997Q1–1999Q4	0.65 (0.02)	0.76 (0.00)	0.83 (0.00)	0.76 (0.00)	0.55 (0.07)
2000Q1–2007Q2	0.44 (0.02)	0.53 (0.00)	0.66 (0.00)	0.35 (0.06)	0.43 (0.02)
2007Q3–2011Q4	0.67 (0.00)	0.59 (0.01)	0.70 (0.00)	0.46 (0.05)	0.79 (0.00)

Notes: Calculated as median correlation for each regional group. East Asia includes the People's Republic of China; Hong Kong, China; the Republic of Korea; and Taipei, China. Southeast Asia includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Asia includes East Asia and Southeast Asia. G7 comprises Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. Significance levels are in parenthesis.

Source: Authors' calculations using data from the IMF's *International Financial Statistics*, and national sources for Taipei, China.

- (iii) Only the correlation between domestic output and Asian output is statistically significant.

$$\rho_t(c_i, y_{World_t}) = \rho_t(c_i, y_{Asia_t}) = 0$$

The correlations between output and consumption growth rates were then examined in each economy with respect to the growth rates of an aggregate of Asian economies (Table 7).³ For the full sample, only domestic output had a statistically significant correlation with Asian

³ For each economy, computed as the aggregate of the other Asian economies in the sample.

output. Domestic consumption over the entire period did not have a significant correlation with regional output growth. This suggests that the correlation with regional output is not driven by risk-sharing, but by the co-movement of domestic output with regional output.

Looking at each period, it was only during the 1997–1998 Asian financial crisis that there was a statistically significant correlation between domestic consumption and regional output, particularly for Southeast Asia (0.57). But even then, the correlation between domestic output and regional output is stronger (0.72). During the global financial crisis, only the G7’s consumption moved in-sync with Asia’s output. All of these findings suggest that risk-sharing is quite limited within Asia.

- (iv) There is some evidence that after the 1997–1998 Asian financial crisis, the correlation of domestic consumption growth with global output growth exceeded correlation with regional output growth, but correlation with domestic output growth remains stronger than both.

Pre-Asian financial crisis and Asian financial crisis:

$$\rho_t(c_i, y_i) > \rho_t(c_i, y_{Asia_i}) > \rho_t(c_i, y_{World_i})$$

Post-Asian financial crisis and global financial crisis:

$$\rho_t(c_i, y_i) > \rho_t(c_i, y_{World_i}) > \rho_t(c_i, y_{Asia_i})$$

Correlations of consumption growth rates with global output were also examined (Table 8).⁴ The correlation of domestic consumption growth (particularly private consumption) with world output is statistically significant for East Asia (0.37) in 2000Q1–2007Q2 and 2007Q3–2011Q4, and is higher than the correlation of domestic output growth with world output growth in 2000Q1–2007Q2. These findings imply that, for a period after the 1997–1998 Asian financial crisis, East Asian economies have experienced more risk-sharing with the rest of the world than with the rest of Asia.

Another implication of risk-sharing is that there would be less correlation between domestic consumption and domestic output than between domestic consumption and regional or global output. Comparing the results for the full sample for Asia in Tables 6, 7, and 8, the correlation of domestic consumption with domestic output (0.55) is much higher than the correlation of domestic output with Asian output (0.13) or global output (0.25). Based on the analysis of correlations, there has been some improvement in risk-sharing in the region over time, although it remains low.

⁴ Global output is proxied with the output of G7 economies, which accounted for 48% of global output in 2011.

Table 7: Correlation of Domestic Consumption Growth and Domestic Output Growth with Asian Output Growth, 1993–2011

	Full Sample	Asia	East Asia	Southeast Asia	G7
Domestic Output					
Full Sample	0.21 (0.07)	0.32 (0.00)	0.26 (0.07)	0.32 (0.00)	0.21 (0.07)
1993Q1–1996Q4	0.06 (0.84)	0.05 (0.86)	0.06 (0.84)	(0.02) (0.93)	0.16 (0.56)
1997Q1–1999Q4	0.61 (0.03)	0.72 (0.01)	0.43 (0.30)	0.75 (0.00)	0.41 (0.18)
2000Q1–2007Q2	0.26 (0.18)	0.21 (0.26)	0.22 (0.24)	0.18 (0.33)	0.34 (0.07)
2007Q3–2011Q4	0.26 (0.30)	0.25 (0.32)	0.27 (0.28)	0.15 (0.56)	0.28 (0.27)
Total Consumption					
Full Sample	0.14 (0.25)	0.13 (0.27)	0.17 (0.16)	0.13 (0.29)	0.18 (0.13)
1993Q1–1996Q4	0.09 (0.76)	0.07 (0.81)	(0.02) (0.76)	0.09 (0.75)	0.19 (0.51)
1997Q1–1999Q4	0.46 (0.14)	0.57 (0.06)	0.30 (0.50)	0.57 (0.06)	0.24 (0.46)
2000Q1–2007Q2	0.06 (0.75)	0.16 (0.40)	0.22 (0.25)	(0.01) (0.95)	0.02 (0.91)
2007Q3–2011Q4	0.26 (0.31)	0.18 (0.47)	0.22 (0.39)	(0.07) (0.78)	0.46 (0.05)
Private Consumption					
Full Sample	0.15 (0.20)	0.14 (0.22)	0.20 (0.11)	0.11 (0.36)	0.18 (0.12)
1993Q1–1996Q4	0.13 (0.65)	(0.08) (0.76)	0.01 (0.63)	(0.08) (0.76)	0.18 (0.52)
1997Q1–1999Q4	0.42 (0.17)	0.56 (0.06)	0.25 (0.45)	0.59 (0.04)	0.05 (0.87)
2000Q1–2007Q2	0.10 (0.62)	0.20 (0.30)	0.28 (0.14)	0.06 (0.77)	0.03 (0.87)
2007Q3–2011Q4	0.25 (0.32)	0.16 (0.52)	0.27 (0.28)	(0.13) (0.60)	0.47 (0.05)

Notes: Calculated as median correlation for each regional group. East Asia includes the People's Republic of China; Hong Kong, China; the Republic of Korea; and Taipei, China. Southeast Asia includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Asia includes East Asia and Southeast Asia. G7 comprises Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. Significance levels are in parenthesis.

Source: Authors' calculations using data from the IMF's *International Financial Statistics*, national sources for Taipei, China.

Table 8: Correlation of Domestic Consumption Growth and Domestic Output Growth with World Output Growth, 1993–2011

	Full Sample	Asia	East Asia	Southeast Asia	G7
Domestic Output					
Full Sample	0.43 (0.00)	0.40 (0.00)	0.43 (0.00)	0.30 (0.01)	0.60 (0.00)
1993Q1–1996Q4	0.02 (0.87)	(0.04) (0.89)	0.05 (0.75)	(0.11) (0.69)	0.08 (0.79)
1997Q1–1999Q4	0.41 (0.19)	0.42 (0.17)	0.27 (0.42)	0.49 (0.11)	0.39 (0.21)
2000Q1–2007Q2	0.34 (0.06)	0.34 (0.07)	0.35 (0.06)	0.32 (0.09)	0.35 (0.06)
2007Q3–2011Q4	0.77 (0.00)	0.58 (0.01)	0.71 (0.00)	0.54 (0.02)	0.83 (0.00)
Total Consumption					
Full Sample	0.26 (0.03)	0.25 (0.03)	0.29 (0.01)	0.05 (0.64)	0.32 (0.00)
1993Q1–1996Q4	0.04 (0.79)	0.14 (0.63)	0.31 (0.26)	(0.28) (0.32)	(0.03) (0.91)
1997Q1–1999Q4	0.31 (0.33)	0.31 (0.32)	0.20 (0.53)	0.31 (0.32)	0.31 (0.33)
2000Q1–2007Q2	0.18 (0.33)	0.13 (0.50)	0.37 (0.05)	0.04 (0.85)	0.20 (0.29)
2007Q3–2011Q4	0.51 (0.03)	0.28 (0.26)	0.43 (0.12)	(0.02) (0.92)	0.69 (0.00)
Private Consumption					
Full Sample	0.30 (0.01)	0.21 (0.07)	0.31 (0.01)	0.03 (0.81)	0.34 (0.00)
1993Q1–1996Q4	0.02 (0.95)	(0.04) (0.89)	0.08 (0.68)	(0.22) (0.43)	0.02 (0.95)
1997Q1–1999Q4	0.31 (0.33)	0.33 (0.29)	0.21 (0.53)	0.42 (0.18)	0.27 (0.40)
2000Q1–2007Q2	0.21 (0.28)	0.17 (0.37)	0.38 (0.05)	(0.07) (0.71)	0.25 (0.18)
2007Q3–2011Q4	0.59 (0.01)	0.29 (0.24)	0.49 (0.08)	0.03 (0.89)	0.71 (0.00)

Notes: Calculated as median correlation for each regional group. East Asia includes the People's Republic of China; Hong Kong, China; the Republic of Korea; and Taipei, China. Southeast Asia includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Asia includes East Asia and Southeast Asia. The G7 growth rate is used as proxy for world output growth. G7 comprises Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. Significance levels are in parenthesis.

Source: Author's calculations using data from the IMF's *International Financial Statistics*, and national sources for Taipei, China.

4.3 Results of Regression Analysis

A test was conducted to determine the presence of risk-sharing by regressing growth rates of consumption on growth rates of output. To isolate the economy-specific movements in output and consumption, the common growth component corresponding to external factors from each variable is taken out. Global growth is subtracted from individual economic output and consumption growth to obtain the economy-specific growth.

The following equation is estimated for the panel data:

$$\Delta \log c_{it} - \Delta \log C_t = \alpha + \beta (\Delta \log y_{it} - \Delta \log Y_t) + \varepsilon \quad (1)$$

An autoregressive model is estimated for each country time-series:

$$\begin{aligned} \Delta \log c_t - \Delta \log C_t = & \alpha + \beta (\Delta \log y_t - \Delta \log Y_t) \\ & + \gamma (\Delta \log c_{t-1} - \Delta \log C_{t-1}) + \delta (\Delta \log c_{t-2} - \Delta \log C_{t-2}) + \varepsilon_t, \end{aligned} \quad (2)$$

where,

c_{it} (y_{it}) denotes growth rate in per capita consumption (GDP) of country i in year t , and C_t (Y_t) is world per capita consumption growth rate (GDP).

Pooled regression and instrumental variable regression were also estimated as alternative specifications. Estimates from OLS regression are close to estimates from panel regression. Instrumental variable regression, on the other hand, generally produces lower estimates and is very erratic. A Hausman test was one of the diagnostic tests used to select the results presented below. Other tests performed included White's test to detect heteroskedasticity, Ramsey specification test for omitted variables, variance inflation factor for multicollinearity, Durbin/Wu-Hausman tests for endogeneity, and Sargan/Basmann tests for validity of instruments.

As countries move toward greater risk-sharing, there will be a lower coefficient of output growth (β), or conversely a higher value of $1-\beta$. The results from estimating the panel model (equation 1) show output to be a statistically significant determinant of consumption. There is a very high coefficient of output, although it declines after the Asian financial crisis (Table 9). This suggests that the power of output in explaining the consumption growth rate—although still high—declined from 2000 to 2011. Examining the relationship on an annual basis—using a 9-year rolling window—shows a steady drop in the coefficient of output growth since the start of the global financial crisis (Table 10).

To see if there are regional differences in this pattern, results for Southeast Asia and East Asia are compared, with largely similar results. However, Southeast Asia shows a bigger decline in the coefficient of output growth during the global financial crisis than does East Asia, suggesting that risk-sharing rose faster in Southeast Asia than in East Asia during the global financial crisis (Table 11).

Aside from this regional difference, there are also country variations in the level of risk-sharing in Asia. The estimated risk-sharing index ($1-\beta$) for each economy was calculated from the time-series model (equation 2) (Table 12). Results across economies show a wide disparity in risk-sharing in the region. Singapore has the highest level of risk-sharing while Malaysia has the lowest. The numbers, however, should be taken with caution as the estimates may change significantly with the addition of other variables, particularly for specifications that have omitted variable problems and consequently have low coefficients of determination.

Table 9: Dependent Variable—Domestic Consumption Growth, 1993–2011
(by period; net of G7 consumption growth)

	Full Sample	1993Q1- 1996Q4	1997Q1- 1999Q4	2000Q1- 2007Q2	2007Q3- 2011Q4
	OLS	OLS	RE	OLS	OLS
Output Growth	0.634*** [0.076]	0.567*** [0.139]	0.994*** [0.109]	0.481*** [0.082]	0.436*** [0.061]
Constant	0.001 [0.001]	0.005* [0.003]	0.001 [0.003]	0.002 [0.001]	0.003* [0.001]
Observations	682	142	108	270	162
Adjusted R ²	0.2308	0.0998		0.1098	0.2355
rho			0.0617		
Risk-Sharing	0.37	0.43	0.01	0.52	0.56

G7 = Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States; OLS = pooled least squares regression; RE = random effects regression.

Notes: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level. Standard error in brackets. Robust standard errors are used as appropriate.

Source: Authors' calculations.

Table 10: Dependent Variable—Domestic Consumption Growth, 1993–2011
(by year; net of G7 consumption growth)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	FE	FE	FE	FE
Output Growth	0.804*** [0.128]	0.803*** [0.141]	0.782*** [0.131]	0.774*** [0.136]	0.782*** [0.135]	0.765*** [0.143]	0.587*** [0.098]	0.513*** [0.074]	0.517*** [0.06]	0.501*** [0.056]	0.502*** [0.049]
Constant	0.002 [0.002]	0.000 [0.002]	0.001 [0.001]	0.000 [0.001]	-0.001 [0.001]	0.000 [0.002]	0.001 [0.001]	0.002 [0.001]	0.002 [0.001]	0.001 [0.001]	0.002** [0.001]
Observations	322	324	324	324	324	324	324	324	324	324	324
Adjusted R ²	0.2637	0.2519	0.2940	0.2866	0.3092	0.2939	0.1445				
rho								0.1328	0.1774	0.1810	0.1909
Risk-Sharing	0.20	0.20	0.22	0.23	0.22	0.24	0.41	0.49	0.48	0.50	0.50

G7 = Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States; OLS = pooled least squares regression; FE = fixed effects regression.

Notes: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level. Standard error in brackets. Robust standard errors are used as appropriate.

Source: Authors' calculations.

Table 11: Dependent Variable—Domestic Consumption Growth, 1993–2011
(by region and period; net of G7 consumption growth)

	Southeast Asia						East Asia					
	Southeast Asia		Southeast Asia		Southeast Asia		East Asia		East Asia		East Asia	
	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS	FE	OLS
Output growth	0.452*** [0.095]	0.688*** [0.078]	0.827*** [0.251]	0.516* [0.279]	0.35** [0.159]	0.296*** [0.092]	0.601*** [0.066]	1.047*** [0.222]	0.566*** [0.073]	0.62*** [0.07]		
Constant	0.002 [0.001]	0.001 [0.001]	0.000 [0.005]	0.005 [0.005]	0.002 [0.002]	0.002 [0.002]	0.005*** [0.001]	-0.001 [0.003]	0.001 [0.001]	0.002 [0.002]		
Observations	378	304	60	78	150	90	64	48	120	72		
Adjusted R ²		0.5038		0.0305	0.0253	0.0948	0.5652	0.6312	0.3587	0.5247		
rho	0.1917		0.2390									
Risking-Sharing	0.55	0.31	0.17	0.48	0.65	0.70	0.40	-0.05	0.43	0.38		

G7 = Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States; OLS = pooled least squares regression; FE = fixed effects regression. Notes: ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level. Standard error in brackets. Robust standard errors are used as appropriate.

Source: Authors' calculations.

Table 12: Dependent Variable—Domestic Consumption Growth, 1993–2011
(by economies; net of G7 consumption growth)

	Singapore	Taipei,China	Thailand	Hong Kong,China	Philippines	China Rep. of	Indonesia	Rep. of Korea	Malaysia
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	IV	OLS
Output Growth	0.280** [0.136]	0.302** [0.136]	0.429*** [0.088]	0.647*** [0.117]	0.676*** [0.117]	0.709*** [0.046]	0.752* [0.435]	0.834** [0.37]	1.094*** [0.213]
Consumption									
lag1	-0.264** [0.115]	-0.378** [0.165]	0.058 [0.108]	0.127 [0.094]			-0.169 [0.179]		-0.157 [0.103]
lag2	-0.147 [0.110]			0.128 [0.092]			-0.156 [0.182]		
constant	0.003	0.002	0.002	0.001	0.000	0.002	0.001	0.001	0.001
	0.003	0.002	0.002	0.001	0.001	0.001	0.005	0.003	0.003
Observations	74	75	74	74	76	76	73	75	75
Adjusted R ²	0.09	0.16	0.26	0.45	0.48	0.76	0.10	0.55	0.25
Risk-Sharing	0.720	0.698	0.571	0.353	0.324	0.291	0.248	0.166	-0.094

G7 = Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States; OLS = pooled least squares regression; IV = instrumental variable regression.
Notes: Instruments: one period lag of consumption and one period lag of output growth. Lag of consumption growth pass the relevance test and variables pass the exogeneity test.
All specifications include a constant term. ***Denotes statistical significance at the 0.01 level, **denotes statistical significance at the 0.05 level, *denotes statistical significance at the 0.10 level. Standard error in brackets. Robust standard errors are used as appropriate.

Source: Authors' calculations.

5. Conclusion

The empirical results show that while there has been some increase in risk-sharing in Asia over time, the degree of risk-sharing in the region remains quite low. While cross-country correlations of consumption tend to be quite high, they reflect the close co-movement of output in Asia. Further, domestic consumption is still highly correlated with domestic output, much more so than with regional or global output. The correlation of domestic consumption and domestic output in the region seems to reflect how trade still drives the impact of regional integration and how financial integration has so far failed to translate into shared risks across the region. These findings suggest that there is little evidence of consumption risk-sharing in the region. Likewise, correlations between domestic consumption and Asian output seem not to be driven by risk-sharing, but rather by the co-movement of domestic output with regional output. Furthermore, domestic consumption growth became more correlated with global output growth following the 1997–1998 Asian financial crisis. In conclusion, while there has been some improvement in the past 2 decades, risk-sharing across Asian economies is mixed at best.

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Has Regional Integration Led to Greater Risk-Sharing in Asia?

One benefit of greater financial integration is that countries can diversify their risks, allowing them to smooth out their consumption. This paper analyzes whether risk-sharing has improved along with the rise in financial integration. Our results show that risk-sharing continues to be low in Asia. The region is more correlated with the global economy than within the region. While intraregional consumption correlation has increased, it is due to stronger economic ties rather than greater risk-sharing.

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