Regional vs. Global Risk Sharing in East Asia

Soyoung Kim, Sunghyun H. Kim, and Yunjong Wang
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Regional vs. Global Risk Sharing in East Asia

Soyoung Kim, Sunghyun H. Kim, and Yunjong Wang
Executive Summary

This paper estimates the degree of risk sharing in 10 East Asian countries within the region and with OECD countries by using cross-country consumption correlation and formal regression analysis. Estimation results reveal that the degree of risk sharing is far from complete and even quite low for most countries in the region. Among individual countries, Taiwan and Singapore have the highest risk sharing, while Indonesia and Malaysia the lowest (and significantly negative) risk sharing. We find no consistent differences in the degree of risk sharing within East Asia and with OECD countries and the degree of risk sharing does not increase over time in most countries. We also measure potential welfare gains from complete risk sharing. The results show that for less developed countries in the region, potential risk sharing gains with OECD countries are larger than those within East Asia.

JEL Classification: F02, F36, F41
Key words: Consumption correlation, East Asia, financial integration, risk sharing, welfare gains.

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Regional vs. Global Risk Sharing in East Asia*

Soyoung Kim**，Sunghyun H. Kim***，and Yunjong Wang****

I. Introduction

As international financial markets develop, countries do not have to fully absorb domestic shocks. Instead, countries can share domestic shocks with foreign countries through cross-border transactions of state contingent assets. By trading financial assets internationally, a country can diversify its income sources and reduce country-specific risks—a typical example of “risk sharing” through financial markets.1)

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1) Risk sharing is based on the completeness of financial markets that provide state-contingent assets for insuring risks from uncertain future income before shocks arise. Another related mechanism is intertemporal
For example, suppose a country holds contingent claims on foreign assets (such as market portfolio) and at the same time, foreign countries hold claims on domestic assets. When a negative country-specific shock hits the economy, this country can reduce the damage since some part of its income depends on the rest of the world (by owning foreign assets) and negative income shocks are transferred to foreign countries that own domestic assets. Through this type of risk sharing activity, facilitated by liberalized financial markets and free capital flows, countries can stabilize their disposable income and consumption, and improve welfare.

The recent discussion on the costs and benefits of possible monetary unions in many regions around the world, including European Union (EU), revived the attention on risk sharing literature. A monetary union does not allow independent monetary policy in member countries, which is an important income stabilization policy

consumption smoothing via international lending and borrowing. This is based on the intertemporal optimization behavior of economic agents through trading of non-contingent assets such as bonds with foreign countries after observing shocks to the economy. In this paper, we focus on risk sharing.

2) Financial market liberalization can have negative effects by increasing the volatility of business cycles if domestic financial markets are not mature enough. In addition, there is some evidence of a threshold effect in the relationship between financial liberalization and economic growth. The beneficial effects of financial liberalization are more likely to be obtained when the developing countries have a certain level of absorptive capacity (Prasad et al. 2003). See Kim, Kim and Wang (2002) for details on this issue.
instrument. When asymmetric output shocks occur across the member countries of a monetary union, monetary policy cannot be tailored to an individual country’s particular disturbances. Hence, it is less costly for the economies to form a common currency area if their business cycles are synchronized. However, countries can share country-specific output shocks through various risk sharing arrangements. Therefore, a high degree of risk sharing within a region can be a good substitute for synchronized business cycles as a condition for a successful monetary union. In sum, the possibility of international risk sharing implies that similarity of shocks is not a strict condition for forming a monetary union if all members are financially integrated and hold claims on each others’ outputs (Karlinger 2002).

This paper aims to analyze various risk sharing properties in East Asian countries to diagnose the current state of risk sharing. First, we document the current degree of risk sharing in East Asian countries. Second, we provide the estimates for the potential welfare gains from risk sharing in each country. We examine how risk sharing opportunities have been missed in these countries and assess the state that can be achieved through future developments of risk sharing arrangements within the region or with OECD countries.

In particular, we are interested in two aspects of risk sharing properties. First, how much risk sharing does each country achieve with other East Asian countries (regional risk sharing within East Asia)? Second, how much risk sharing does each country achieve with OECD countries (global risk sharing)? Due to geographic and structural proximities, some East Asian countries might have engaged in risk sharing activities more with other Asian countries than with developed countries. On the other hand, the lack of financial
integration and the insufficient menu of local financial assets might have deterred risk-sharing activities within the region. The former (regional risk sharing within East Asia) is related to the costs of monetary union in East Asia. While the latter (global risk sharing) implies the general risk sharing ability of the East Asian countries.

To infer the degree of risk sharing, we first use informal statistics such as cross-country consumption correlation of each country with other East Asian countries and with OECD countries. We compare consumption correlation with output correlation to distinguish the effects of common output cycles in generating consumption correlation from risk sharing activities. Next, we introduce a more formal regression method to measure the degree of risk sharing by regressing domestic consumption growth rate on aggregate consumption growth rate and domestic output growth rate. This allows us to explicitly control for the role of idiosyncratic output shocks on consumption correlation. Finally, we derive potential welfare gains from risk sharing when countries are engaged in complete asset markets, following van Wincoop (1999). We compare potential risk sharing gains when countries share risks within the East Asian region or with OECD countries.

Estimation results reveal that the degree of risk sharing of East Asian countries is far from complete and quite low for both within East Asia and with OECD countries. Among individual countries, Taiwan and Singapore have the highest level of risk sharing, while Indonesia and Malaysia are the countries with lowest (and significantly negative) risk sharing. We also find that there is no consistent difference in the degree of risk sharing within East Asia and with OECD countries and the degree of risk sharing does not
increase over time in most countries.

Finally, we show that the average potential risk sharing gains with other East Asian countries are 1.5 percent, while with OECD countries, the average potential gains are 1.85 percent. Indonesia and Malaysia have the highest potential gains (more than 5 percent) with both East Asian and OECD countries. In less developed countries in the region (Malaysia, Indonesia, Thailand and China), potential risk sharing gains with OECD countries are larger than those within East Asia, which implies that business cycles in these countries are more correlated with other East Asian countries than with OECD countries. This result also indicates that these countries might achieve more benefits from financial integration with developed countries, than with other East Asian countries.

The remainder of this paper consists of the following sections. Section II first reviews theories that relate consumption correlation with the degree of risk sharing. We then report cross-country consumption correlation of each sample country within East Asia and with OECD countries in various sample periods. We also report the consumption correlation with 15-year rolling windows in order to observe time-series pattern of correlation. In Section III, we adopt a formal regression analysis and measure the degree of risk sharing. Section IV discusses potential welfare gains of each sample country within the region versus with OECD countries, and Section V concludes.
II. Measuring the Degree of Risk Sharing: Cross-country Consumption Correlation

This section first introduces a risk sharing theory that explains consumption correlation under perfect risk sharing. Then, we measure simple cross-country consumption correlation for each sample country and evaluate the current state of risk sharing in the region.

II.1. Theories on consumption correlation under perfect risk sharing

Empirical studies on risk sharing have grown rapidly in recent years. The formal literature started by testing the null hypothesis of full risk sharing at various aggregation levels, such as among individuals in villages (Townsend 1994), households (Mace 1991; Cochrane 1991; Altug and Miller 1990) and countries (Canova and Ravn 1996; Lewis 1996). Informal tests of full risk sharing using cross-country income and consumption correlations were pioneered by Backus, Kehoe and Kydland (1992), and spurred a plethora of “cross-correlations” literature. These seminal papers were essentially based on the consumption Euler equation under a complete (asset) market that implies perfect risk sharing, which we review in this section. The presentation in this section closely follows Mace (1991) and Crucini and Hess (2000).

Suppose there are $R$ countries in a region. Each country $i$ is assumed to consist of a representative household. Uncertainty is summarized by the state variable $s_{\tau}$, $\tau = 1, 2, \ldots, S$ that takes on $S$ different values in each time $t$. The term $\pi_\ell(s_\tau)$ captures the
probability of state $s_\tau$ occurring at $t$ with $s_{\tau=1}^S \pi_s(s_\tau) = 1$. The expected lifetime utility of the representative household in the country is given by

$$
\sum_{i=0}^{\infty} \beta_i \sum_{\tau = 1}^{S} \pi(s_\tau) U(c^i_\tau(s_\tau), b^i_\tau(s_\tau))
$$

(1)

where $c^i_\tau(s_\tau)$ is consumption for the representative household in region $i$ at time $t$ when the state is $s_\tau$, and $0 < \beta < 1$ is the subjective discount factor, assumed to be the same across households. $b^i_\tau(s_\tau)$ is an exogenous preference shock to region $i$, given the state of nature.

In the case of complete international asset markets in which assets are freely traded across countries and contracts can be made contingent on any state of nature, the stochastic discount factor (or marginal rate of substitution) is equalized across countries for all states of nature. That is,

$$
\frac{\beta_i U^i(c^i_{i,t+1}(s_\tau), b^i_{i,t+1}(s_\tau))}{U^i(c^i_t(s_\tau), b^i_t(s_\tau))} = \frac{\beta_j U^j(c^j_{j,t+1}(s_\tau), b^j_{j,t+1}(s_\tau))}{U^j(c^j_t(s_\tau), b^j_t(s_\tau))}
$$

for all $i, j$ and $\tau$.

(2)

To understand a broad empirical prediction of the model, assume that the representative individual has the following constant relative risk aversion (CRRA) utility function:

$$
U(c^i_\tau(s_\tau), b^i_\tau(s_\tau)) = \exp(b^i_\tau)(\frac{1}{1-\gamma}) (c^i_\tau)^{1-\gamma}, \gamma > 0
$$

(3)

where $\gamma$ is the coefficient of the constant relative risk aversion. Then, after taking logs, equation (2) becomes
\[ \Delta \log(c_{it}) = (\log \beta_i - \log \beta_{jt}) + \Delta \log(c_{jt}) + \frac{1 - \gamma}{\gamma} \Delta(b_{it} - b_{jt}), \quad i = 1,2,\ldots,R \]  

Therefore, consumption growth rate is perfectly correlated across countries, holding the preference shocks constant.

Alternatively, by taking weighted average (using each country’s relative size in the region) of equation (4) for \( j = 1, \ldots, n \),

\[ \Delta \log(c_{it}) = (\log \beta_i - \log \beta_{it}) + \Delta \log(c_{at}) + \frac{1 - \gamma}{\gamma} \Delta(b_{it} - b_{at}), \quad i = 1,2,\ldots,R \]  

where the variables with subscript \( a \) are the aggregate of the region. Therefore, consumption growth rate of a country is perfectly correlated with the world aggregate consumption growth rate under perfect risk sharing, holding the preference shocks constant.

In implementing the above equation empirically, a problem may arise in a large country case. A large country’s consumption changes can be substantially correlated with aggregate consumption changes even without any risk sharing. We introduce another version of the equation that can control such effects by excluding own country in constructing the aggregate. By taking weighted average of equation (4) for all \( j \) except for \( i \),

\[ \Delta \log(c_{it}) = (\log \beta_i - \log \beta_{bi}) + \Delta \log(c_{bt}) + \frac{1 - \gamma}{\gamma} \Delta(b_{it} - b_{bt}), \quad i = 1,2,\ldots,R \]  

where the variables with subscript \( b \) are the aggregate of the region, excluding own country \( i \).
Based on the above equations, past studies have calculated the correlation of consumption growth rates across countries and examined whether it is close to the perfect risk sharing benchmark (perfect correlation). Alternatively, some studies run regressions of the world consumption growth rate on each country’s consumption growth rate and investigated whether the coefficient on the world consumption growth rate is close to one, which indicates the perfect risk sharing benchmark case. The former method is applied in Section 2.2. and the latter in Section 3.

II.2. Estimation results

This section reports cross-country consumption correlation of the East Asian countries as a rough measure of the degree of international risk sharing. We use the consumption data of ten East Asian countries from the Penn World Table.\textsuperscript{3} Sample period is 1970-2000. The degree of risk sharing is measured by correlation of (per capita) consumption growth rate of individual country with the (per capita) consumption growth rate of the region. We measure consumption correlation with East Asian countries and with OECD countries separately in order to calculate how much risk sharing is done within and outside of the region. When we construct the consumption growth rate of East Asia, we exclude the own country in order to correctly capture the relevant consumption correlation only as explained. That is, consumption can be positively correlated

\textsuperscript{3} Data of Taiwan and Singapore are not complete in the Penn World Table and we use the data from the Asian Development Bank for these missing data.
even without risk sharing if the aggregate consumption of the region includes the own consumption. The consumption growth rate of OECD is calculated using the same method.4)

A positive consumption correlation may not necessarily reflect a positive degree of risk sharing. For example, if output growth rates of countries are correlated, then we would observe positive consumption correlation even without any risk sharing. Therefore, we compare consumption correlation and output correlation in order to see how much risk sharing is done in the region. If consumption correlation is higher than output correlation, then it can be interpreted as evidence of risk sharing. Table 1 reports average cross-country correlation of both consumption and output growth rates within East Asia, with OECD countries and with all. Other than the whole sample analysis, we also report sub-period statistics (1970s, 1980s and 1990s) in order to reflect the fact that many countries have gone through various structural changes during this period. For 1990s, we report the correlation before the crisis period as well.5)

The statistics from the whole sample period show that five countries have significantly positive consumption correlation with all countries. They are Hong Kong, Taiwan, Singapore, Korea and Thailand, and the correlation ranges from 0.23 in Korea to 0.68 in Taiwan. Other countries have near zero or negative correlations. China and Indonesia display significantly negative correlation, especially with OECD countries (-0.25 and -0.57, respectively). That is, China and Indonesia have a low degree of risk sharing with other

4) In our sample, OECD countries include 21 developed countries excluding Turkey and Korea.
5) We use a 10-year period (1987-1996) for this sample.
countries. Comparison of correlations within East Asia and with OECD countries does not reveal any consistent pattern. Some countries share risks more within East Asia (China, Indonesia, Malaysia and Thailand). Consumption in Taiwan and Singapore are highly correlated with that in OECD countries (0.72 and 0.35, respectively), while consumption correlation within East Asia is negative (-0.03 and -0.17, respectively).

Comparison of consumption and output correlation shows that the degree of risk sharing is quite low in most East Asian countries. In Table 1, we can see the cases where consumption correlation is higher than output correlation with bold numbers. We observe only two cases, Thailand and Taiwan, that consumption correlation is higher than output correlation. Even in these cases, differences between these correlations are quite small. For example, in Taiwan, even though the absolute level of consumption correlation is high (0.68), this is mostly due to high output correlation (0.66), indicating that the degree of risk sharing might not be high at all.

The sub-period analysis reveals interesting findings. We can easily see that risksharing is increasing over time. The number of cases where consumption correlation is higher than output correlation increases from one in 1970s to three in 1980s and to five in 1990s before the Asian crisis. This observation is more apparent in risk sharing with OECD countries, where we observe six boldfaced numbers in the 1990s. With other Asian countries, positive risk sharing is observed only in one case.
### Table 1: Cross-Country Consumption and Output Correlation

#### Within East Asia

<table>
<thead>
<tr>
<th></th>
<th>Whole Period</th>
<th>1970s</th>
<th>1980s</th>
<th>1990s</th>
<th>1990s before crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>Y</td>
<td>C</td>
<td>Y</td>
<td>C</td>
</tr>
<tr>
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<td>-0.35</td>
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<td>-0.68</td>
</tr>
<tr>
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<tr>
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</tr>
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#### With OECD countries

<table>
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<th>1990s before crisis</th>
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Note: CHN, HKG, IDN, JPN, KOR, MYS, PHL, SGP, THA and TWN denote China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand and Taiwan, respectively.

For the 1990s data, we focus on the statistics from the pre-crisis period because the crisis affected most East Asian countries and distorted the statistics. In most countries, consumption correlation within East Asia becomes negative without the crisis period. Most Asian countries show negative correlation with OECD countries in the 1990s including the crisis period but the numbers become positive in many countries excluding the crisis period. This observation is consistent with the story that these economies suffer from severe economic downturn in the late 1990s, while OECD countries continuously enjoy high output growth rates in the late 1990s.
<Figure 1> Cross-Country Consumption Correlation (15-year rolling window)
In deriving statistics in Table 1, we impose certain cutoff year in dividing sub-periods. However, the statistics are sensitive to the choice of the cutoff year. Therefore, we report the rolling consumption correlation with 15-year window for each country. Figure 1 enables us to easily trace how consumption correlation changes over time.

Main characteristics from the figure are consistent with those found in Table 1. Overall, China and Indonesia maintain low consumption correlation both within East Asia and with OECD countries throughout the whole period. Relatively developed countries in the region, in particular Taiwan and Singapore, show that the consumption correlation with OECD countries are positive and higher than the correlation within East Asia by a significant amount in the whole sample period. A similar pattern is observed in Korea, Hong Kong and Thailand except for the Asian crisis period. Asian crisis countries including Hong Kong show that the consumption correlation with other Asian countries significantly increases in the late 1990s when the crisis period is included. In Japan, consumption correlation with OECD countries (excluding Japan) jumps up into a positive number when 1980s and mid 1990s are included, while in the same period correlation with other East Asian countries decreases. For developing countries in Southeast Asia, Indonesia, Malaysia and the Philippines, consumption correlation with OECD countries are near zero or negative and lower than or similar to that with other East Asian countries.
III. Regression Analysis

Past studies testing the null hypothesis of perfect risk sharing using equations (4), (5) and (6) often rejected the null, so literature started to investigate the incompleteness of the risk sharing arrangement.\(^6\) To be consistent with Crucini (1999), Crucini and Hess (2001), Obstfeld (1994, 1995), and Asdrubali and Kim (2003b), if the representative agent in each region only pools a fraction \(\lambda\) of their income with the remaining fraction, \(1-\lambda\), of their income not pooled, then consumption changes by region approximately follows the process:

\[
\Delta \log(c_{ii}) = \alpha + \lambda \Delta \log(c_{bi}) + (1-\lambda) \Delta \log(y_{ii}) + e_{ii}, i=1,2,\ldots, R
\]  

(7)

where the constant term, \(\alpha\), may reflect the difference in the discount factor across countries and the error term, \(e_{ii}\), may reflect the preference shocks.\(^7\) Intuitively, the above equation indicates that the domestic consumption growth rate resembles the aggregate consumption growth rate as much as the risk sharing arrangement


\(^7\) The presence of common shocks does not strongly bias the estimate. The above regression equation can be re-organized as

\[
\Delta \log(c_{ii}) - \Delta \log(c_{bi}) = \alpha + (1-\lambda)[\Delta \log(y_{ii}) - \Delta \log(c_{bi})] + e_{ii}, i=1,2,\ldots, R.
\]

When aggregate income changes are similar to aggregate consumption changes, the regression is similar to using country specific variables.
has done, but the remaining fraction of the consumption growth rate should follow the domestic output growth rate (which is available domestically).\(^8\)

In this section, we estimate equation (6) to examine the degree of risksharing in each East Asian country. By using (6), we are able to control for the role of country-specific output shock on consumption correlation. This analysis provides us with a more formal analysis on measuring the degree of risk sharing than the simple consumption correlation does. First, we use consumption growth rate of East Asia as the regressor to infer the risk sharing of each East Asian country with the rest of East Asia. Second, we use the consumption growth rate of the OECD as the regressor to infer the risk sharing of each East Asian country with the OECD countries.

Table 2 reports the results of estimating equation (6). The first column shows the country name. The next three columns are the results for the case when East Asian aggregate is used while the last three columns are the results for the case that OECD aggregate is used. The numbers in parentheses are standard errors. ‘*’ and ‘**’ indicate that the estimate is significant at the 10-percent and 5-percent levels, respectively.

The results show that the estimated \( \lambda \) is less than 1 in all cases,

---

8) Crucini (1999) uses permanent income instead of current income by assuming that international intertemporal trade is perfect. On the other hand, Obstfeld (1995) used the current income by assuming financial autarky. Asdrubali and Kim (2003b) discuss the intermediate cases. If income process follows a random path, changes in current income and permanent income would be equal. For more details, see Asdrubali and Kim (2003a).
which suggests that the risk sharing is not perfect in any cases. Further, in most cases, the estimated \( \lambda \) is not high, implying that the degree of risk sharing is low. Still, the estimated \( \lambda \) is positive in most cases, which implies that some risk sharing is achieved, though incomplete. There are two exceptions, Indonesia and Malaysia for which a negative coefficient is found.

Regarding the risk sharing within East Asia, a positive and significant \( \lambda \) is estimated in four cases; Korea, the Philippines, Singapore and Taiwan. It ranges from 0.19 in Korea to 0.34 in Singapore. Other positive but insignificant coefficients include 0.17 in Thailand, 0.11 in Hong Kong, 0.07 in Japan and 0.06 in China. The lowest estimate is found for Indonesia and Malaysia, where negative \( \lambda \) is obtained.

Table 2 also reports similar estimated coefficients regarding risk sharing with OECD countries. Three countries show positive and significant estimates: the Philippines, Singapore and Taiwan. The estimates for Singapore and Taiwan are quite high, 0.63 and 0.71, which are significantly higher than the degree of risk sharing within East Asia, 0.34 and 0.29, respectively. The estimate for the Philippines is 0.39, which is slightly higher than the coefficient for within East Asia, 0.30. Four countries show quite low \( \lambda \); Indonesia and Malaysia show negative estimates and Thailand and China show the estimate less than 0.1. For Thailand, Malaysia and Korea, the observed degree of risk sharing is higher within East Asia than with OECD countries. For other countries including China, Hong Kong and Japan, the estimated coefficients are similar across the two groups.
### Table 2: Regression Results (all periods)

<table>
<thead>
<tr>
<th></th>
<th>Within Asia</th>
<th></th>
<th></th>
<th>With OECD</th>
<th></th>
<th></th>
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<tr>
<td></td>
<td>α</td>
<td>λ</td>
<td>Rbar²</td>
<td>α</td>
<td>λ</td>
<td>Rbar²</td>
</tr>
<tr>
<td>CHN</td>
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<td>0.70</td>
<td>-0.0087</td>
<td>0.05</td>
<td>0.69</td>
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<tr>
<td></td>
<td>(0.0050)</td>
<td>(0.10)</td>
<td></td>
<td>(0.0053)</td>
<td>(0.10)</td>
<td></td>
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<tr>
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<td>(0.0049)</td>
<td>(0.11)</td>
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<td></td>
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<td>(0.35)</td>
<td></td>
<td>(0.0129)</td>
<td>(0.32)</td>
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<tr>
<td>JPN</td>
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<td>0.07</td>
<td>0.27</td>
<td>0.0048</td>
<td>0.05</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>(0.0045)</td>
<td>(0.12)</td>
<td></td>
<td>(0.0042)</td>
<td>(0.23)</td>
<td></td>
</tr>
<tr>
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<td>0.19*</td>
<td>0.75</td>
<td>-0.0076</td>
<td>0.14</td>
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</tr>
<tr>
<td></td>
<td>(0.0042)</td>
<td>(0.08)</td>
<td></td>
<td>(0.0050)</td>
<td>(0.10)</td>
<td></td>
</tr>
<tr>
<td>MYS</td>
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<td>0.29</td>
<td>-0.035**</td>
<td>-0.55</td>
<td>0.31</td>
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<tr>
<td></td>
<td>(0.013)</td>
<td>(0.44)</td>
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<td>(0.014)</td>
<td>(0.41)</td>
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<tr>
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<td>-0.0055</td>
<td>0.39**</td>
<td>0.38</td>
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<tr>
<td></td>
<td>(0.0051)</td>
<td>(0.11)</td>
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<td>(0.0046)</td>
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<tr>
<td>SGP</td>
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<td>0.00</td>
<td>0.0068</td>
<td>0.63**</td>
<td>0.24</td>
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<tr>
<td></td>
<td>(0.0077)</td>
<td>(0.17)</td>
<td></td>
<td>(0.0077)</td>
<td>(0.16)</td>
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<td>THA</td>
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<td>(0.0066)</td>
<td>(0.17)</td>
<td></td>
<td>(0.0071)</td>
<td>(0.16)</td>
<td></td>
</tr>
<tr>
<td>TWN</td>
<td>0.011**</td>
<td>0.29**</td>
<td>0.28</td>
<td>0.030**</td>
<td>0.71**</td>
<td>0.53</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.11)</td>
<td></td>
<td>(0.006)</td>
<td>(0.14)</td>
<td></td>
</tr>
</tbody>
</table>

To infer how risk sharing properties change over time, we run the regression for three sub-periods: 1970s, 1980s and 1990s. For 1990s, we also examine the 1991-1996 period to exclude the influence of the Asian crisis; Table 3 reports the results. From the results, we can roughly infer how risk sharing patterns change over time in each country, although most estimates are not very significant due to the low degree of freedom.
A few countries, including China, Japan and Singapore, achieve more risk sharing over time. China exhibits an increasingly high degree of risk sharing with both East Asian and OECD countries over time, where the coefficient for the 1990s before the crisis period is 0.44 and 0.59 with East Asian and OECD countries, respectively. During the same period, Japan exhibits quite a positive coefficient.
0.54 and 0.70 with East Asian and OECD countries, respectively. These are especially high numbers considering that the same coefficients from the whole sample period were 0.07 and 0.05, respectively, as reported in Table 2. In Singapore, the risk sharing coefficient increases over time with East Asian countries when the crisis period is excluded.

However, this is not the general pattern. In most other countries, the degree of risk sharing remains unchanged or even decreases over time. Hong Kong, Indonesia, Malaysia, Thailand and Taiwan display a decreasing coefficient over time with both East Asian and OECD countries over time. In particular, the coefficients of Hong Kong, Indonesia and Malaysia during the 1990s before the crisis period show significantly negative numbers, ranging from -0.49 to -2.36. Korea (excluding the 1990s with the crisis period) and the Philippines show consistently positive coefficients in all sub-periods without any particular trend.
IV. Potential Welfare Gains from Risk Sharing

What are the potential welfare gains when countries perfectly diversify country specific income shocks and smooth out consumption stream? Many economists have tried to measure potential welfare gains from consumption risk sharing by comparing welfare level of the complete markets economy with that of autarky (or incomplete markets economies). In this section, we follow van Wincoop (1994, 1999) to estimate potential welfare gains when each Asian country attains complete risk sharing with other Asian countries and with OECD countries.\(^9\) As shown in Kim, Kim and Levin (2003) and van Wincoop (1999), potential welfare gains positively depend on the degree of risk aversion, time discount factor, and the persistence and volatility of output shocks. Welfare gains negatively depend on the cross-country correlation of output shocks.

Following van Wincoop (1999), we assume that there are \(N\) symmetric countries with complete asset markets and each country \(i\) maximizes the following utility function;

\[
U_i = E \int_0^T e^{-\beta t} \frac{c_i^{1-\gamma}}{1-\gamma} dt, \tag{7}
\]

\(^9\) Van Wincoop (1999) derived closed form solution for welfare gains of complete markets from autarky. Kim, Kim and Levin (2003) further analyze potential welfare level when countries are restricted to trade non-contingent bonds only (incomplete markets economy) compared to the complete markets economy and autarky.
where \( T \) is the time horizon (number of years), \( \gamma \) is the risk aversion parameter, \( c_i \) is aggregate consumption. Endowment \( y_i \) follows a random walk with drift

\[
d y_{it} = \mu y_{it} \, dt + \sigma y_{it} \, d\eta_i,
\]

(8)

where \( \eta \) is a standard Brownian motion and \( \rho = d\eta_i \, \eta_k (i \neq k) \) represents the correlation between innovations of endowment growth rates of two different countries.

Under autarky, domestic consumption is equal to domestic endowment and the expected utility becomes

\[
E(U_i) = \frac{1 - e^{-\nu T}}{\nu} \frac{c_{i0}^{1-\gamma}}{1-\gamma},
\]

(9)

where \( \nu = \beta + (\gamma - 1) (\mu - 0.5 \gamma \sigma^2) \).

Under complete asset markets, country specific risks are perfectly diversified and consumption in each country is equal to the average world endowment: \( c_i = y^w_i = \frac{1}{N} \sum_{i=1}^{N} y_i / N \).

In the complete markets with the same endowment process in (5), consumption in each country follows approximately a random walk with variance \( \sigma_w^2 = \sigma^2 (1/N + (1 - 1/N) \rho)^2 \). Welfare gains are measured by changes in certainty equivalent consumption.

\[
\text{Welfare Gains} \approx - \frac{0.5 \gamma d \sigma^2}{r - \bar{r}} \left[ 1 - T (r - \bar{r}) \frac{e^{-T (r - \bar{r})}}{1 - e^{-T (r - \bar{r})}} \right],
\]

(10)
where $\tilde{\mu} = \mu - 0.5\gamma\sigma^2$ denotes the risk adjusted growth rate and $d\sigma^2 = \sigma^2_w - \sigma^2$ is the change in the variance of consumption growth rate when moving from autarky to the complete markets economy.

We adopt the parameter values in van Wincoop (1999). The risk-free real interest rate $r$ is assumed to be 0.85 percent and the risk aversion parameter $\gamma$ is 3. The horizon for welfare calculation $T$ is set at 10 years. For the mean growth rate and variance of per capita consumption, and the correlation between domestic consumption and average world consumption growth rates are estimated from the data that are used in Section 3 of this paper. By using the East Asian average and the OECD average for the average world consumption growth rate, we can calculate welfare gains of risk sharing within East Asia and with OECD countries. Pooling the East Asian and OECD data allows us to calculate risk sharing gains with all 31 OECD and East Asian countries in the sample.

Table 4 reports the potential welfare gains that each East Asian country can achieve when they have complete risk sharing with other East Asian countries and with OECD countries. The numbers represent percentage gains in certainty equivalent consumption level when countries move from the current state to complete risk sharing. Indonesia and Malaysia are the countries with the highest potential welfare gains from risk sharing: 6.4 percent and 4.9 percent, respectively. That is, Indonesia can achieve more than

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10) The formula used in the paper calculates welfare gains from autarky to the complete markets. However, by using the consumption data for calculating variance of endowment process, we can safely claim that we measure welfare gains when countries move from the current state to the complete markets (van Wincoop 1994, 1999).
6-percent increase in permanent consumption by completely diversifying its domestic income risks. This result is consistent with the result in the previous section; these two countries achieved the lowest degree of risk sharing. The welfare gains are generally larger for countries whose consumption is less correlated with other countries. For Japan, Korea, Taiwan, Singapore and the Philippines, risk sharing gains are less than 1 percent of consumption. On average, risk sharing gains within East Asia are 1.5 percent and with OECD countries are 1.85 percent.

The comparison of risk sharing gains within East Asia and with OECD countries reveals important features. In many countries, risk sharing gains within East Asia are smaller than or similar to those with OECD countries. This is especially true for China, Indonesia, Malaysia and Thailand (less developed countries in the region), which indicates that these countries have followed different business cycles from those in developed countries. On the other hand, for Singapore and Taiwan, potential risk sharing gains within East Asia are significantly larger than those with OECD countries. This indicates that business cycles of these two countries are more similar to those in OECD countries than those in other East Asian countries.

These numbers are consistent with other results. For example, van Wincoop (1999) finds that risk sharing gains from the OECD countries range from 1.1 percent to 3.5 percent with a 50-year horizon. Athanasoulis and van Wincoop (2000) estimate using 49 developed and developing countries that risksharing gains are around 6.5 percent on average. In Prasad, et al. (2003), they report that potential risk sharing gains for emerging markets are around 3.5 percent and for OECD countries, they are less than 1 percent.
<table>
<thead>
<tr>
<th>Country</th>
<th>Within Asia</th>
<th>With OECD</th>
<th>With all</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1.53</td>
<td>1.94</td>
<td>1.90</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>1.08</td>
<td>1.09</td>
<td>1.10</td>
</tr>
<tr>
<td>Indonesia</td>
<td>4.49</td>
<td>6.43</td>
<td>6.40</td>
</tr>
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<td>Japan</td>
<td>0.51</td>
<td>0.47</td>
<td>0.53</td>
</tr>
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<td>Korea</td>
<td>0.93</td>
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<td>0.94</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3.48</td>
<td>4.68</td>
<td>4.94</td>
</tr>
<tr>
<td>The Philippines</td>
<td>0.65</td>
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<td>0.64</td>
</tr>
<tr>
<td>Singapore</td>
<td>0.94</td>
<td>0.55</td>
<td>0.66</td>
</tr>
<tr>
<td>Thailand</td>
<td>1.03</td>
<td>1.56</td>
<td>1.18</td>
</tr>
<tr>
<td>Taiwan</td>
<td>0.42</td>
<td>0.12</td>
<td>0.14</td>
</tr>
<tr>
<td>Average</td>
<td>1.50</td>
<td>1.85</td>
<td>1.84</td>
</tr>
</tbody>
</table>

(Unit: %)
V. Conclusion and Policy Implications

In this paper, we have estimated degree of risk sharing of East Asian countries within the region and with OECD countries, using cross-country consumption and output correlation and formal regression analysis. From the estimation results, we derived the following conclusion. First, in general, the degree of risk sharing of East Asian countries is far from complete and quite low for both within East Asia and with OECD countries. Second, among individual countries, Taiwan and Singapore achieve the highest degree of risk sharing, especially with OECD countries, while Indonesia and Malaysia are the countries with the lowest (and significantly negative) degree of risk sharing. Third, there are no consistent differences in the degree of risk sharing within East Asia and with OECD countries. Some countries (Taiwan and Singapore) attain higher risk sharing with OECD countries than within East Asia, while most other countries have similar degree of risk sharing with both groups. Fourth, the sub-period analysis shows that the degree of risk sharing in China and Japan have an increasing trend with both groups, while for other countries the degree of risk sharing remains unchanged or even decreases over time (Hong Kong, Indonesia, Malaysia, Thailand and Taiwan).

There can be many reasons why the degree of risk sharing in East Asia, especially within the region, is too low. First, there are too much uninsurable country specific risks such as shocks in the nontraded sector, wage and labor markets. These risks cannot be easily diversified across countries and most Asian countries have
quite high volatilities and uncertainties in labor market and nontraded sector productivities. Second, most East Asian countries have less developed financial markets with high transaction costs and information asymmetry. Lack of financial securities that can be used for diversifying country specific risks prevents countries from engaging in risk sharing activities.

We also measured potential welfare gains that each country can achieve through perfect risk sharing within East Asia and with OECD countries. The results reveal that the countries that currently have lowest level of risk sharing, Indonesia and Malaysia, have the highest potential gains around 5-6 percent of permanent consumption. More importantly, we show that for less developed countries in the region (China, Indonesia, Malaysia and Thailand), potential risk sharing gains with OECD countries are larger than those within the region. This is because business cycles of these countries are similar to other East Asian countries and different from OECD countries.

This result provides some directions on financial market liberalization policies. The less developed countries can achieve more welfare gains by implementing financial market liberalization with developed countries rather than with other East Asian countries. Despite the recent discussion on developing regional financial integration, potential welfare gains from regional integration might not be high and countries might be better off by integrating their financial markets with other developed countries outside of the region. In other words, buying securities issued by developed countries might be better than purchasing assets in other East Asian countries. However, even OECD countries do not achieve sufficient degree of risk sharing with each other, as documented by many past
studies such as Sorensen and Yosha (1998), Mliz and Zumer (2000),
and Asdrubali and Kim (2003a, 2003b). In this context, one can
consider the possibility of developing financial markets that can allow
the international transfer of GDP risk through GDP-linked securities,
as discussed in Shiller (1993), Athanasoulis and Shiller (2001), and
Borensztein and Mauro (2002).\(^{11}\)

Since this paper focuses on macroeconomic aspects of risk sharing,
it ignores detailed discussion on financial institutions and assets that
are essential to international risk sharing. What type of foreign
securities can allow us to insure against domestic country specific
shocks, especially for the risks that cannot be insured by existing
financial assets? What type of financial infrastructure should we
develop to enhance international financial transactions? Such
microeconomic analysis on financial markets would help us to
understand how countries can achieve better risk sharing using
existing financial institutions and how countries can effectively
develop appropriate infrastructure for the advancement of financial
markets.

A number of future related works will be fruitful. Our empirical
method is limited in that it is static in nature and assumes a simple
exogenous income process. Pursuit of a more general empirical

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\(^{11}\) Many economists have proposed a variety of securities whose return
would depend on the evolution of a country’s GDP. The best-known
proposal put forward by Shiller (1993) is the creation of a market for
perpetual claims on GDP. However, the market infrastructure for such
claims does not exist. In this regard, Borensztein and Mauro (2002)
make a more practical proposal for GDP-indexed bonds. See
Borensztein and Mauro (2002) for more details.
method that can incorporate dynamic interactions among variables and more complicated, possibly endogenous, income process may be worthwhile in future works.\(^{12}\) In addition, a research on international intertemporal consumption smoothing such as international lending and borrowing in East Asia, which is another important consequence of international financial market liberalization, will be interesting.

\(^{12}\) See Asdrubali and Kim (2003a) for such an example.


