Chapter 10

Choosing Partners for Integration: Maximising Benefits from Risk Sharing

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CHAPTER 10

Choosing Partners for Integration: Maximising Benefits from Risk Sharing

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This chapter estimates the risk reduction and welfare improvement from optimal pools of nine countries in East Asia plus the addition of the United Kingdom and the United States. Our results confirm that the welfare gains can be significant—under some assumptions, up to 5 percent of annual consumption for some countries. We show that the bulk of gains comes from pairs (that is, pools of two) with relatively little additional risk reduction added by larger pools. For most countries, the best pair is a developed country with a different business-cycle pattern. Though subject to change depending on the assumptions Australia could be the preferred pair partner for most countries in the region. There is no evidence that the current Association of South-East Asian Nations Five (ASEAN 5) grouping is optimal in terms of risk reduction, or that there are gains from a grouping of China–Japan–Korea. The policy implication is that the welfare benefits of risk sharing are large enough that they should form an additional part of the policy dialogue on regional integration. The results of such discussions might change the perspective on which partners should begin the process of closer financial cooperation.

Keywords: Risk sharing, financial Integration, East Asia
JEL Classifications: E32, F33

1. Introduction

Initiatives towards regional integration have traditionally been based on political definitions of national and regional boundaries. Even if the move to integration is primarily trade driven, as it is in East Asia, rather than politically motivated, as it has arguably been in Europe, the definition of the region and the identity of the nation-states within the region are the result of political history. The choice of partners within an integrating region can therefore be somewhat arbitrary. When there are conditions on entry—as, for example, the Maastricht conditions in Europe—existing members of a region have some control over who joins. But it is rare that these conditions are set on the basis of which countries will contribute most to the economic welfare of the integrated group. Nor do individual countries usually pick their partners on the basis of careful, welfare-maximizing conditions. Outcomes might be better if they did. The conditions for optimal currency unions are now well recognized and it is clear that currency unions that are very far from those conditions can face convulsions and disintegration.

In this chapter, we apply recently developed methods to show which groups of countries in the East Asian region will benefit most from closer financial integration. The benefits come both from improved stability of income and consumption streams and from the calculable welfare gains that these deliver. Section 2 of the chapter sets out the research question in more detail in the context of the relevant literature. Section 3 describes the research methodology. Section 4 describes the results and Section 5 presents our conclusions.

2. Research Questions

If it were possible to perfectly smooth consumption streams (which would in theory maximize welfare), a given country would consume a fixed fraction of aggregate world income regardless of the state of its economy. This situation is known in the literature as full diversification risk. If a country experiences an unusually positive outcome in its

economy, it would pay some fraction of its increased income to countries with negative outcomes and vice versa. That ideal situation can be achieved only when countries have access to perfect and complete financial markets and they have perfect ability to monitor and enforce contractual arrangements across borders. The absence of these conditions in the real world raises important research and policy questions: what second-best outcomes can be achieved by integrating with well-chosen partners?

In our context, this gives rise to the two questions we address in this chapter.

1. Which pool of countries is most attractive for regional risk-sharing opportunities in East Asia?
2. How large is the welfare gain from the optimal regional risk-sharing pool for countries in East Asia?

3. Literature Review

3.1. Optimal Risk

There is an abundant literature on the benefits of international risk sharing, and most studies agree that most countries in the world are yet to achieve the condition of complete international sharing of risk.

The discussion of the measurement of countries' risk sharing began when Lucas (1987) estimated the welfare cost of consumption uncertainty in the US economy. By proposing a method that compared countries' levels of utility under financial autarky with the levels of utility when countries can trade on international financial markets, Lucas argued that the gain from eliminating consumption variability was relatively small—that is, less than 1 percent of lifetime consumption. Hence, the cost of business cycles for the United States is insignificant. In the same spirit as Lucas, Obstfeld (1994) carefully distinguished the effects of risk aversion and inter-temporal substitution on the gain from reducing consumption volatility. Though producing a higher figure for the gain of eliminating consumption variability than Lucas, Obstfeld's estimation was still low.

More recent work (Callen et al., 2009) produces much larger welfare gains by examining the optimal country groupings for risk-sharing arrangements. The novelty of this approach relies on the fact that the reduction in volatility can be maximized by choosing partners who provide the best offsetting pattern of output variance. This suggests using the variance–covariance matrix to run a systematic search of the ideal pool from a group of countries worldwide. Callen et al. (2009) calculate the output volatility across a group of 74 countries and compare it with the volatility of output of each country individually. If the former has a lower figure than the latter, they infer potential welfare gains from international risk sharing. Furthermore, they conclude that the largest gains from risk sharing are obtained in a group that consists of less than 10 countries, and these gains can be of significant magnitude. In practice, weak institutional quality of potential partners and a history of default on international obligations might hinder the creation of these first best risk-sharing pools.

3.2. Welfare Implications

Many studies have tried to estimate the welfare effects of business cycles and international risk sharing. Among these, Cole and Obstfeld (1991), Lucas (1987) and Tesar (1995) find low welfare gains (less than 0.5 percent), while studies by Kim and Sheen (2007), Kim et al. (2006), Obstfeld (1994) and van Wincoop (1994, 1999) give a higher result.

Cole and Obstfeld (1991) evaluate the gains from international risk sharing using a simple general equilibrium model that incorporates output uncertainty. In a model that mimics selected moments of US and Japanese data to approximate the gain from international risk sharing, the magnitude is about a 0.2 percent increase in annual output. This gain, however, disappears once assumptions on preferences and technologies are altered. Tesar (1995) introduces different sources of uncertainty—market structure, country size, technology and preferences—and finds that the size of gains from risk sharing range from 0 to 2 percent of lifetime consumption. Such low results for the potential benefit of risk sharing might explain why countries appear to have a strong bias towards domestic assets, low international consumption correlations, and high correlations between domestic saving and investment (that is, a low level of international risk sharing).

Van Wincoop (1999), estimating Organization for Economic Cooperation and Development (OECD) countries' potential welfare gain from risk sharing, points out that the gains are sensitive to the parameterization of representative agents' preferences and to the assumption about the stochastic process and measurement of endowment. The first is important since it relates to the implicit risk-free interest rate, the rate of relative risk aversion, and the elasticity of substitution between tradable and non-tradable goods. Using almost full information on the factors that determine the benefits of risk sharing, van Wincoop (1999) estimates the welfare gain from risk sharing in the range of a 1.1 percent to 7.4 a percent permanent increase in consumption over 50 and 100-year horizons.

Using the same framework as van Wincoop (1994, 1999), Kim et al. (2006) calculate the potential welfare gain for 10 Asian countries when they perfectly diversify idiosyncratic country-income shocks. For all these countries, they find that risk-sharing gains are an increase of between 1.4 percent and 7 percent in consumption. The gains are higher if the United States is included in the set of countries that is available as risk-sharing partners, and range from 2 percent to almost 10 percent. For the ASEAN 5 subgroup, Kim et al. (2006) estimate an increase in annual consumption of about 2–9.5 percent for 10 and 50-year horizons. The gain for this group is higher than for the groups of Northeast Asia, developed countries and greater China.

4. Research Methodology

This section of the chapter discusses the procedures that we follow to estimate the possible extent of risk sharing between different groups of countries. The standard theory of risk sharing between countries asserts that, with complete markets, each country within the group will consume a fixed amount of aggregate output but does not give any information on the appropriate measure of the welfare gain associated with risk sharing. The main objective of this chapter—as with the literature reviewed above—is to estimate the scale of welfare gains from risk sharing. We go beyond the standard results, however, by not only asking what are the gains from risk-sharing versus no risk-

sharing but also quantifying the effect of risk-sharing arrangements between different countries in East Asia.

The initial step is to calculate the variance of output growth rates for each country under autarky and within different risk-sharing pools and then to evaluate the welfare implications of the different pools.

We define a "pool" as any group of countries that engage in complete risk sharing with each other (Callen et al., 2009). While Callen et al. use a large group of countries, we choose to narrow our search for the optimal pool and consider 10 countries in the Asia-Pacific region plus the United Kingdom as our universe of countries. These countries are Australia, China, Indonesia, Japan, the Philippines, Malaysia, Singapore, South Korea, Thailand, the United States and the United Kingdom. Our data are real gross domestic product (GDP) in purchasing power parity (PPP) US dollars over the period 1980–2009, taken from the World Bank's *World Development Indicators* (World Bank, various years).[1]

4.1. Descriptive Results

Figures 1 and 2 show the dynamics of GDP growth rates in the sample of countries between 1981 and 2009. The ASEAN 5 countries had relatively more volatile income than their peers. All countries in the ASEAN 5 experienced major downturns in their economic performance in 1998 and again in 2001 and 2009. While the impact of the Asian Financial Crisis (AFC) of 1998 was restricted to East Asian countries (excluding China), the more recent wave of crisis was experienced not only in East Asia but also in developed countries such as the United Kingdom and the United States. The coefficients of variation in Table 1 support the evidence of the graphs. This makes clear that not only did levels of income fall, but also growth rates became significantly more volatile about the time of the AFC. The ability to smooth consumption in such circumstances could be very valuable to improve welfare. Table 2 further shows high correlations between domestic consumption and output[2] for the countries in our

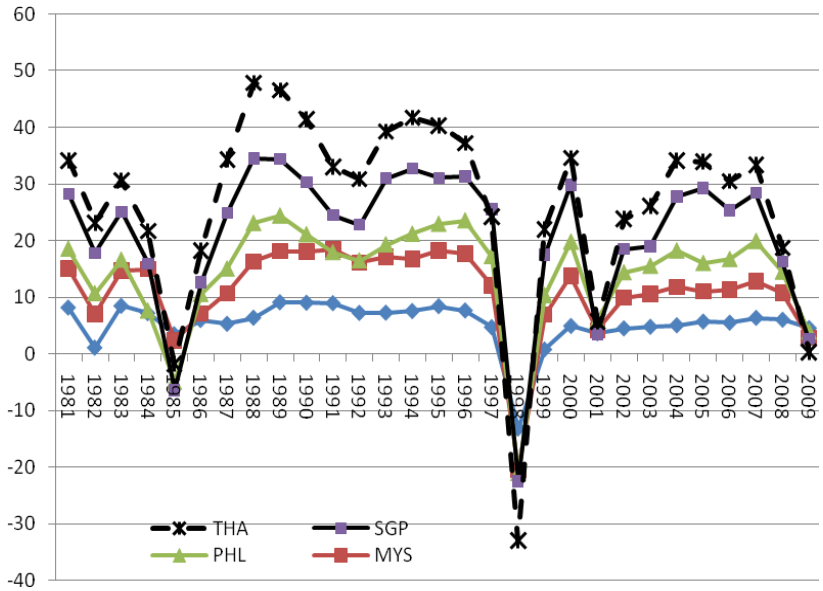
[1] Callen et al. (2009) note that the overall result of their analysis is similar when they use the Penn World Tables (PWT) dataset.

[2] With the curious exception of Indonesia, which might be the result not of high volatility in both series but of a difference in the timing of the volatility.

sample—consistent with a low ability to smooth consumption streams when income shocks occur.

Tesar (1995) explains that models of international risk sharing imply that, with high levels of risk sharing, countries' consumption streams should be highly correlated with each other. Since idiosyncratic shocks would be removed, the only remaining shocks would be system-wide ones and all countries' consumption would move together. She shows, however, that consumption in most countries had low correlation with global consumption while output had higher correlation with global output. This is inconsistent with any significant risk sharing. In Table 3, we report correlations between global and country output and consumption for selected East Asian countries for the period 1981–2009. The results confirm Tesar's findings and reiterate the findings in several previous studies (Corbett and Maulana, 2010; Kim et al. 2006) that risk-sharing activities are far from optimal for countries in the region. Correlations of consumption with global consumption are low in the region and are lower than for the developed-country benchmarks of the United States and the United Kingdom. Our data show—contrary to Tesar's—low correlations with global output, though other chapters in this study provide more information on the synchronization of business cycles and suggest a close synchronization with US real economic activity, though less close with other business cycles (for example, China's).

Figure 1. GDP Growth Across ASEAN 5 Countries, 1981–2009



Source: Data for all tables and charts are from World Bank's *World Development Indicators*, <http://data.worldbank.org/indicator>.

Figure 2. GDP Growth Across Non–ASEAN 5 Countries, 1981–2009

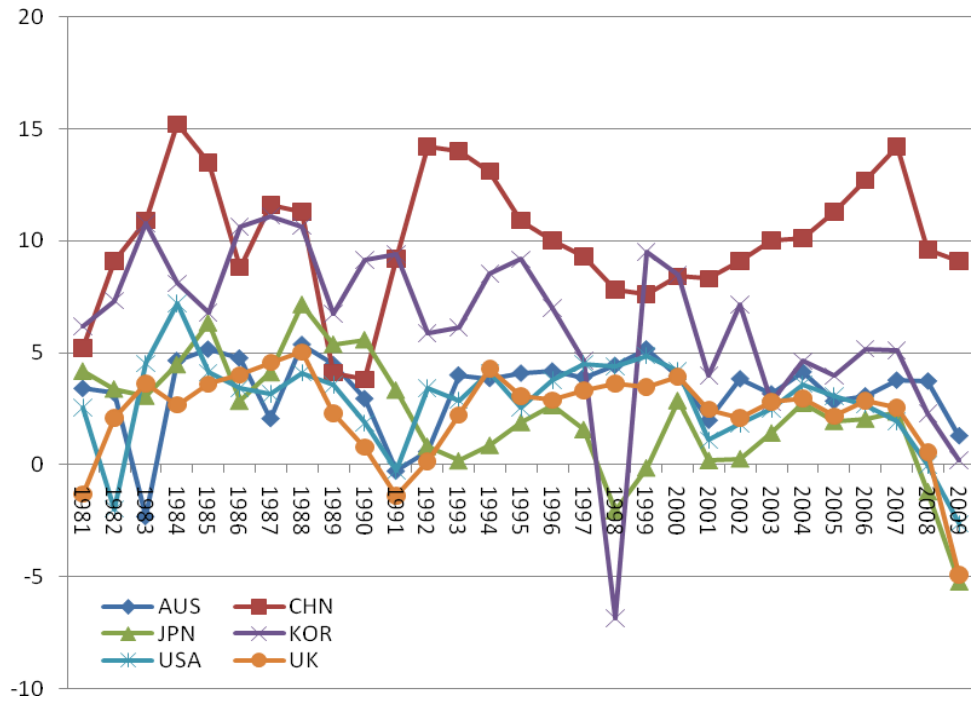


Table 1. Coefficients of Variation of GDP Growth Rates

Country	Coefficient variation					
	1981–85	1986–90	1991–95	1996–2000	2001–05	2006–09
Australia	107.44	34.40	86.65	11.58	26.33	38.86
China	34.79	46.47	16.73	11.30	11.06	20.41
Indonesia	56.28	24.04	9.28	1,234.36	15.53	13.65
Japan	29.21	31.78	86.67	215.78	83.67	–644.34
Korea	21.91	17.80	20.90	153.78	35.07	74.96
Malaysia	69.83	52.35	4.30	150.05	51.06	99.52
Philippines	–452.18	34.22	107.42	69.13	37.15	58.54
Singapore	70.42	42.49	28.49	70.38	107.24	112.91
Thailand	8.83	28.23	5.41	1,568.10	36.73	135.74
UK	96.26	52.56	137.94	10.90	14.92	1,734.54
USA	103.95	25.65	65.93	9.06	40.44	499.73

Table 2. Correlation of Growth of Domestic Consumption and Output, 1981–2008

Country	Coefficient
Australia	0.425
China	0.740
Indonesia	0.462
Japan	0.844
Korea	0.923
Malaysia	0.790
Philippines	0.846
Singapore	NA
Thailand	0.926
USA	0.851
UK	0.867

Note: Singapore's consumption data are available only for the three-year period 2003–05.

Table 3. Correlations with Global Consumption and Output

Correlation coefficient between growth of consumption and output in each country with world data

Country	Corr(c(i),c(w))	Corr(y(i),y(w))
Australia	0.46	0.18
China	0.25	0.16
Indonesia	0.09	–0.36
Japan	0.47	0.07
Korea	0.21	0.06
Malaysia	0.24	0.11
Philippines	0.26	0.16
Singapore	0.41	0.62
Thailand	0.21	0.02
USA	0.68	0.64
UK	0.69	0.57

4.3. Optimal Risk-Sharing Arrangements

Following the strategy of Callen et al. (2009), we use a (weighted) variance of the growth rate of output as a metric for output uncertainty. To estimate the covariance matrix, Callen et al. (2009) assume that the change in growth rates of GDP is identically distributed over windows of observations. This assumption allows them to decompose the resulting variance of country pools into the sum of each country's growth rate plus covariances between countries within the pool.[3]

[3] Callen et al. (2009) also test a different stochastic process for the growth rates of GDP and find that the main result of the analysis is largely unaffected.

We adapt Callen et al.'s (2009) criterion to select the "preferred" pool of countries by selecting the combination of countries that gives the minimum variance of the growth rate of GDP for the pool. Theoretically, if there is full integration and complete markets for a pool of countries then each country in the pool will consume a constant fraction of pool output. This implies that the percentage change in consumption for all countries in the pool will be equal to the percentage change in pool-wide output and will change only along with pool uninsurable risks. For this reason, we focus on the comparison of the volatility (variance) of pool-wide GDP with the volatility (variance) of each country's GDP (rather than using consumption variances).

Identifying the countries that give the minimum variance of the growth rate of pool-wide GDP is a not a trivial task, given the large number of possible combinations. To cover all combinations would take 2,047 calculations. Callen et al. (2009) used a binary traverse and window recursion computational algorithm but we devise a simpler, systematic enumerative strategy that keeps the number of calculations to a reasonably low quantity while at the same time logically identifying which group of countries has the lowest pool variances. Our procedure has one important difference from Callen et al (2009). We assume that the variance of the first pair identified as variance minimizing will always be in the set of larger best pools. With this approach, we reduce the number of variance calculations from 20 possible calculations to nine calculations for each country. This may result in overlooking best combinations of countries that do not include the initial pair.

We illustrate the enumerative processes using the Philippines.

1. Estimate the variance–covariance of the growth rate of output for the Philippines alone and with each country in the sample. The formula for group variance is

$$Var(g_p) = Var\left(\sum_{i=1}^{p} w_i g_i\right) = \sum_{i}^{p} w_i^2 Var(g_i) + \sum_{i=1}^{p}\sum_{j=i}^{p} w_i w_j \, Cov(g_i, g_j) \;\; for \; i \neq j \qquad (1)$$

where w_i represents the share of country i in the pool production, g_p is the growth of aggregate output for a pool of p countries and g_i is individual countries' growth rate. Using the formula, we can decompose the variance of the growth rate of group GDP into a weighted average of individual countries'

variances and the weighted sum of all bilateral covariances. In this way, we can characterize the group of countries that are optimal risk-sharing partners for a particular country.

2. Beginning with pools of two countries, the process gives variances of the Philippines and all two-country groups that have the Philippines as one of the members (pairing with each of our 10 countries). Theoretically, the variance of the groups will be smaller than the Philippines alone. The best two-country pool for the Philippines is the one that gives the lowest variance calculation. Using our results, China is the variance-minimizing best pair for the Philippines.
3. To search for the best pool for the Philippines in the case of three countries, we combine the Philippines–China group with the remaining nine countries and select the one that gives the lowest variance. With this approach, we reduce the number of variance calculations from 20 possible calculations to nine calculations. On the other hand, the approach assumes the variance of combinations with the 11 countries that we "skip" is higher than that of the nine combinations.
4. We repeat the above steps for the remaining countries' pooling.
5. We repeat these steps for each of the countries in the sample.[4]

We now turn to explaining the welfare implication of these best pools. The welfare gain is defined as the percentage increase in annual country consumption that would make the representative individual indifferent between autarky and pooling.

Thus, the welfare gain, δ , for country *j* at time *0* is defined as:

$$U(C_0^j(1+\delta), \mu_j\ \sigma_j^2) = U\left(\underline{C_0}, \underline{\mu}, \underline{\sigma}^2\right) \qquad (2)$$

where μ_j is the expected growth rate for one country and is assumed to be the same as the expected growth under pooling, $\underline{\mu}$, and σ_j^2, $\underline{\sigma}^2$ denote country *j* and pool-wide output variance; C_0^j is the individual country consumption level in the beginning period

[4] Our recursive procedure is not fully equivalent to Callen et al.'s (2009), with possible consequences that are noted in the conclusion.

and $\underline{C_0}$ is the pool-wide consumption level. Note the link between Equation (2) and the variances calculated in the previous pooling exercises.

Obstfeld (1994) argues that the "standard" constant relative risk aversion (CRRA) utility function cannot be used to specify (2) because CRRA fails to capture the offsetting effects of the inverse of inter-temporal substitution and relative risk-aversion coefficient. For this reason, the Epstein and Zin (1989) utility function is preferable. Assuming that C_t is log normally distributed then[5]

$$\log C_{t+1}^j = \log C_t^j + \mu_j - \frac{1}{2}\sigma_j^2 + \varepsilon_{t+1}^j \quad \text{where } \varepsilon_{t+1}^j \sim N\left(0, \sigma_j^2\right) \tag{3}$$

As we know, in the absence of risk-sharing arrangements, any single country's change in consumption equals the change in their individual output (income). That is, $C_t^j = Y_t^j$. The corresponding Epstein and Zin utility function at initial period *t = 0* for an individual country, *j*, is as follows:

$$U_0^j = U\left(C_0^j, \mu_j, \sigma_j^2\right) = C_0^j\left(1 - \beta exp\left[(1-\theta)\left(\mu_j - \frac{1}{2}\gamma\sigma_j^2\right)\right]\right)^{-\left(1/(1-\theta)\right)} \tag{4}$$

Likewise, the Epstein and Zin utility for the condition under a risk-sharing arrangement is given by

$$U_t = U\left(\underline{C_t}, \underline{\mu}, \underline{\sigma}\right) = \underline{C_t}\left(1 - \beta exp\left[(1-\theta)\left(\underline{\mu} - \frac{1}{2}\gamma\underline{\sigma^2}\right)\right]\right)^{-\left(1/(1-\theta)\right)} \tag{5}$$

The parameter θ is the inverse of the inter-temporal elasticity of substitution in consumption, γ is the parameter of relative risk aversion, β is the discount rate and $\sigma^2{}_j, \underline{\sigma^2}$ are individual and pool-wide variance, respectively. There are two points to be noted from (4) and (5). First, since $(\mu - 1/2\ [\gamma\sigma]^{\wedge}2)$ positively affects the level of period *t* utility, we can see that the smaller the variance of pool-wide GDP, the bigger is the increase in the "certainty equivalent" utility. The scale of the effect is given by the size of the parameter for risk aversion, γ; a higher risk-aversion coefficient will lead to greater welfare gains from a given reduction in variance. Second, as the term for the

[5] Limpert et al. (2001) point out that when a variable has low mean values, large variance and is non-negative then it is innocuous to assume the variable has a log normal distribution.

inverse of inter-temporal substitution, θ , increases, it reduces the welfare gain coming from a decrease in variance.

Having specified the measure for country welfare in (4) and (5), now we are ready to answer the question of how much is the welfare gain associated with moving from the autarky position to the risk-sharing arrangement. Full risk sharing within the pool ensures individual country *j*'s consumption grows with pool-wide output at rate $\underline{\mu}$ and fluctuates with pool-wide output variance, $\underline{\sigma^2}$. Substituting, we can calculate the welfare gain as:

$$\delta = \frac{C_0^j \left(1 - \beta exp\left[(1-\theta)\left(\mu_j - \frac{1}{2}\gamma\sigma j^2\right)\right]\right)^{-\left(1/(1-\theta)\right)}}{\underline{C_j}\left(1 - \beta exp\left[(1-\theta)\left(\underline{\mu} - \frac{1}{2}\gamma\underline{\sigma^2}\right)\right]\right)^{-\left(1/(1-\theta)\right)}} \qquad (6)$$

The welfare function (6) has three constituent parts: i) the difference between individual and pool-wide volatilities; ii) the expected difference between growth in country j in autarky and the growth of the pool; and iii) the ratio between the initial consumption of the individual country with no risk sharing and the initial consumption of pool-wide countries. In order to isolate the effects due directly to the diversification gain that country j will receive under risk sharing, we set $\mu_j = \underline{\mu}$ and $C_0^j = \underline{C_0}$, thus assuming that growth and consumption levels are equal in country j and the pool.[6] This approach also abstracts from the possibility of transfers on entry between countries in the pool. We therefore focus entirely on the welfare implications of the fall in volatility associated with international risk sharing and preserve the emphasis in Obstfeld (1994). From (6), we can deduce that the gain from international risk sharing will be small for a country that has volatility measures that are similar in the pooled and autarky situations. If volatility is related to size then countries' relative sizes matter in explaining the gain. Further, we assume that shocks to consumption follow a random walk (Callen et al., 2009, explain what happens if the random-walk assumption is relaxed), so we do not consider situations where certain countries are systematically subject to consumption shocks.

[6] Callen et al. (2009) extend the welfare calculation by allowing differential growth rates between countries and the pool and differentials in initial consumption levels. In the appendix, we show the effects of assuming different growth rates for all countries, but do not examine different growth rates for individual countries (see Note 8).

4. Results[7]

In this section, we present the variance and welfare calculations for each of the nine East Asian countries when paired with combinations of our group of 11 countries, and the optimal groupings between them.

We illustrate the intuition using the Philippines. We ask what pools of countries are optimal from the point of view of the Philippines. Figure 3 reports the variance of pool-wide GDP for the lowest variance combination of countries giving pools of different sizes, as the Philippines chooses partners from the set of all 11 countries to create ever larger pools. The bar graph against the right-hand scale is added to show the welfare effects of country pooling for the Philippines.

In this case, we observe an increasing trend of pool-wide variance as the pool size increases. The pool-wide variance reaches its peak when the Philippines pairs with 10 countries, at 1.142 percentage points, though this is still far below the 12.487 figure of the Philippines' own variance.

Using the pure diversification gains for the Philippines' consumption level as the measure of welfare, we show the gain from different-sized pools. We constrain the initial level of consumption for the Philippines to be identical to the aggregate pool consumption so that the gains come entirely from the reduction in variance of consumption, as noted above. The bar graph in Figure 3 shows the welfare gain for different pool sizes. To construct the figure, we adopt the values used by Callen et al. (2009)—namely, the discount rate $\beta = 0.95$, the inverse of the inter-temporal substitution rate $\theta = 2$ and the coefficient of relative risk aversion $\gamma = 5$. We use 3 percent as the common expected growth of the Philippines and pool-wide combinations.[8] These values are generally supported in the literature with values on risk aversion, γ, ranging between value 1 and 10 (Obstfeld (1994), Cole and Obstfeld,

[7] Our results depend heavily on the estimation of the variance–covariance matrices of GDP growth rates and these will be appropriate only if those series are statistically stable over time. Using the Augmented Dickey Fuller (ADF) test, unit roots are rejected in all countries' GDP growth rates excluding Japan, so we conclude that our estimator for the variance–covariance matrices is justifiable. The results of the ADF test for the unit root component for each country's growth of GDP are available upon request.

[8] Callen et al. (2009) use 3 percent growth as a reasonable global average. Since the East Asian region typically has higher growth than the world average, we tested the results with different values of expected growth and demonstrate a negative relationship between welfare gains for pooling and expected growth. The higher the expected growth, the lower is the gain that a country will receive under pooling.

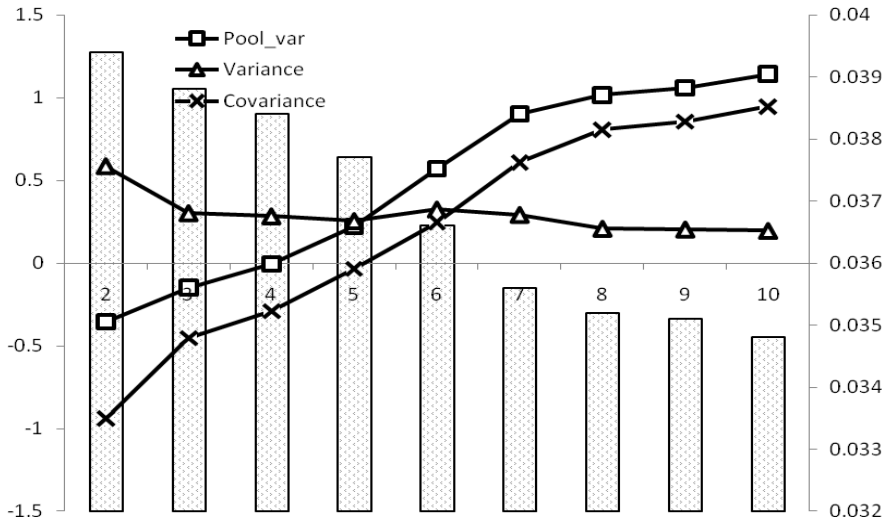
(1991) and Tesar (1995)). The literature suggests that a value for subjective time preference of 0.95 is relatively low. Obstfeld (1994) uses more conservative values of gamma=1, theta=4, and beta=0.95 to calculate gains for eliminating consumption variability for developing countries. We have kept close to Callen et al for comparability of results.

For the Philippines, the total gains are decreasing with pool size, and are at the maximum when the Philippines pools with just one other country. This best pair country is China, and the maximum welfare gain for the Philippines is about 4 percent of permanent increase in annual consumption when it pairs with China. Although these results take no direct account of the pattern of trade and are based entirely on the characteristics of growth volatility (so the outcome is the result of the negative co-movement of the growth of GDP between the two countries), there are, in fact, close trade links between China and the Philippines (EIU, various dates).

Interestingly, in view of the Philippines' participation in ASEAN, it turns out that the risk-minimizing combination of five countries for the Philippines would actually be achieved when it pairs with China, Australia, Singapore and Malaysia. This result shows that the optimal group of risk-sharing partners for the Philippines is not the current political group of ASEAN but a mix of some existing regional ties, China and a developed country, Australia (but see the Appendix for the effect of variations in assumptions).

Similar individual country results for other countries are shown in Appendix 1.

Figure 3. The Philippines' Risk-Sharing Indicator with its Best Pair and Welfare Implication



Note: Left-hand axis shows variance; right-hand axis shows welfare measure.

4.1. Pooling Risk Within Subgroups

4.1.1. ASEAN 5 Countries

Building on individual country results, we can draw out some suggestive conclusions for the process of integration in the East Asian region. We consider whether the current groupings, such as ASEAN, are optimal for risk-sharing partners and, if not, what are the optimal combinations for each country.

As the individual country results in Appendix 1 show, most countries in the region achieve their maximum gain from groupings of six or fewer countries (Singapore and Indonesia are exceptions). In Table 4, we show the optimal, GDP-growth-variance-minimizing combinations for each of the ASEAN 5 countries when combined with up to six countries, using the starting (1980) weights of each country in the region's GDP.[9]

[9] See the appendix for the effect of changing the weights.

Table 4. Ideal Risk-Sharing Partners for ASEAN 5 Countries and Welfare Implications

	Ideal partner				
Country	**2**	**3**	**4**	**5**	**6**
Indonesia	IDN-AUS	IDN-AUS-SGP	IDN-AUS-SGP-UK	IDN-AUS-SGP-UK-PHL	IDN-AUS-SGP-UK-PHL-CHN
Variance (17.11)	–0.4585	0.0776	0.3656	0.5296	0.6517
Welfare	[0.0548]	[0.0531]	[0.0522]	[0.0517]	[0.0509]
Philippines	PHL-CHN	PHL-CHN-AUS	PHL-CHN-AUS-SGP	PHL-CHN-AUS-SGP-MYS	PHL-CHN-AUS-SGP-MYS-JPN
Variance (12.49)	–0.3544	–0.1495	–0.0064	0.2215	0.5712
Welfare	[0.0394]	[0.0388]	[0.0384]	[0.0377]	[0.0366]
Singapore	SGP-AUS	SGP-AUS-IDN	SGP-AUS-IDN-UK	SGP-AUS-IDN-UK-PHL	SGP-AUS-IDN-UK-PHL-CHN
Variance (18.95)	0.3155	0.0776	0.3656	0.5296	0.6517
Welfare	[0.0584]	[0.0592]	[0.0583]	[0.0578]	[0.057]
Malaysia	MYS-AUS	MYS-AUS-CHN	MYS-AUS-CHN-PHL	MYS-AUS-CHN-PHL-SGP	MYS-AUS-CHN-PHL-SGP-JPN
Variance (16.82)	0.1814	0.3506	0.0457	0.2215	0.5712
Welfare	[0.0518]	[0.0513]	[0.0522]	[0.0517]	[0.0506]
Thailand	THA-AUS	THA-AUS-USA	THA-AUS-USA-PHL	THA-AUS-USA-PHL-IDN	THA-AUS-USA-PHL-IDN-SGP
Variance (21.24)	0.2915	0.5029	0.3496	0.3254	0.3564
Welfare	[0.0662]	[0.0655]	[0.066]	[0.0661]	[0.066]

Source: Authors' calculations. *Note*: In performing the above welfare calculations, we use the following assumptions: i) γ =5, θ =2, and β =0.95; ii) growth rates = 3 percent.

It is clear that pooling risk can significantly reduce the variance of GDP growth of ASEAN countries over the single-country variance (shown in Column 1). Furthermore, both the individual country figures in the Appendix and those in Figure 4 (showing just the welfare effects) indicate that each country achieves the bulk of its gains from the first pair. Adding more countries does not, in most cases, add significantly to the risk reduction and, even where some gain is achieved with more partners, the proportional

gain is small compared with the initial improvement. Only Singapore and Malaysia gain from additional partners, though most countries do not lose much from additional countries in their best pool. An important consequence is that Australia is the key risk-reducing partner for all ASEAN 5 countries except the Philippines. In general, a mix between developed and ASEAN partners is the ideal combination for income insurance for all ASEAN countries, rather than a pool of the current ASEAN 5 countries.

Figure 4. Welfare Implication of Different Pooling Size in ASEAN 5 Countries

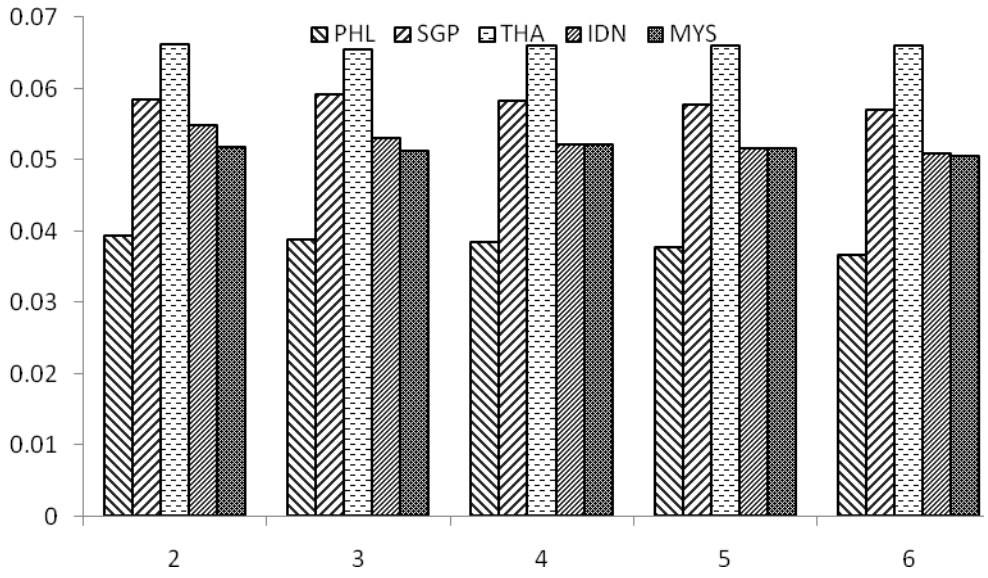


Figure 4 also shows two striking findings: on average, ASEAN countries have the possibility to gain close to 5 percent of annual consumption as a result of risk-sharing arrangements; and the more volatile is a country's income, the larger is the country's gain.

These findings for ASEAN 5 should not be surprising. Earlier research (Corbett and Maulana, 2010) showed that most East Asian countries smooth only about 25 percent of their GDP shocks via the standard international risk-sharing channels. The striking feature of the findings is that sequential risk-sharing agreements, starting with Australia as a partner, can bring a much larger gain than previous estimates suggest.

4.1.2. Non–ASEAN 5 Countries

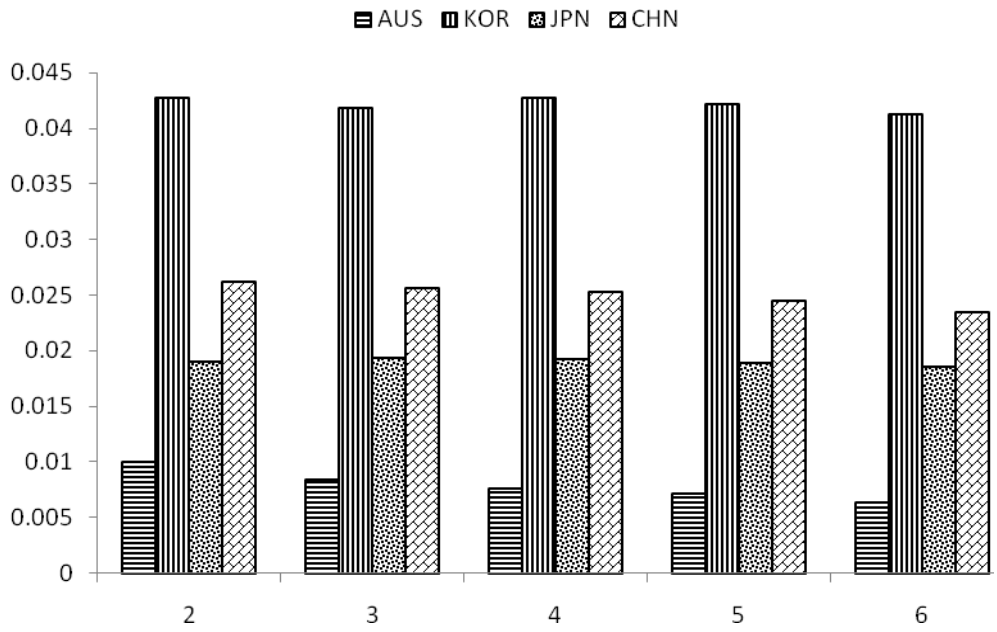
A similar calculation for non-ASEAN countries in the region is shown in Table 5. Interestingly, there is no evidence that a grouping of China–Japan–Korea is welfare improving for any of the partners. Only for Japan is China the best partner, while Korea gains most from links with Australia, and China gains most from links with the Philippines. Australia gains relatively little, in terms of stability, from risk-sharing links within the region, but contributes a lot. As in the case of the ASEAN 5, the bulk of gains come from the first pair and there is little gained or lost by adding members to the pools.

Table 5. Ideal Risk-Sharing Partner for Non–ASEAN 5 Countries and Its Welfare Implications

	Ideal partner				
Country	**2**	**3**	**4**	**5**	**6**
Australia	AUS-IDN	AUS-IDN-SGP	AUS-IDN-SGP-UK	AUS-IDN-SGP-UK-PHL	AUS-IDN-SGP-UK-PHL-CHN
Variance					
2.912	–0.4585	0.0776	0.3656	0.5296	0.6517
Welfare	[0.01]	[0.0084]	[0.0076]	[0.0071]	[0.0063]
Korea	KOR-AUS	KOR-AUS-CHN	KOR-AUS-CHN- PHL	KOR-AUS-CHN-PHL-SGP	KOR-AUS-CHN-PHL-SGP-MYS
Variance					
13.937	0.1048	0.3696	0.1046	0.2757	0.5856
Welfare	[0.0427]	[0.0418]	[0.0427]	[0.0421]	[0.0412]
Japan	JPN-CHN	JPN-CHN-PHL	JPN-CHN-PHL-AUS	JPN-CHN-PHL-AUS-SGP	JPN-CHN-PHL-AUS-SGP-MYS
Variance					
6.697	0.3922	0.2885	0.3411	0.4273	0.5712
Welfare	[0.019]	[0.0193]	[0.0192]	[0.0189]	[0.0185]
China	CHN-PHL	CHN-PHL-AUS	CHN-PHL-AUS-SGP	CHN-PHL-AUS-SGP-MYS	CHN-PHL-AUS-SGP-MYS-JPN
Variance					
8.298	–0.3544	–0.1495	–0.0064	0.2215	0.5712
Welfare	[0.0262]	[0.0256]	[0.0252]	[0.0245]	[0.0234]

Source: Authors' calculations. *Note*: In performing the above welfare calculations, we use the following assumptions: i) γ =5, θ =2, and β =0.95; ii) growth rates = 3 percent.

Figure 5. Welfare Effects for Non-ASEAN Countries



5. Conclusions

This chapter addresses the question of how much welfare could be gained by countries in the East Asian region from greater use of the risk-sharing opportunities that are presented by integration with countries that have different patterns of income variation. The relatively low level of international risk sharing globally has been widely noted. The low level of consumption smoothing and risk sharing amongst East Asian countries has also been previously noted. A frequent conclusion has been that the scale of the benefits is not large enough to overcome the home bias in investment that probably results from financial market friction and from a lack of confidence in institutional and legal structures to support cross-border financial transactions. More recent work, such as that of Callen et al. (2009), however, argues that the welfare gains are much more significant than previously estimated. We adapt the method of Callen et al. (2009) to estimate the risk reduction and welfare improvement from optimal pools of

nine countries in East Asia with each other plus the addition of the United Kingdom and the United States (to capture the possible benefits of links with highly developed countries well outside the region). Our results confirm that the welfare gains can be significant—at up to 5 percent of annual consumption for some countries. More strikingly, we show that for most countries in the region the bulk of gains comes from pairs (that is, pools of two), with relatively little additional risk reduction added by larger pools. For most countries, the best pair is a developed country with a different business-cycle pattern—often, Australia. There is no evidence that the current ASEAN 5 grouping is optimal in terms of risk reduction, or that there are gains from a grouping of China–Japan–Korea.

The method employed in the chapter has some limitations. It does not conduct a systematic search over all possible combinations of countries either within the region or across the globe. In order to keep computations simple, we developed a recursive technique that examines the effect of larger pools once the best small pool has been established. It is possible that this technique misses some better pool combinations that exclude the initial best partner, though the frequency of such combinations is likely to be low. We also show in the appendix that if actual growth is higher than the 3 percent we assumed, the scale of welfare gain is somewhat reduced. Importantly, changing the weights assigned to each country in the pool also changes the choice of best partner, with implications described below.

These limitations suggest important directions for future research. To draw solid and credible policy conclusions about the sensitive matter of the best choice of partners for integration gains, this research should be extended to use the full Callen et al. (2009), or similar, method to examine all possible combinations for East Asian countries. Further research is also needed to examine the appropriate parameter values for preferences, elasticities of inter-temporal substitution and risk aversion within the region, rather than using standard global norms. In addition, since optimal choices depend on the weights of countries in the possible pools (see Appendix 2), alternative calculations should explore the use of weights averaged over a plausible period to give a more representative value than the two extreme end-point weights we use in the text and the appendix. There would also be value in forecasting the change in partner

composition if differential growth rates result in foreseeable changes in the weights in the region (for example, the rise of China).

We have also focused exclusively on the welfare gains from the smoothing of income and consumption volatility. Our optimal pools do not, therefore, take account of trade gains that might arise from choosing the most trade-creating partnerships for free-trade agreements (which in any case we know would, optimally, be global rather than regional), nor do they say anything about the choice of partners to join in monetary agreements or common currency areas. Nonetheless, they demonstrate the possibility of deriving concrete information on another aspect of regional integration and one that should also become a standard part of the discussion of the benefits of closer financial integration to achieve risk diversification.

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Appendix 1. Effects of Pool Size for Individual Countries

Here we show the individual country welfare and variance changes with the "best" partners in each pool size. Note these calculations use the standard parameter values described in the text, our limited recursive method of calculation and the beginning-period weights in the variance–covariance matrix. As noted in Appendix 2, the best combinations, and the welfare values, will change with different weight and growth rate assumptions.

Figure A1.1. Dynamics of Singapore's Best Pool

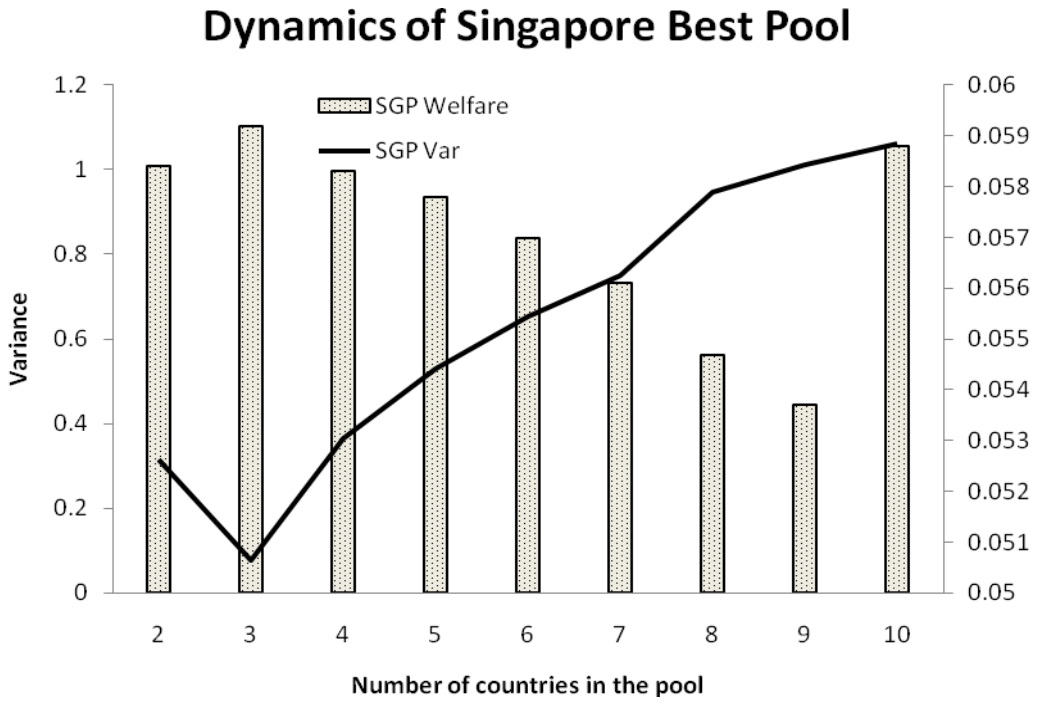


Figure A1.2. Dynamics of Indonesia's Best Pool

Figure A1.3. Dynamics of Korea's Best Pool

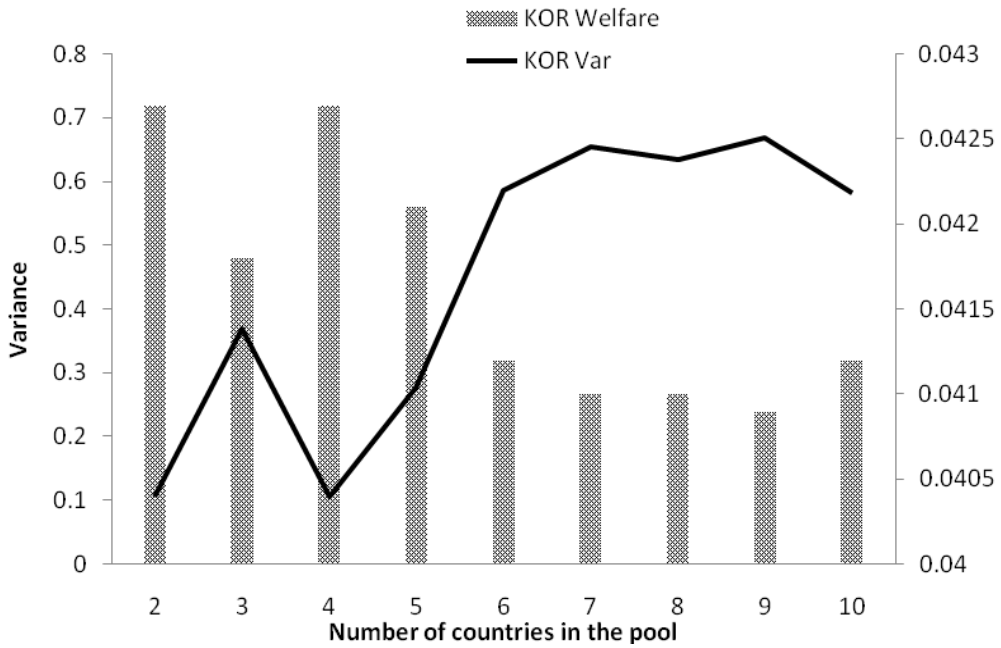


Figure A1.4. Dynamics of Malaysia's Best Pool

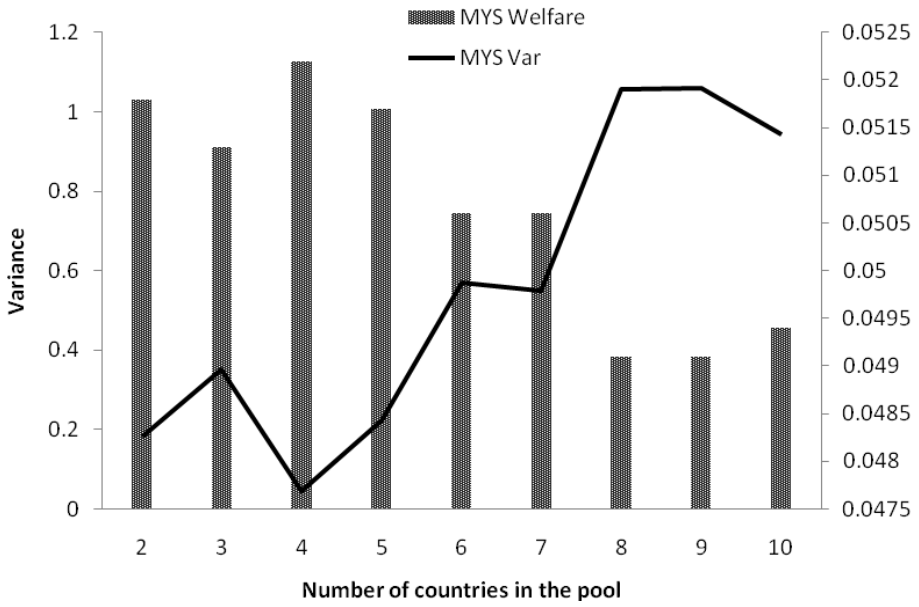


Figure A1.5. Dynamics of Japan's Best Pool

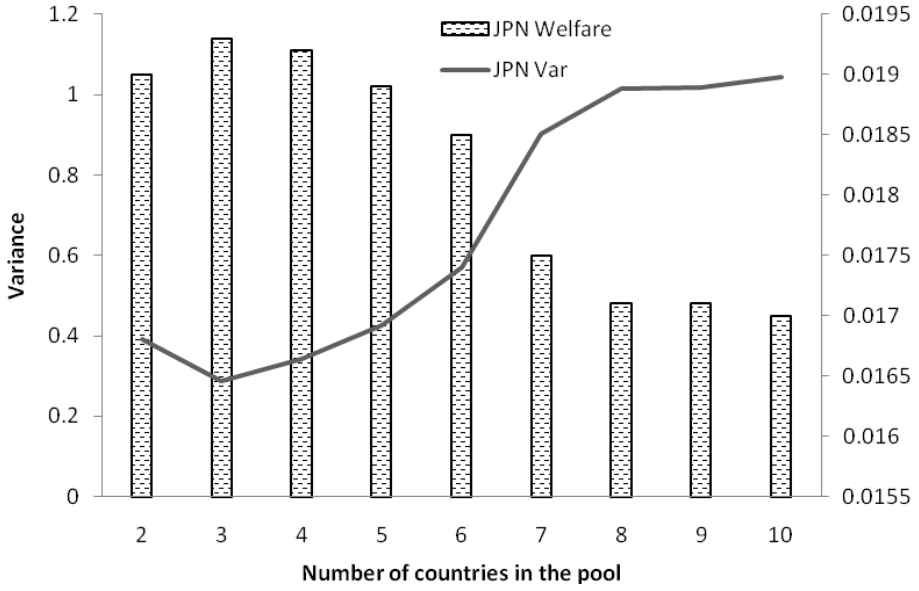


Figure A1.6. Dynamics of Thailand's Best Pool

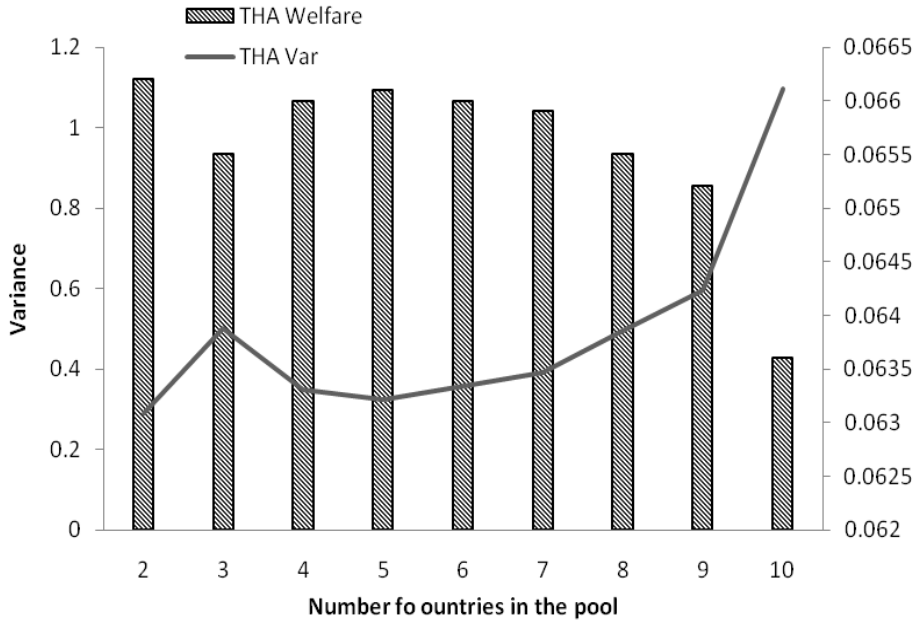


Figure A1.7. Dynamics of Australia's Best Pool

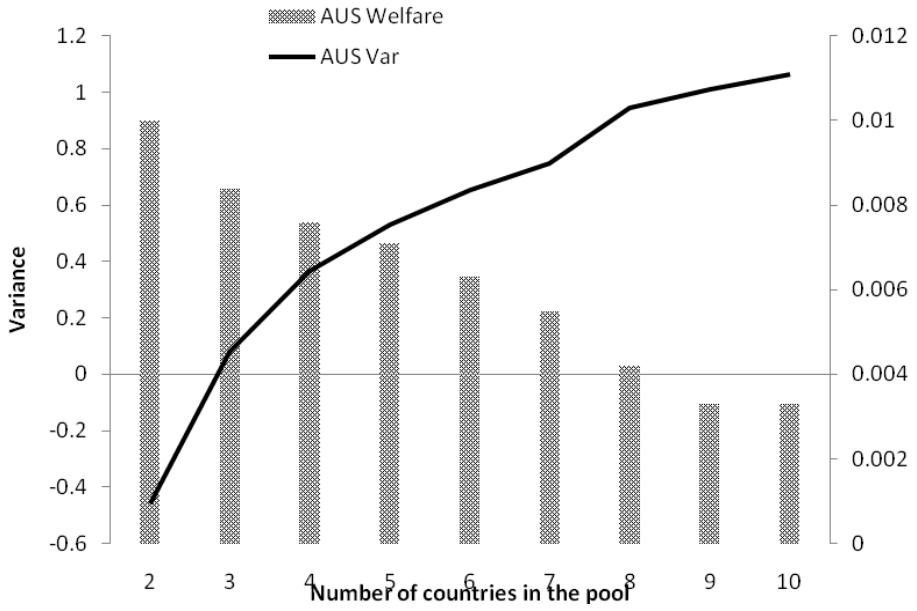
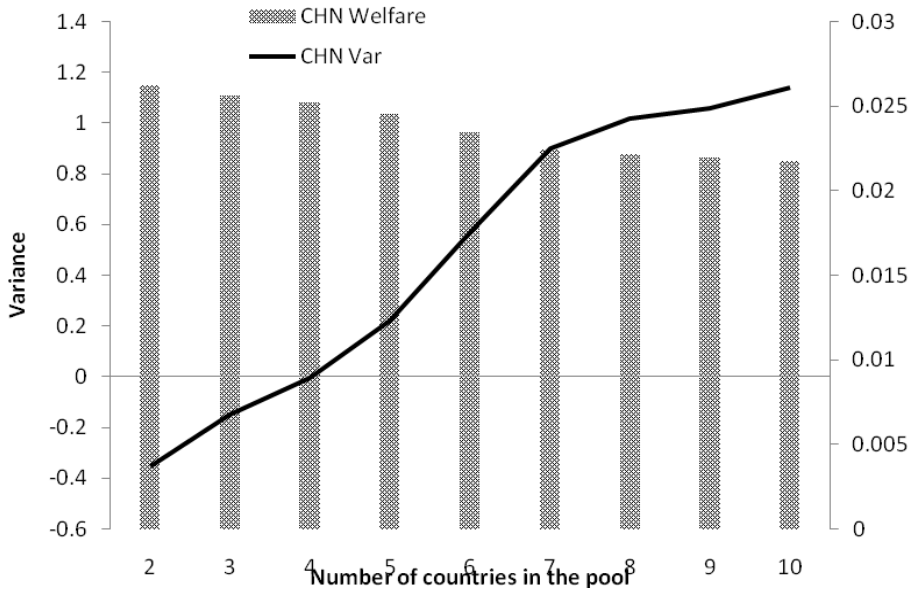


Figure A1.8. Dynamics of China's Best Pool



Appendix 2. Effect of Parameter Values Assumptions on Welfare Calculations

Altering the Assumptions

To compute the welfare implication of pooling, assumptions are needed for the following parameters: the discount rate, β , the coefficient of relative risk aversion, γ , and the inverse elasticity of inter-temporal substitution, θ . In addition to these parameters, an assumption is needed for the expected GDP growth rates for each country and for the pools. Given the scope of this chapter, we did not test the effects of different assumptions for all of these variables, but this appendix provides a simple sensitivity analysis of how the metric of welfare changes with different values of growth rates and how the ideal risk pooling between countries changes as we change the weights for covariance matrix estimation for GDP growth rates. We find that raising the growth rates to 5 percent (from the original assumption of 3 percent) decreases countries' gains from pooling. In addition, the method of calculating pool-wide variance is quite sensitive to changes in the variance weight of countries. We show this using countries' 2009 GDP as the weight for the covariance matrix estimations and find that the combinations of ideal risk-sharing partners for countries are sensitive to this assumption.

Growth Rate at 5 Percent Instead of 3 Percent

In the chapter, we assume that the expected growth rate is the same for the whole sample of countries and the various pools. To preserve comparability with Callen et al. (2009), we use the assumption of 3 percent expected growth rates and values of 2 for the coefficient of relative risk aversion, and 5 for the inverse elasticity of inter-temporal substitution. Using these values, Callen et al. (2009) find that (total income-weighted) welfare gains are monotonically increasing with pool size. In our results, in contrast, adding more countries to the ideal risk-sharing pool often causes the welfare for individual countries to decrease. Take Malaysia as an example. Malaysia's highest welfare gain is when paired with Australia. Malaysia experiences a 5.18 percent

increase in annual consumption and the figure drops when adding more countries to Malaysia's ideal-pool countries.

Table A 2.1. Risk Sharing Ideal partner for ASEAN 5 Countries and Its Welfare Implications with Growth at 5%

	Ideal Partner				
Country	**2**	**3**	**4**	**5**	**6**
Indonesia	IDN-AUS	IDN-AUS-SGP	IDN-AUS-SGP-UK	IDN-AUS-SGP-UK-PHL	IDN-AUS-SGP-UK-PHL-CHN
Poolwide variance	-0.4585	0.0776	0.3656	0.5296	0.6517
Welfare	[0.043]	[0.0417]	[0.041]	[0.0406]	[0.04]
Philippines	PHL-CHN	PHL-CHN-AUS	PHL-CHN-AUS-SGP	PHL-CHN-AUS-SGP-MYS	PHL-CHN-AUS-SGP-MYS-JPN
Poolwide variance	-0.3544	-0.1495	-0.0064	0.2215	0.5712
Welfare	[0.0311]	[0.0306]	[0.0302]	[0.0297]	[0.0288]
Singapore	SGP-AUS	SGP-AUS-IDN	SGP-AUS-IDN-UK	SGP-AUS-IDN-UK-PHL	SGP-AUS-IDN-UK-PHL-CHN
Poolwide variance	0.3155	0.0776	0.3656	0.5296	0.6517
Welfare	[0.0459]	[0.0464]	[0.0457]	[0.0453]	[0.0447]
Malaysia	MYS-AUS	MYS-AUS-CHN	MYS-AUS-CHN-PHL	MYS-AUS-CHN-PHL-SGP	MYS-AUS-CHN-PHL-SGP-JPN
Poolwide variance	0.1814	0.3506	0.0457	0.2215	0.5712
Welfare	[0.0407]	[0.0403]	[0.041]	[0.0406]	[0.0398]
Thailand	THA-AUS	THA-AUS-USA	THA-AUS-USA-PHL	THA-AUS-USA-PHL-IDN	THA-AUS-USA-PHL-IDN-SGP
Poolwide variance	0.2915	0.5029	0.3496	0.3254	0.3564
Welfare	[0.0518]	[0.0513]	[0.0517]	[0.0518]	[0.0517]

Source: Authors' calculation Notes: In performing the above welfare calculations we use the following assumptions. (i) γ =5, θ =2 , and β =0.95 (ii) growth rates= 5 %

Table A 2.2. Risk sharing ideal partner for Non ASEAN 5 Countries and Its Welfare Implications with Growth at 5%

	Ideal Partner				
Country	2	3	4	5	6
Australia	AUS-IDN	AUS-IDN-SGP	AUS-IDN-SGP- UK	AUS-IDN-SGP- UK-PHL	AUS-IDN-SGP- UK-PHL-CHN
Variance	-0.4585	0.0776	0.3656	0.5296	0.6517
Welfare	[0.008]	[0.0067]	[0.006]	[0.0056]	[0.005]
Korea	KOR-AUS	KOR-AUS-CHN	KOR-AUS-CHN- PHL	KOR-AUS-CHN- PHL-SGP	KOR-AUS-CHN- PHL-SGP-MYS
Variance	0.1048	0.3696	0.1046	0.2757	0.5856
Welfare	[0.0336]	[0.033]	[0.0336]	[0.0332]	[0.0324]
Japan	JPN-CHN	JPN-CHN-PHL	JPN-CHN-PHL- AUS	JPN-CHN-PHL- AUS-SGP	JPN-CHN-PHL- AUS-SGP-MYS
Variance	0.3922	0.2885	0.3411	0.4273	0.5712
Welfare	[0.015]	[0.0153]	[0.0152]	[0.015]	[0.0146]
China	CHN-PHL	CHN-PHL-AUS	CHN-PHL-AUS- SGP	CHN-PHL-AUS- SGP-MYS	CHN-PHL-AUS- SGP-MYS-JPN
Variance	-0.3544	-0.1495	-0.0064	0.2215	0.5712
Welfare	[0.0207]	[0.0202]	[0.0199]	[0.0193]	[0.0185]

Source: Authors' calculation Notes: In performing the above welfare calculations we use the following assumptions. (i) γ =5, θ =2 , and β =0.95 (ii) growth rates= 5 %

Changing the Weight to the End Period

Table A2.3 shows the effect of changing the weights for pool variance calculation. Callen et al. (2009) use the value of real GDP of each country in the first year of their observation to calculate the weights. In our case, using the beginning period values as country weights, we found that the ideal two-pair partner for Indonesia, Singapore, Malaysia and Thailand is Australia, while the ideal two-pair partner for the Philippines is China. Changing the weights has a significant effect, so that, when using the end of the period as countries' weight, we find that the ideal two-pair partner for Indonesia, Singapore, Malaysia and Thailand is the United Kingdom, while for the Philippines it is the United States of America. This suggests that further research is needed to track the changes in the economic structure of the region over the past 20 years and to examine the changes in optimal grouping as different countries rise in importance.

Table A2.3. Ideal Risk-Sharing Partners for ASEAN 5 Countries and their Welfare Implications (Using end year as weight)

Country	Ideal Partner				
	2	**3**	**4**	**5**	**6**
Indonesia	IDN-UK	IDN-UK-AUS	IDN-UK-AUS-PHL	IDN-UK-AUS-PHL-SGP	IDN-UK-AUS-PHL-SGP-USA
Pool-wide variance	–0.5798	0	–0.3038	0.2533	0.4767
Welfare	[0.0672]	[0.0663]	[0.0655]	[0.0646]	[0.0636]
Philippines	PHL-USA	PHL-USA-IDN	PHL-USA-IDN-THA	PHL-USA-IDN-THA-MYS	PHL-USA-IDN-THA-MYS-AUS
Pool-wide variance	0.2507	0.3183	0.1743	0.2245	0.2705
Welfare	[0.0419]	[0.0374]	[0.0421]	[0.0331]	[0.0418]
Singapore	SGP-UK	SGP-UK-IDN	SGP-UK-IDN-AUS	SGP-UK-IDN-AUS-PHL	SGP-UK-IDN-AUS-PHL-USA
Pool-wide variance	0.2098	–0.0569	0.014	0.2533	0.4767
Welfare	[0.0523]	[0.0532]	[0.0529]	[0.0522]	[0.0409]
Malaysia	MYS-UK	MYS-UK-SGP	MYS-UK-SGP-AUS	MYS-UK-SGP-AUS-JPN	MYS-UK-SGP-AUS-JPN-USA
Pool-wide variance	–0.1766	0.2037	0.3779	0.5071	0.4685
Welfare	[0.0558]	[0.0546]	[0.0541]	[0.0537]	[0.0538]
Thailand	THA-UKA	THA-UKA-IDN	THA-UKA-IDN-AUS	THA-UKA-IDN-AUS-SGP	THA-UKA-IDN-AUS-SGP-USA
Pool-wide variance	–0.04	0.4747	0.0085	0.4731	0.4801
Welfare	[0.0712]	[0.0514]	[0.0711]	[0.0656]	[0.0696]

Source: Authors' calculations.

Note: In performing the above welfare calculations, we use the following assumptions: i) γ =5, θ =2, and β =0.95; ii) growth rates = 3 percent.

Table A2.4. Ideal Risk-Sharing Partners for ASEAN 5 Countries and their Welfare Implications (Using end year as weight)

Country	Ideal Partner				
	2	3	4	5	6
Australia	AUS-IDN	AUS-IDN-UK	AUS-IDN-UK-PHL	AUS-IDN-UK-PHL SGP	AUS-IDN- UK-PHL SGP-USA
Poolwide Variance	-0.4272	-0.3038	-0.0516	0.2533	0.4767
Welfare	[0.0112]	[0.0109]	[0.0101]	[0.0092]	[0.0082]
Korea	KOR-AUS	KOR-AUS-CHN	KOR-AUS-CHN-JPN	KOR-AUS-CHN-JPN PHL	KOR-AUS-CHN-JPN PHL-SGP
Poolwide Variance	0.0537	0.3696	0.5306	0.3949	0.4419
Welfare	[0.0424]	[0.0418]	[0.0408]	[0.0413]	[0.0412]
Japan	JPN-UKA	JPN-UKA-PHL	JPN-UKA-PHL-AUS	JPN-UKA- PHL-AUS CHN	JPN-UKA- PHL-AUS CHN-SGP
Poolwide Variance	0.2262	0.2006	0.2822	0.2627	0.2889
Welfare	[0.0145]	[0.0146]	[0.0143]	[0.0144]	[0.0143]
China	CHN-JPN	CHN-JPN-PHL	CHN-JPN-PHL-AUS	CHN-JPN-PHL-AUS SGP	CHN-JPN- PHL-AUS SGP-MYS
Poolwide Variance	0.2387	0.0625	0.0456	0.0897	0.18
Welfare	[0.0262]	[0.0267]	[0.0268]	[0.0267]	[0.0264]

Source: Authors' calculations.

Note: In performing the above welfare calculations, we use the following assumptions: i) γ =5, θ =2, and β =0.95; ii) growth rates = 3 percent.