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Risk Properties of AMU denominated Asian Bonds*

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Abstract

This paper is to investigate risk properties of AMU (Asian Monetary Unit) denominated Asian bonds by comparing them with those of local currency denominated bonds issued in East Asian countries. We suppose the AMU as an Asian currency unit which is formed as a currency basket of East Asian currencies. In this paper, we simulate a currency basket composed by ASEAN5 countries, Japan, China, Korea, and Hong Kong. Our results indicate that the AMU denominated bonds can lower the risks for both US and Japanese investor. It is because the portfolio effects should reduce the foreign exchange risk. These results depend on the currency system in the East Asian countries.

JEL classification: F31, F33, G15

Key words : Asian bond, a currency basket, AMU(Asian Monetary Unit),, foreign exchange risk

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1. Introduction

After experiencing the Asian Crisis in 1997, East Asian countries have recognized the underlying problems caused by double overdependence on banking sector in their financial systems and on the US dollar in their currency systems. We can propose to establish an Asian bond market denominated in terms of not the US dollar but a basket currency as the method of solving both the problems simultaneously. The monetary authorities of East Asian countries including Japan are actually promoting the Asian Bond Market Initiative, that is, an international cooperation to establish the Asian bond markets in East Asia.

Recent discussion of the Asian Bond Market Initiative focuses on the choice of denomination currency as well as the credit guarantee and rating agency. For example, Ito (2003) proposed an Asian bond which is designed to be a fund of the local currency denominated bonds issued by governments of East Asian countries. On one hand, a group of central banks in East Asia is considering a fund composed with the local currency denominated bonds is examined as an Asian Bond Fund (ABF) Part II. It follows the Asian Bond Fund which consists of the US dollar denominated bonds.

Ogawa and Shimizu (2002, 2004) supposed the G3 currency basket (a currency

basket of the US dollar, the euro, and the Japanese yen) denominated bond as a Asian bond to compare it with each of single currency (the US dollar, the euro and the Japanese yen) denominated bond in terms of interest risk and foreign exchange risk. In this paper, we suppose another currency basket denomination to investigate their risk properties. As Kawai, Ogawa and Ito (2004) discussed, the AMU which is composed of the currency basket of ASEAN+3 currencies would be expected to be equivalent to the G3 currency basket if each of East Asian countries adopted the common G3 currency basket as a reference or target in conducting their exchange rate policies. The G3 currency basket denominated Asian bond and the AMU denominated Asian bond would be equivalent to each other even though there are some differences between them in the current situation.

The reminder of this paper consists of the following sections. Section 2 briefly summarizes the preceding literature on the related issues. Section 3 describes our method to simulate risks of the AMU denominated bond to compares the risk properties between the AMU denominated bond and each of local currency denominated bond issued in East Asian countries. Section 4 considers foreign exchange risk reduction through international diversified investments and effectiveness of the AMU denominated bond in reducing the foreign exchange risk.

The final section offers concluding remarks.

2. Contagion of financial crisis and Asian bond markets

It is pointed out that a financial crisis in a country is spilled over to neighboring countries. It is one of the main features of the financial crisis happened across the world in 1990s. In the Asian Crisis, the strong trade linkages among the East Asian countries caused to propagate the crisis throughout the regional economies. In addition, some emphasize the imperfections of the international financial markets as one of the major reasons of a contagion (Krugman(1999), and Kaminsky, Lyons, and Schmukler(2003)).

One approach to explain the contagion of financial crisis uses the finance theory of portfolio management. Schinasi and Smith (1999) used a model of the basic portfolio theory to explain "contagion selling" of higher risk assets. They showed that a shock to a single asset's return distribution may lead to a reduction in position of other risky assets.[2] In addition, Mello and Hussein (2001) used a simple model of foreign debt portfolio management to explain that the currency

[2] They conclude that an investor with a leveraged portfolio will reduce risky asset positions if the return on the leveraged portfolio is less than the cost of funding.

composition of a country's foreign debt portfolio was responsive to exchange rate movements. They conducted an empirical analysis on the existence of a stable long-run relationship between the currency composition of a country's foreign debt portfolio and exchange rate movements in the case of fourteen emerging market economies and four major currencies (the US dollar, the Deutsche mark, the Japanese yen, and the Swiss francs) during an analytical period of 1970-1998. They obtained a result that foreign debt portfolios were not managed optimally for the investors in the sense that adverse movements in the exchange rates were not offset by increasing portfolio shares of debts denominated in terms of appreciating currencies.[3]

On one hand, we have recognized that the regional cooperation is necessary to cope with the currency crisis which occurred in East Asia in 1997-1998. There are several policy suggestions in order to strengthen the regional financial cooperation in East Asia. Kuroda and Kawai (2003) recommend a more effective surveillance

[3] This is particularly true in the case of the Japanese yen denominated foreign debt. The persistent appreciation of the Japanese yen vis-à-vis the US dollar has not made investors reduce the volume of the Japanese yen denominated debt in their portfolios. These findings may be attributed to some rigidity in the currency composition of foreign debts, which impose constraints on portfolio diversification for investors.

process and consider the option on creating a common pool of foreign exchange reserves to allow flexible financial supports at times of crises and their contagion while minimizing the problem of moral hazard. Recently, the monetary authorities in East Asian countries established the Cheng Mai Initiative that is a swap agreement in order to prevent another currency and financial crises in the future.[4] Establishing and developing regional bond markets in East Asia is also recommended in order to circulate directly regional savings into regional investments in East Asia. In addition, we often discuss possibilities to introduce a common currency or a common currency basket unit as a new regional financial architecture in East Asia.[5]

Concerning the effectiveness of basket currency denominated bonds in East Asian countries, Ogawa and Shimizu (2002, 2004) conducted empirical analyses which compared the G3 currency basket (a currency basket of the US dollar, the euro, and the Japanese yen) denominated bonds and each of single currency

[4] The Chiang Mai Initiative, agreed in May 2000, created bilateral swap agreements worth $40 billion.

[5] As for the existing research concerning the common currency basket system, Ito, Ogawa, and Sasaki (1999), Bénassy-Quéré (1999), Williamson (2000), Ogawa and Ito (2002) and Ogawa, Ito and Sasaki (2002)) are listed.

denominated bonds including local currencies of ASEAN5 countries, Korea, China, Hong Kong, and Taiwan as well as the three major currencies in terms of both relative risk and liquidity. The analytical result showed that issuing a currency basket denominated bond would contribute to reducing foreign exchange risk for bond issuers in East Asian countries excluding the dollar pegging countries which include Malaysia, China, and Hong Kong. In addition, the currency basket denominated bonds could reduce the foreign exchange risk for international investors in many cases.

In Ogawa and Shimizu (2002, 2004), we supposed the G3 currency basket as a denomination currency of the Asian bonds. We can suppose another type of currency basket bond whose currency basket is composed of local currencies such as the AMU in East Asia. It is important to recognize risk properties of the currency basket denominated bonds in designing currency basket denominated Asian bonds. An objective of this paper is to investigate the risk properties of the AMU denominated bonds by comparing with them of each of local currency denominated bond issued in East Asian countries.

We use yield data of East Asian bonds to simulate returns of the AMU denominated bonds. In addition, we divide the their returns into interest returns

and foreign exchange returns to compare the AMU denominated bonds and each of the local currency denominated bonds in terms of both interest rate and foreign exchange risks.

3. Risk properties of the AMU denominated bonds and single local currency denominated bonds

In this section, we use the yield data of benchmark bonds issued in the nine East Asian countries that include ASEAN5 countries, Japan, China, Korea, and Hong Kong to investigate their risk properties. We simulate returns and risks of for the AMU denominated bonds.

3-1. Risk properties of single local currency denominated bonds in East Asia

3-1-1. Data and calculation formulas

At first, we explain yield data of the nine East Asian countries. Table 1 shows the details of the yield data of benchmark bond in the nine East Asian countries. They are denominated in terms of the local currency.

Next, we calculate returns for international investors who evaluate their returns in terms of the major currencies such as the US dollar. We suppose that

there are two types of international investors who evaluate their returns in terms of the US dollar and who evaluate their returns in terms of the Japanese yen. Standard deviations of returns are used as risk of investing the bonds. We show average returns, standard deviation of returns as investment risks, and a ratio of returns to risk (the Sharpe ratio) for each of the bonds.

We suppose two investment time horizons which include one month and six months in order to look at effects of the time horizons on reducing risks. We calculate the following method for returns of investing the bonds. An investor who evaluate in terms of the US dollar is supposed to exchange an initial US dollar to a local currency at the relevant exchange rate, purchase a local currency denominated bond at its price in terms of the local currency, hold it for 1 month (6 months), sell it at its price in terms of the local currency 1month (6month) later, and exchange the revenue in terms of local currency into the US dollar. [6] [7] The returns are divided into two factors which include interest rate (bond yield) returns and the foreign

[6] We suppose the case in which investors do not use forward swap transaction for covering foreign exchange risk.

[7] We suppose each local bond as a zero coupon bond. In addition, the yield data are rate on annual basis, so we convert them on monthly basis for calculation.

exchange returns. We calculate the similar method for returns for an investor who evaluate in terms of the Japanese yen.

Our formula of calculating a value of a local currency denominated bond in terms of the US dollar for one month investment is represented as follows:

$$\begin{aligned} \textit{Bond Value}_t(\textit{USdollar equivalent}) &= 100 \times E_t \times (1 + Y_t) / E_{t+1} \\ &= 100 + \left(100 \times E_t \times Y_t / E_{t+1}\right) + \left(100 \times E_t / E_{t+1} - 100\right) \\ &\quad (= \text{principal} + \text{interest return} + \text{foreign exchange return}) \end{aligned} \tag{1}$$

where E_t : closing rate of foreign exchange rate against the US dollar at month t, Y_t : closing rate of bond yield on monthly basis at month t.

Yield data is used to calculate interest returns for each of the bonds. As for foreign exchange returns, we calculate actual ex-post returns which are uncovered by forward transaction at the beginning of month and realized when the bond values are converted to the US dollar at the end of month.

Our formula of calculating a value of a local currency denominated bond in terms of the US dollar for six month investments is represented as follows:

$$\begin{aligned} \textit{Bond Value}_t(\textit{USdollar equivalent}) &= 100 \times E_t \times (1 + Y_t^{t+6}) / E_{t+6} \\ &= 100 + \left(100 \times E_t \times Y_t^{t+6} / E_{t+6}\right) + \left(100 \times E_t / E_{t+6} - 100\right) \\ &\quad (= \text{principal} + \text{interest return} + \text{foreign exchange return}) \end{aligned} \tag{2}$$

where E_t : closing rate of foreign exchange rate against the US dollar at month t, Y_t^{t+6} : bond yield calculated at compound interest for six months at month t.

Values of a local currency denominated bond in terms of the Japanese yen for one month and six month investments are calculated in the same way as that in terms of the US dollar.

3-1-2. A case of one month investment

Table 2 shows both bond values and returns of local currency denominated bond for one month investments for investors who evaluate them in terms of the US dollar. During the sample period, there are clear differences in standard deviations of the bond values between the dollar-pegging countries (Malaysia, China, and Hong Kong) and the others. In the dollar-pegging countries, the standard deviations of bond values are far lower than those in the other countries. Their fluctuations are mainly attributed to fluctuations in interest returns for bonds issued in terms of the dollar-pegged currencies. The standard deviation of the HK dollar denominated bond is the highest among the three dollar pegging countries.

On one hand, the standard deviations of bond value for local bonds denominated in terms of the non-dollar-pegged currencies are relatively high in comparison with the dollar-pegged currency denominated bonds. Fluctuations in

the bond values are mainly attributed to fluctuations of foreign exchange return, which are far lager than those of interest return. Among the non-dollar-pegging countries, the Singaporean bond has the lowest standard deviation of bond value (1.35%). The Japanese bond has the highest standard deviation (2.51%) and the Korean bond has the second highest one (2.45%).[8] Concerning the average of bond values, the Korean bond has the highest (100.56) and the Malaysian bond has the lowest (100.25). The Sharpe ratios of the dollar-pegged currency denominated bonds are much larger than those of the non-dollar-pegged currencies denominated bonds. Among the non-dollar-pegged currency denominated bonds, the Philippine bond has the lowest Sharpe ratio (0.16) and the Singaporean and Korean bonds have the highest (0.23).

Table 3 shows both bond values and returns of single local currency denominated bond for investors who evaluate them in terms of the Japanese yen. In contrast to investors who evaluate them in terms of the US dollar, the standard deviations of bond value are not so different between the dollar-pegging countries and the others. Their levels are much higher than those of bond value in terms of

[8] Due to the lack of sample number, we do not compare the standard deviations of Chinese and Indonesian bonds.

the US dollar. The Singaporean bond has the lowest standard deviation (2.40%) while the Philippine bond has the highest one (3.34%) among the local bonds except for the Japanese bond. The fluctuations are mainly attributed to fluctuations in foreign exchange returns. Concerning the average of bond values, the Korean bond has the highest (100.44) and the Malaysian bond has the lowest (100.15). As for the Sharpe ratio, the Korean bond has the highest (0.15) and the Malaysian bond has the lowest (0.05) though there are not so much differences between them.

3-1-3. A case of six month investment

Table 4 shows both bond values and returns of single local currency denominated bonds in the case of six month investments for investors who evaluate them in terms of the US dollar. Table 3 shows almost the same characteristics as Table 1. Standard deviations of the bond value for the dollar-pegged currencies denominated bonds are lower than the others. In addition, variation of standard deviation among the non-dollar-pegging countries is larger in the case of the six month investment than the case of the one month investment. Among the non-dollar-pegging countries, the Singaporean bond has the lowest standard deviation (2.51%), the Japanese bond has the highest (7.69%), and the Korean bond bas the second highest (6.05%). Fluctuations of the bond value of the non-dollar-

pegged currency denominated bonds are mainly attributed to the fluctuations of foreign exchange return. However, the fluctuation of interest return is larger than the case of one month investments. It means that the differences of bond yield between countries are more important in the case of six month investments than the case of one month investment. The Sharpe ratios are higher in the case of six month investments than the case of one month investments. It means that the longer is the investment period, the higher is the relative returns in terms of risks.

Table 5 shows both bond values and returns of local currency denominated bond for investors who evaluate them in terms of the Japanese yen for six month investment. The standard deviations of bond values are entirely higher than the case of one month investments. Excluding the Japanese bond, the Philippine bond has the highest standard deviation (9.22%) while the Singaporean bond has the lowest (5.67%). The impacts of interest returns on bond value are larger than the case of one month investments. Furthermore, the impacts of foreign exchange returns and their fluctuations are larger than the case of one month investments. Thus, the foreign exchange returns are still a main factor of the fluctuations of bond values for the investors who evaluate them in term of the Japanese yen. As for the average of bond values, the Korean bond has the highest (103.02) while the

Malaysian bond has the lowest (101.11). Concerning the Sharpe ratio, the Korean bond has the highest (0.51) while the Malaysian bond and Philippine bond (0.15) have the lowest. These levels are higher than the case of one month investments though they are still lower than for the investors who evaluate them in terms of the US dollar.

3-2. Risk properties of AMU denominated bonds

3-2-1. Composition of AMU denominated bonds and calculation formulas

Next, we simulate returns of the AMU denominated bonds which are composed of the nine East Asian countries' government bonds to investigate their risk properties. In order to simulate the AMU denominated bonds, we have to make criteria to decide composition of each country's government bond in the AMU denominated bonds.

We use an equal composition as one criterion. We suppose an AMU denominated bond which is composed of each of the East Asian countries' government bonds with an equal share. On the other hand, practically, in the cases of international bond funds, which investors often use as an index for international portfolio investments, their composition are based on market capitalization. For

example, the Asian Dollar Bond Index (ADBI) of HSBC is calculated on the basis of shares of the total market capital in each of East Asian countries. Here we suppose that the AMU denominated bonds are composed of the government bonds of East Asian countries. Table 6 shows their current outstanding in the market. It indicates that the current outstanding of the Japanese government bond is much larger than the other East Asian countries. The Japanese bond would occupy extremely large part of the AMU denominated bond if we decide its composition on the basis of the current outstanding of the government bonds in market. It is difficult for us to use it as a criterion for Asian bond's composition.

Instead, we shall use two kinds of data regarding external debts classified by country. The data is quarterly data which is obtained from the *Quarterly Review* of BIS. The two kinds of data include International Debt Securities by Nationality of Issuer (Table 12A in the *Quarterly Review*) and International Bonds and Notes by Country of Residence (Table 14B in the *Quarterly Review*). According to these data, we calculate two patterns of country weights. Table 7 and Table 8 show the composition weights depend on data of International Debt Securities by Nationality of Issuer and International Bonds and Notes by Country of Residence, respectively.

We simulate returns of the three types of the AMU denominated bonds

according to the above criteria. We simulate them by supposing that investors invest in the AMU denominated bonds for one or six months and evaluate in terms of the US dollar or the Japanese yen in the same way as the above simulation for the single local currency denominated bonds.

Our formula of calculating a value of the AMU denominated bonds in terms of the US dollar for one month investment is represented as follows:[9]

$$\begin{aligned} \textit{Bond Value}_t(\textit{USdollar} \quad \textit{equivalent}) &= \sum_{i=1}^{9} w_i \cdot \left(100 \times E_{t,i} \times \left(1 + Y_{t,i}\right) \Big/ E_{t+1,i} \right) \\ &= 100 + \sum_{i=1}^{9} w_i \cdot \left(100 \times E_{t,i} \times Y_{t,i} \Big/ E_{t+1,i} \right) + \sum_{i=1}^{9} w_i \cdot \left(100 \times E_{t,i} \Big/ E_{t+1,i} - 100 \right) \end{aligned} \tag{3}$$

(= principal + interest return + foreign exchange return)

where $E_{t,i}$: closing rate of foreign exchange rate of country i against the US dollar at month t, $Y_{t,i}$: closing rate of bond yield of country i on monthly basis at month t.

Our formula of calculating a value of the AMU denominated bonds in terms of the US dollar for six month investment is represented as follows:

[9] We suppose the AMU denominated Asian bond as a portfolio investment into the nine East Asian countries' government bond in this paper.

$$Bond\ Value_t\ (USdollar\quad equivalent) = \sum_{i=1}^{9} w_i \cdot \left(100 \times E_{t,i} \times \left(1 + Y_{t,i}^{t+6}\right) \Big/ E_{t+6,i} \right)$$

$$= 100 + \sum_{i=1}^{9} w_i \cdot \left(100 \times E_{t,i} \times Y_{t,i}^{t+6} \Big/ E_{t+6,i} \right) + \sum_{i=1}^{9} w_i \cdot \left(100 \times E_{t,i} \Big/ E_{t+6,i} - 100 \right) \quad (4)$$

(= principal + interest return + foreign exchange return)

where $E_{t,i}$: closing rate of foreign exchange rate of country i against the US dollar at month t, Y_t^{t+6} : bond yield calculated at compound interest for 6 months at month t.

Values of the AMU denominated bonds in terms of the Japanese yen for one month and six month investments are calculated in the same way as that in terms of the US dollar.

3-2-2. A case of one month investments

At first we compare the AMU denominated bonds with single local currency denominated bonds in terms of risks and Sharpe ratio. Table 9 shows bond values, returns, and risks for investors who evaluate them in terms of the US dollar. The standard deviation of the AMU denominated bond with equal composition is lower than those of each government bond in the six non-dollar-pegging East Asian countries.

There are two reasons for the AMU denominated bond with equal composition to be able to reduce its risks. One is large reduction of foreign exchange risk because

it is equally composed of government bonds of all the countries. Foreign exchange risk is reduced through portfolio effect. Another is to reduce interest risk because it includes Japanese, Malaysian and Singaporean government bonds whose interest rates are quite stable. The Sharpe ratio (0.36) substantially exceeds those in the case of investing in each of the government bonds of non-dollar-pegging countries. The results suggest that for the investors who evaluate their returns in terms of the US dollar, both of foreign exchange risk and interest risk are reduced by investing into the AMU denominated bond rather than each of the local currency denominated bonds.

There exist differences in standard deviations among the three types of AMU denominated bonds. The standard deviation of the AMU denominated bond with a composition which is composed of the country weights based on the international debt securities data of the BIS is the highest (2.08%). It is because the weight on the Japanese government bond in the BIS1 type of AMU denominated bond is 50 % to 70% and relatively higher than the others. The standard deviation of the BIS2 type of AMU denominate bond which is composed of the East Asian country bonds based on the international bonds and notes data is 1.68%. It is lower than return of investing into a single currency denominated bond of the non-dollar-pegging

countries except for Singapore (1.35%). The share of the Japanese government bond in the BIS2 type of AMU denominated bond is 30 to 50 %, which is still higher than the AMU denominated bond with equal composition. The results suggest that smaller share of the Japanese government bond is better for the investors who evaluate their returns in terms of the US dollar because returns of the Japanese government bond has low return with high fluctuations. [10]

Table 10 shows that the standard deviation of the AMU denominated bonds for investors who evaluate their returns in terms of the Japanese yen are lower than those of the single local currency denominated bonds except for the Japanese bond. Their Sharpe ratios are higher than the single local currency denominated bonds except for the Japanese and Korean bonds. It means that the investors who evaluate their returns in terms of the Japanese yen can improve their return par unit risk by investing into the AMU denominated bond. Among the three types of AMU denominated bond, the BIS1 type of AMU denominated bond has the lowest standard deviation (0.86%) and the highest Sharpe ratio (0.19). It is because the

[10] In this paper we focus on the risks and returns of bonds. However, higher share of the Japanese bond should be desirable if we take into account other factors such as a transaction cost, grade and liquidity in the market.

BIS1 type of AMU denominated bond has higher share of the Japanese government bond than the other types. The results suggest that the higher share of the Japanese government bond is better in reducing their risks for the investors who evaluate their returns in terms of the Japanese yen. The investors who evaluate their returns in terms of the Japanese yen could obtain less risky and more profitable performance by investing into the AMU denominated bond because the AMU denominated bond consists of both the East Asian government bonds, whose returns and risks are high, and the Japanese government bond, whose return and risk are quite low.

3-2-3. A case of six month investments

Table 11 shows returns and risks of investing into the AMU denominated bonds for six months. We compare risks and Sharpe ratios of the AMU denominated bonds with single local currency denominated government bonds.

The standard deviation of AMU denominated bond with equal composition is 2.60% and is much lower than those of single local currency denominated government bonds of the six non-dollar-pegging countries except for Singapore. Its Sharpe ratio (0.87) substantially exceeds those of the single local currency denominated government bonds. The reason for the AMU denominated bond with

equal composition improve its Sharpe ratio is attributable to the higher Sharpe ratio of interest return (8.36). The results suggest that the effect on interest returns by including the high yield bonds in the AMU denominated bond is larger as the investment period is longer. Among the three types of AMU denominated bond, the standard deviations of the BIS1 and BIS2 types of AMU denominated bond are higher 5.72% and 4.72%, respectively. They are higher than the equal composition type. Accordingly, the investors who evaluate their returns in terms of the US dollar prefer the equal composition type to the other types which are based on the outstanding of external debts.

Table 12 shows performances of the AMU denominated bonds for investors who evaluate them in terms of the Japanese yen. The standard deviations of the AMU denominated bond are lower than those of the single local currency denominated bonds except for the Japanese bond. Their Sharpe ratios are higher than those of the single local currency denominated bonds except for the Japanese and Korean bonds. Among the three types of AMU denominated bond, the standard deviations of the BIS1 type of AMU denominated bond is the lowest (2.12%) and its Sharpe ratio (0.52) is the highest. Investors who evaluate their performances in terms of the Japanese yen could invest into the AMU denominated bond to improve

its Sharpe ratio because the AMU denominated bond has the higher Sharpe ratio of interest return. The results suggest that the effect on interest returns by including the high yield bonds in the AMU denominated bonds is larger for investors who evaluate their performances in terms of the Japanese yen as well as the US dollar as the investment period is longer.

4. Foreign exchange risk reduction effect of the AMU denominated bond

In the previous section, we conducted the simulation analysis to show that investors would be able to reduce the risk of investment return by investing in the AMU denominated bond. In this section, we focus especially on their foreign exchange risk and give a theoretical explanation about how investing into the AMU denominated bonds can contribute to reduce their foreign exchange risk.

International portfolio diversification is widely practiced by investors who seek to reduce their investment risks. Recently, international investors have been turning to foreign markets to obtain greater scope for diversification than domestic markets offer. On one hand, investors should concern with a foreign exchange risk when they invest into foreign currency denominated bonds. So it is important to consider not only their portfolio effects on interest returns and risks also foreign

exchange returns and risks.

At first, we use a basic portfolio theory to explain the portfolio effect on reducing investment risks. A return (R_p) of portfolio investment into bonds of country i (its return is R_i) with its share $\tilde{w}$ at time t is represented as follows:.

$$R_{p,t} = \sum_{i=1}^{n} \tilde{w} \cdot R_{i,t} \tag{5}$$

where $\tilde{w} = (w_1, w_2, \ldots w_n)$.

This portfolio has the following expected returns and variance:

$$\begin{aligned} \mu_p &= n\sum_{i=1} w_i \mu_i \\ \sigma_p^2 &= \sum\sum_{i,j} \sigma_{ij} \\ &= (w_1, \ldots, w_n) \begin{pmatrix} \sigma_{11,}\sigma_{12}, \ldots, \sigma_{1n} \\ \vdots \quad \vdots \quad \vdots \\ \sigma_{n1,}\sigma_{n2}, \ldots, \sigma_{nn} \end{pmatrix} \begin{pmatrix} w_1 \\ \vdots \\ w_n \end{pmatrix} \\ &= \tilde{w}^T \Omega \, \tilde{w} \end{aligned} \tag{6}$$

where μ_i : expectation value of R_i, σ_i^2: variance of R_i, σ_{ij}: covariance with R_i and R_j, ρ_{ij} : correlation coefficient with R_i and R_j, Ω : variance-covariance matrix of σ_{ij}.

Then we separate the variance (V_p^2) of the portfolio return into a sum of variances and a sum of covariance as follows:

$$V_p^2 = \sum_{i=1}^{n} w_i^2 \sigma_i^2 + 2\sum\sum_{i<j} w_i w_j \sigma_{ij} \tag{7}$$

The portfolio effect means that the variance of the portfolio return should be smaller when investors put more different kind of bonds because fluctuations of their returns on each of bonds are partly cancelled out each other. We can use the portfolio theory to consider about the portfolio effect on foreign exchange risk in the case of the AMU denominated bond for international investors. The returns of each local government bond, which compose the AMU denominated bond, are including both interest returns and foreign exchange returns, but we focus on only their foreign exchange risk to investigate how the portfolio investments reduce foreign exchange risk.

A variance of returns on the AMU denominated bond with equal composition is represented as follows:

$$\sigma_p^2 = \frac{1}{n}\left(\frac{1}{n}\sum_{i=1}^{n}\sigma_i^2\right) + \frac{2}{n^2}\sum\sum_{i<j}\sigma_{ij}$$

$$= \frac{1}{n}(\text{average of } \sigma_i^2) + \frac{n(n-1)}{n^2}(\text{average of } \sigma_{ij}) \qquad (8)$$

In the above equation, the first term is the average of foreign exchange risk of each of the local government bonds. The AMU denominated bond is composed of the non-dollar-pegging countries' government bonds and the dollar-pegging countries' government bonds. The former has a high foreign exchange risk while the latter has a nearly zero exchange risks against the US dollar. Accordingly, the foreign

exchange risk of the AMU denominated bond is substantially lower than those of investing into local government bonds in non-dollar-pegging countries individually. The second term is almost equal to an average of covariance of exchange rate returns among the local government bonds.

The covariance (σ_{ij}) is described as follows:

$$\sigma_{ij} = \rho_{ij} \cdot \sigma_i \cdot \sigma_j \qquad (9)$$

If the correlation coefficient ρ_{ij} is negative and, in turn, σ_{ij} also is negative, the portfolio investments reduce foreign exchange risk more. The AMU denominated bonds consist of the dollar-pegged currency denominated bonds and the non-dollar-pegged currency denominated bonds. Even for the non-dollar-pegging countries in East Asia, their currencies have highly co-movements with the US dollar. Correlation coefficients among East Asian currencies, especially the dollar-pegged currencies and the Japanese yen tend to be negative in terms of the foreign exchange returns. Table 13 and Table 14 show correlation coefficient matrixes of investing into the government bond during one and six months in terms of the US dollar, respectively. Both of the tables show that most of the correlation coefficients between the dollar-pegging countries and the non-dollar-pegging countries are negative. Accordingly for the investors who

evaluate their return in terms of the US dollar, the AMU denominated bond should be effective in reducing the foreign exchange risk.

On one hand, for the investors who evaluate their returns in terms of the Japanese yen, the average of foreign exchange risks in the first term could be reduced by including the Japanese government bond into the AMU denominated bond. The higher is the share of the Japanese government bond, the lower is the foreign exchange risk of the AMU denominated bond.

Accordingly, the AMU denominated bond should have the portfolio effect on reducing foreign exchange risk of the Asian bonds for both of the investors who evaluated their returns in terms of the US dollar and investors who evaluate their returns in terms of the Japanese yen.

5. Conclusion

In this paper, we conducted the simulation analysis to investigate the risk properties of the AMU denominated bonds. We divided their risks into interest risk and foreign exchange risk to compare them.

For both of the investors who evaluate their returns in terms of the US dollar and the investors who evaluate their returns in terms of the Japanese yen, the risk

of investing into the AMU denominated bonds could be lower than those of investment each of the local currency denominated bonds in the East Asian countries except for the dollar-pegging countries. Especially for the investors who evaluate their returns in terms of the US dollar, investing into the the AMU denominated bonds with equal composition is effective both in reducing their risks and improving their Sharpe ratio in comparison with those of investing into each of the East Asian countries' government bonds except for the dollar-pegging countries. It is because the portfolio effects should reduce of foreign exchange risk. These results depend on the currency system in the East Asian countries.

On one hand, the share of the Japanese yen denominated bond in the AMU denominated bond is critical for the investors who evaluate their returns in terms of the Japanese yen. The BIS1 type of AMU denominated bond should have the lowest risk and the highest Sharpe ratio for the investors who evaluate their return in terms of the Japanese yen in contrast the investors who evaluate their returns in terms of the US dollar. It is because the share on the Japanese government bond in the BIS1 type of bond is higher than the other types. In addition, the effectiveness on the interest return by including the high yield bonds in the AMU denominated bond is larger for both investors who evaluate their returns in terms of the US

dollar and the Japanese yen as the investment period is longer.

When investors evaluate their returns of investing into the single currency denominated government bonds, their risks depend on their foreign exchange risk rather than their interest risk. Therefore, the introduction of the AMU denominated bond could prevent the contagion selling of the local currency denominated bonds caused by a sudden depreciation of one local currency.

In this paper we focus only on the risk reduction effect of the AMU denominate bonds. However, we would have other important factors, such as their transaction costs, market liquidity and their credit rating, to influence investors' decision if the AMU denominated bonds were actually traded in the capital market.[11] In addition, our results indicate that the risk reduction effect of the AMU denominated bonds largely depend on the country share. The further discernment for the optimal share for risk reduction while taking into account their returns in the AMU denominated bond is needed in near future.

[11] For example, concerning the influence of transaction cost, when transaction cost is required for holding overseas assets, the efficient frontier shifts to the lower part equal to the transaction cost amount and the investor's utility is seemed to decrease.

References

Bénassy-Quéré, Agnes (1999) "Optimal pegs for East Asian currencies," *Journal of the Japanese and International Economies*, vol. 13, 44-60.

Ito, Takatoshi, Eiji Ogawa, and N. Yuri Sasaki (1998) "How did the dollar peg fail in Asia?" *Journal of the Japanese and International Economies*, vol. 12, 256-304.

Ito, Takatoshi (2003) "Construction of Infrastructures for the Development of Regional Bond Market," in Choong Yong Ahn, Takatoshi Ito Masahiro Kawai and Yung Chul Park ed., *Financial Development and Integration in East Asia*,, Korea Institute for International Economic Policy, 206-221.

Ito, Takatoshi and Yung Chul Park (2004) "Overview: Challenges and strategies," in Takatoshi Ito and Yung Chul Park ed., *Developing Asian BONDMARKETS*, Asian Pacific Press at the Australian National University, 1-15.

Ito, Takatoshi (2004) "Promoting Asian basket currency bonds," in Takatoshi Ito and Yung Chul Park ed., *Developing Asian BONDMARKETS*, Asian Pacific Press at the Australian National University, 67-89.

Kaminisky, Graciela L., Richard Lyons, and Serio L. Schmukler, (2003) "Manager, Investors, and Crises: Mutual Fund Strategies in Emerging Markets," *Journal of International Economics,* forthcoming.

Kawai, Masahiro, Eiji Ogawa, and Takatoshi Ito, (2004) "Developing New Regional Financial Architecture: A Proposal," mimeo.

Krugman, Paul (1999) "Balance Sheets, the Transfer Problem, and Financial Crises," International Tax and Public Finance, 459-473.

Kuroda, Haruhiko and Masahiro Kawai (2003) "Strengthening Regional Financial Cooperation in East Asia," *PRI Discussion Paper Series* (No.03A-10).

Mello, Luiz de and Khaled Hussein (2001) "Is Foreign Debt Portfolio Management Efficient in Emerging Economies?" *IMF Working Paper*. WP/01/121.

Ogawa, Eiji and Takatoshi Ito (2002) "On the desirability of a Regional Basket Currency Arrangement," *Journal of the Japanese and International Economies*, vol. 16, No. 3, 317-334.

Ogawa, Eiji. and Takatoshi Ito, and N. Yuri Sasaki (2004) "Costs, Benefits, and Constraints of the Basket Currency Regime," in Asian Development Bank ed., *Monetary and Financial Integration in East Asia: The Way Ahead*, Volume 2, Palgrave, 209-239.

Ogawa, Eiji and Junko Shimizu (2002) "Roles of regional currency in bond markets in East Asia," *Hitotsubashi University, Faculty of Commerce, Working Paper*, no. 81.

Ogawa, Eiji and Junko Shimizu (2004) "Bond issuers' trade-off for common currency basket denominated bonds in East Asia," *Journal of Asian Economics,* Volume 15, 719-738.

Schinasi, Garry J. and R. Todd Smith (1999) "Portfolio Diversification, Leverage, and Financial Contagion," *IMF Working Paper,* WP/99/136.

Williamson, John (2000) *Exchange Rate Regimes of Emerging Markets: Reviving the Intermediate Option*, Institute for International Economics, Washington, D.C.

Table 1. Bond Yield of East Asian Countries

	Categories of Bond	Sample Period
Singapore	Singapore Treasury Bonds 10 year	Jan. 1999 - Dec. 2003
Thailand	Loan Bonds 10 year	Jan. 1999 - Dec. 2003
Korea	Korea Treasury Bond 5 year	Jan. 1999 - Dec. 2003
Philippines	Fixed Rate Treasury Notes 7 year	Jan. 1999 - Dec. 2003
Indonesia	Recapitalization Bonds (RECAP)	July.2002 - Dec. 2003
Malaysia	Malaysian Gov't Securities 10 year	Jan. 1999 - Dec. 2003
Hong Kong	Exchange Fund Notes 5 year	Jan. 1999 - Dec. 2003
China	Treasury Bonds 10 year	May 2001 - Dec. 2003
Japan	Japanese Government Bond 10 year	Jan. 1999 - Dec. 2003

Source: Datastream, Bloomberg, and HomePage of Central Banks

Table 2. 1 Month Bond Value of Asian Local Bonds in terms of US Dollar 1999-2003

	Singapore	Thailand	Korea	Philippines	Indonesia	Malaysia	Hong Kong	China	Japan
＜Bond Value＞									
Max	103.78	106.58	106.12	106.20	105.29	100.46	101.00	100.56	105.06
Min	96.90	94.21	94.18	91.35	97.72	100.19	99.97	100.45	94.05
Average(μ)	100.31	100.36	100.56	100.33	101.39	100.25	100.42	100.50	100.46
Return(%,(μ-100)/100)	0.31	0.36	0.56	0.33	1.39	0.25	0.42	0.50	0.46
Std. Dev.(σ)	1.35	2.10	2.45	2.15	1.98	0.05	0.15	0.03	2.51
Return/σ	0.23	0.17	0.23	0.16	0.70	5.10	2.90	17.28	0.18
＜Interest Return＞									
Max	0.394	0.695	0.808	1.503	1.271	0.459	0.588	0.554	0.129
Min	0.154	0.240	0.346	0.536	0.708	0.224	0.201	0.454	0.043
Average(μ)	0.309	0.459	0.557	0.930	0.935	0.252	0.428	0.500	0.096
Std. Dev.(σ)	0.060	0.106	0.133	0.241	0.186	0.046	0.124	0.028	0.024
μ/σ	5.13	4.31	4.17	3.87	5.02	5.43	3.44	17.62	4.00
＜Foreign Exchange Return＞									
Max	3.468	6.023	5.533	5.000	4.374	0.026	0.717	0.010	4.941
Min	-3.384	-6.280	-6.417	-9.677	-3.055	-0.039	-0.282	-0.011	-6.058
Average(μ)	0.003	-0.096	0.006	-0.596	0.450	-0.001	-0.003	0.000	0.364
Std. Dev.(σ)	1.340	2.106	2.426	2.104	1.928	0.015	0.105	0.005	2.503
μ/σ	0.00	-0.05	0.00	-0.28	0.23	-0.06	-0.03	0.02	0.15

Notes：Bond Value for 1 month is starting from 100 at the beginning of month. Then it is invested into every Asian local bond for 1month and converted in terms of US dollar by using every foreign exchange rate against US dollar at the end of month. All series without Indonesia and China are from 2/1999 to 12/2003, and the number of sample is 59. Indonesia and China are starting from 8/2002 and 6/2001, and each number of sample is 17 and 31, respectively.

Notes：Interest returns are calculated by every bond yield. Foreign exchange returns are the actual ex-post foreign exchange related returns which are uncovered by forward transaction at the beginning of period and realized when the Bond Value are convereted in terms of US dollar at the end of period.

Table 3. 1 Month Bond Value of Asian Local Bonds in terms of Japanese yen 1999-2003

	Singapore	Thailand	Korea	Philippines	Indonesia	Malaysia	Hong Kong	China	Japan
＜Bond Value＞									
Max	105.92	106.11	106.29	108.30	105.60	107.07	107.31	107.01	100.12
Min	94.41	91.49	91.77	92.30	97.47	93.59	93.86	95.81	100.04
Average(μ)	100.19	100.25	100.44	100.23	100.74	100.15	100.33	100.20	100.10
Return(%,(μ-100)/100)	0.19	0.25	0.44	0.23	0.74	0.15	0.33	0.20	0.10
Std. Dev.(σ)	2.40	3.01	2.92	3.34	2.56	2.86	2.85	2.53	0.02
Return/σ	0.08	0.08	0.15	0.07	0.29	0.05	0.11	0.08	4.07
＜Return on Interest rate＞									
Max	0.394	0.709	0.845	1.525	1.258	0.468	0.589	0.581	0.124
Min	0.154	0.236	0.341	0.521	0.696	0.215	0.202	0.455	0.044
Average(μ)	0.309	0.458	0.556	0.931	0.931	0.252	0.428	0.499	0.096
Std. Dev.(σ)	0.060	0.108	0.133	0.248	0.191	0.048	0.125	0.032	0.024
μ/σ	5.15	4.25	4.17	3.76	4.87	5.25	3.41	15.35	4.07
＜Foreign Exchange Return＞									
Max	5.567	5.631	5.448	7.171	4.676	6.814	6.850	6.457	0.000
Min	-5.916	-8.994	-8.808	-8.733	-3.229	-6.638	-6.680	-4.707	0.000
Average(μ)	-0.116	-0.212	-0.120	-0.704	-0.192	-0.099	-0.102	-0.302	0.000
Std. Dev.(σ)	2.396	2.998	2.895	3.242	2.468	2.847	2.834	2.513	0.000
μ/σ	-0.05	-0.07	-0.04	-0.22	-0.08	-0.03	-0.04	-0.12	0.00

Notes：Bond Value for 1 month is starting from 100 at the beginning of month. Then it is invested into every Asian local bond for 1month and converted in terms of US dollar by using every foreign exchange rate against US dollar at the end of month. All series without Indonesia and China are from 2/1999 to 12/2003, and the number of sample is 59. Indonesia and China are starting from 8/2002 and 6/2001, and each number of sample is 17 and 31, respectively.

Notes：Interest returns are calculated by every bond yield. Foreign exchange returns are the actual ex-post foreign exchange related returns which are uncovered by forward transaction at the beginning of period and realized when the Bond Value are convereted in terms of Japanese yen at the end of period.

Table 4. 6 Month Bond Value of Asian Local Bonds in terms of US dollar 1999-2003

	Singapore	Thailand	Korea	Philippines	Indonesia	Malaysia	Hong Kong	China	Japan
＜Bond Value＞									
Max	106.68	111.94	115.25	111.77	114.75	102.06	103.29	103.25	120.23
Min	96.74	89.49	86.70	85.95	102.25	101.34	101.46	102.83	86.92
Average(μ)	101.74	101.95	103.70	101.71	109.09	101.48	102.57	103.03	101.63
Return(%,(μ-100)/100)	1.74	1.95	3.70	1.71	9.09	1.48	2.57	3.03	1.63
Std. Dev.(σ)	2.51	4.91	6.05	4.67	4.17	0.14	0.60	0.15	7.69
Return/σ	0.69	0.40	0.61	0.37	2.18	10.93	4.26	20.18	0.21
＜Interest Return＞									
Max	2.359	3.698	5.183	7.373	7.206	2.059	3.471	3.250	1.065
Min	1.066	1.729	2.245	3.248	4.415	1.366	1.459	2.835	0.346
Average(μ)	1.854	2.751	3.421	5.560	5.881	1.484	2.603	3.026	0.699
Std. Dev.(σ)	0.346	0.545	0.826	1.275	0.959	0.133	0.726	0.150	0.180
μ/σ	5.36	5.05	4.14	4.36	6.13	11.16	3.58	20.13	3.89
＜Foreign Exchange Return＞									
Max	4.686	8.239	10.631	4.539	8.485	0.026	0.719	0.010	19.191
Min	-4.935	-13.414	-16.217	-19.286	-2.293	-0.039	-0.335	-0.008	-13.773
Average(μ)	-0.118	-0.798	0.279	-3.850	3.212	-0.002	-0.030	0.000	0.929
Std. Dev.(σ)	2.473	5.043	5.773	4.504	3.693	0.014	0.187	0.005	7.638
μ/σ	-0.05	-0.16	0.05	-0.85	0.87	-0.13	-0.16	-0.04	0.12

Notes：Bond Value for 6 months is starting from 100 at the beginning of month. Then it is invested into every Asian local bond for 6 months and converted in terms of US dollar by using every foreign exchange rate against US dollar at the end of period. All series without Indonesia and China are from 2/1999 to 12/2003, and the number of sample is 53. Indonesia and China are starting from 8/2002 and 6/2001, and each number of sample is 11 and 25, respectively.

Notes：Interest returns are calculated by every bond yield. Foreign exchange returns are the actual ex-post foreign exchange related returns which are uncovered by forward transaction at the beginning of period and realized when the Bond Value are convereted in terms of US dollar at the end of period.

Table 5. 6 Month Bond Value of Asian Local Bonds in terms of Japanese yen 1999-2003

	Singapore	Thailand	Korea	Philippines	Indonesia	Malaysia	Hong Kong	China	Japan
＜Bond Value＞									
Max	114.02	116.86	117.17	120.93	116.11	117.82	119.40	116.03	100.90
Min	88.18	82.36	89.58	82.97	91.36	85.16	86.66	91.39	100.35
Average(μ)	101.21	101.47	103.02	101.35	105.54	101.11	102.20	101.43	100.69
Return(%,(μ-100)/100)	1.21	1.47	3.02	1.35	5.54	1.11	2.20	1.43	0.69
Std. Dev.(σ)	5.67	7.70	5.89	9.22	7.49	7.55	7.72	6.70	0.17
Return/σ	0.21	0.19	0.51	0.15	0.74	0.15	0.28	0.21	4.08
＜Interest Return＞									
Max	2.371	3.719	5.231	8.342	7.217	2.032	3.607	3.574	0.902
Min	1.071	1.610	2.073	2.899	3.940	1.227	1.384	2.581	0.347
Average(μ)	1.844	2.746	3.399	5.580	5.712	1.480	2.599	2.982	0.694
Std. Dev.(σ)	0.350	0.597	0.810	1.501	1.100	0.181	0.760	0.285	0.170
μ/σ	5.26	4.60	4.20	3.72	5.19	8.16	3.42	10.46	4.08
＜Foreign Exchange Return＞									
Max	11.785	13.707	11.935	12.587	9.769	15.957	15.937	12.459	0.000
Min	-13.804	-20.189	-14.139	-22.291	-12.575	-16.101	-16.224	-11.406	0.000
Average(μ)	-0.636	-1.275	-0.377	-4.226	-0.170	-0.373	-0.402	-1.553	0.000
Std. Dev.(σ)	5.576	7.542	5.603	8.274	6.632	7.423	7.408	6.450	0.000
μ/σ	-0.11	-0.17	-0.07	-0.51	-0.03	-0.05	-0.05	-0.24	0.00

Notes：Bond Value for 6 months is starting from 100 at the beginning of month. Then it is invested into every Asian local bond for 6 months and converted in terms of US dollar by using every foreign exchange rate against US dollar at the end of period. All series without Indonesia and China are from 2/1999 to 12/2003, and the number of sample is 53. Indonesia and China are starting from 8/2002 and 6/2001, and each number of sample is 11 and 25, respectively.

Notes：Interest returns are calculated by every bond yield. Foreign exchange returns are the actual ex-post foreign exchange related returns which are uncovered by forward transaction at the beginning of period and realized when the Bond Value are convereted in terms of Japanese yen at the end of period.

Table 6. Government Bond Market Outstanding of East Asian Countries

	Government bond market outstanding	
	in local currenry	in the US dollar (billion)
Singapore[1]	63,050 (S$ million)	37.13
Thailand[2]	742,176 (Baht million)	18.73
Malaysia[3]	130,800 (RM million)	34.40
Indonesia[4]	386,522 (IDR billion)	45.89
Philippines[5]	512,646 (PHP million)	9.23
Korea[6]	105,332 (Won billion)	88.40
Hong Kong[7]	120,152 (HK$ million)	15.48
China[8]	870,866 (Yuan million)	105.21
Japan[9]	437,564 (Yen billion)	4082.89

Notes: We use closing rate of foreign exchange rates against the US dollar in 2003 to couvert the outstanding in local currency into the US dollar. For China, the figure is not a market outstanding but a spot trading turnover of T-Bond in 2002 due to the constraint of data. The details of each data are follows:

1. Dec,2003. Total outstanding of Bills and Bonds of Singapore Government Securities by MAS.
2. Dec, 2003. Thai BDC Trading and Outstanding of Government securities by BOT.
3. Dec, 2003. Balances of Conventional Malaysian Government Securities by Bank Negara Malaysia.
4. Nov, 2003. Market capitalization of government bond in Surabaya Stock Exchange by Bank Indonesia.
5. May, 2003. Claims on National Government Securities by Central Bank of Philippines.
6. Nov, 2003. Outstanding amounts of Monetary Stabilisation Bonds(public offerings) by Bank of Korea.
7. Dec, 2003. Outstanding amount of Exchange Fund Bills and Notes byHong Kong Monetary Authority.
8. Total in 2002. Turnover of Spot Trading of T-Bond Transaction by People's Bank of China.
9. Sept, 2003 Outstanding amounts of Government Bonds by Ministry of Finance HP

Table 7. Country weights on the basis of BIS 1 (International Debt Securities) %

	Singapore	Thailand	Korea	Philippines	Indonesia	Malaysia	Hong Kong	China	Japan
1998/4Q	1.2	3.2	12.0	2.4	na	2.8	7.2	na	71.2
1999/1Q	1.4	3.3	11.7	2.7	na	3.0	7.8	na	70.0
1999/2Q	1.4	3.4	11.3	2.9	na	3.2	8.1	na	69.7
1999/3Q	1.5	3.1	10.5	3.0	na	3.2	8.0	na	70.8
1999/4Q	1.4	3.1	10.4	3.1	na	3.2	8.2	na	70.5
2000/1Q	1.5	3.4	11.6	1.8	na	3.2	6.2	na	72.3
2000/2Q	1.9	3.4	11.6	1.7	na	3.2	6.1	na	72.0
2000/3Q	2.0	3.3	11.8	3.8	na	3.3	7.1	na	68.7
2000/4Q	2.3	3.4	11.9	3.8	na	3.6	7.4	na	67.6
2001/1Q	2.7	3.3	11.8	3.7	na	3.7	8.5	na	66.4
2001/2Q	2.9	3.3	11.5	3.7	na	3.8	8.9	na	65.9
2001/3Q	3.3	2.8	10.7	3.4	na	3.9	8.3	4.1	63.5
2001/4Q	3.7	2.7	11.3	3.7	na	3.8	8.5	4.2	62.1
2002/1Q	4.1	2.7	11.0	4.2	na	4.3	9.7	4.6	59.4
2002/2Q	3.6	2.5	11.2	4.2	na	4.6	9.4	4.2	60.4
2002/3Q	3.6	2.7	11.5	4.2	2.1	4.6	9.0	3.9	58.4
2002/4Q	3.7	2.6	12.0	4.4	2.1	5.0	9.1	3.8	57.2
2003/1Q	3.8	2.6	12.3	4.7	2.1	5.0	9.6	3.6	56.3
2003/2Q	4.2	2.4	12.7	4.9	2.1	5.1	10.0	3.7	54.8
2003/3Q	4.2	2.2	13.3	4.9	2.1	4.8	9.7	3.7	55.0

Source：BIS Quarterly Review, International Debt Securities by Nationality of Issuer (BIS Table12A)
Notes: Country weights are calculated according to the data avilability.

Table 8. Country weights on the basis of BIS 2 (Internation Bonds and Notes) %

	Singapore	Thailand	Korea	Philippines	Indonesia	Malaysia	Hong Kong	China	Japan
1998/4Q	2.0	4.9	20.8	3.6	na	5.1	8.4	na	55.3
1999/1Q	2.4	5.2	20.2	4.1	na	5.2	9.3	na	53.5
1999/2Q	2.5	5.5	19.9	4.5	na	5.7	8.9	na	53.0
1999/3Q	4.1	5.5	20.9	6.3	na	6.1	9.4	na	47.8
1999/4Q	4.2	5.4	21.0	6.3	na	6.7	9.7	na	46.7
2000/1Q	3.0	5.5	20.8	5.9	na	5.8	9.9	na	49.1
2000/2Q	3.9	5.5	20.7	6.0	na	5.9	9.2	na	48.7
2000/3Q	2.7	5.1	18.8	4.7	na	5.8	9.6	na	53.4
2000/4Q	3.1	5.7	21.0	5.5	na	6.5	10.7	na	47.5
2001/1Q	4.3	5.3	20.9	6.1	na	6.9	10.2	na	46.3
2001/2Q	4.6	5.1	19.8	6.0	na	6.8	10.4	na	47.4
2001/3Q	5.5	4.5	18.2	5.8	na	7.0	11.3	5.8	42.1
2001/4Q	6.5	4.3	18.7	6.2	na	6.7	10.8	5.6	41.2
2002/1Q	6.8	4.2	17.3	6.6	na	7.1	13.0	5.8	39.2
2002/2Q	6.2	3.8	17.3	6.6	na	7.7	13.0	5.0	40.3
2002/3Q	6.2	3.7	18.7	7.0	1.0	8.0	13.8	5.0	36.7
2002/4Q	6.1	3.6	17.9	7.0	0.9	8.2	13.6	4.4	38.2
2003/1Q	6.2	3.5	18.0	7.2	0.9	8.1	13.9	4.3	37.9
2003/2Q	6.3	3.0	18.3	7.3	1.1	7.9	14.6	4.0	37.4
2003/3Q	6.6	3.0	18.8	7.4	1.3	7.4	14.5	3.9	37.2

Source：BIS Quarterly Review, International Bonds and Notes by Country of Residence (BIS Table14B)

Notes: Country weights are calculated according to the data avilability.

Table 9. 1 Month AMU Denominated Asian Bond Value
in terms of US dollar, 1999-2003

	AMU denominated Asian bond（equally weighted）	AMU denominated Asian bond（BIS1）	AMU denominated Asian bond（BIS2）
＜Bond Value＞			
Max	102.81	105.58	104.28
Min	97.22	94.89	95.55
Average(μ)	100.39	100.32	100.35
Return(%,(μ-100)/100)	0.39	0.32	0.35
Std. Dev.(σ)	1.07	2.08	1.68
Return/σ	0.36	0.15	0.21
＜Interest Return＞			
Max	0.561	0.308	0.426
Min	0.345	0.175	0.218
Average(μ)	0.462	0.253	0.329
Std. Dev.(σ)	0.059	0.033	0.055
μ/σ	7.78	7.65	6.00
＜Foreign Exchange Return＞			
Max	2.333	5.277	3.858
Min	-3.194	-5.331	-4.745
Average(μ)	-0.072	0.066	0.022
Std. Dev.(σ)	1.068	2.078	1.672
μ/σ	-0.07	0.03	0.01

Note：There are 3 types of currency basket ratio. Equally weighted AMU denominated Asian bond is composed with all countries' bonds at the same ratio. AMU denominated Asian bond BIS1 and BIS2 are composed with all countries' bonds at the ratio in relation to the balanse of International Debt Securities and the balanse of International Bonds and Notes, respectively.

Table 10. 1 Month AMU Denominated Asian Bond Value
in terms of Japanese yen, 1999-2003

	AMU denominated Asian bond（equally weighted）	AMU denominated Asian bond（BIS1）	AMU denominated Asian bond（BIS2）
＜Bond Value＞			
Max	105.58	102.23	103.44
Min	95.28	98.24	97.11
Average(μ)	100.26	100.16	100.21
Return(%,(μ-100)/100)	0.26	0.16	0.21
Std. Dev.(σ)	2.26	0.86	1.38
Return/σ	0.12	0.19	0.15
＜Interest Return＞			
Max	0.602	0.308	0.433
Min	0.335	0.176	0.219
Average(μ)	0.455	0.252	0.329
Std. Dev.(σ)	0.072	0.033	0.055
μ/σ	6.32	7.70	5.94
＜Foreign Exchange Return＞			
Max	5.109	1.974	3.096
Min	-5.221	-2.031	-3.228
Average(μ)	-0.195	-0.090	-0.121
Std. Dev.(σ)	2.240	0.861	1.367
μ/σ	-0.09	-0.10	-0.09

Note：There are 3 types of currency basket ratio. Equally weighted AMU denominated Asian bond is composed with all countries' bonds at the same ratio. AMU denominated Asian bond BIS1 and BIS2 are composed with all countries' bonds at the ratio in relation to the balanse of International Debt Securities and the balanse of International Bonds and Notes, respectively.

Table 11. 6 Month AMU Denominated Asian Bond Value
in terms of US dollar, 1999-2003

	AMU denominated Asian bond（equally weighted）	AMU denominated Asian bond（BIS1）	AMU denominated Asian bond（BIS2）
＜Bond Value＞			
Max	106.69	115.24	112.56
Min	96.19	89.57	90.69
Average(μ)	102.26	101.90	102.11
Return(%,(μ-100)/100)	2.26	1.90	2.11
Std. Dev.(σ)	2.60	5.72	4.76
Return/σ	0.87	0.33	0.44
＜Interest Return＞			
Max	3.387	1.915	2.644
Min	2.183	1.161	1.433
Average(μ)	2.771	1.506	1.977
Std. Dev.(σ)	0.332	0.204	0.323
μ/σ	8.36	7.40	6.12
＜Foreign Exchange Return＞			
Max	4.005	13.381	10.235
Min	-6.655	-11.905	-11.127
Average(μ)	-0.506	0.392	0.129
Std. Dev.(σ)	2.667	5.655	4.724
μ/σ	-0.19	0.07	0.03

Note：There are 3 types of currency basket ratio. Equally weighted AMU denominated Asian bond is composed with all countries' bonds at the same ratio. AMU denominated Asian bond BIS1 and BIS2 are composed with all countries' bonds at the ratio in relation to the balanse of International Debt Securities and the balanse of International Bonds and Notes, respectively.

Table 12. 6 Month AMU Denominated Asian Bond Value
in terms of Japanese yen, 1999-2003

	AMU denominated Asian bond（equally weighted）	AMU denominated Asian bond（BIS1）	AMU denominated Asian bond（BIS2）
＜Bond Value＞			
Max	112.81	105.50	108.31
Min	87.97	96.51	94.44
Average(μ)	101.74	101.11	101.39
Return(%,(μ-100)/100)	1.74	1.11	1.39
Std. Dev.(σ)	5.77	2.12	3.27
Return/σ	0.30	0.52	0.43
＜Interest Return＞			
Max	3.404	1.845	2.651
Min	2.008	1.159	1.383
Average(μ)	2.762	1.496	1.968
Std. Dev.(σ)	0.398	0.199	0.343
μ/σ	6.94	7.50	5.74
＜Foreign Exchange Return＞			
Max	9.767	3.883	6.146
Min	-14.678	-4.874	-7.513
Average(μ)	-1.027	-0.390	-0.577
Std. Dev.(σ)	5.565	2.049	3.122
μ/σ	-0.18	-0.19	-0.18

Note：There are 3 types of currency basket ratio. Equally weighted AMU denominated Asian bond is composed with all countries' bonds at the same ratio. AMU denominated Asian bond BIS1 and BIS2 are composed with all countries' bonds at the ratio in relation to the balanse of International Debt Securities and the balanse of International Bonds and Notes, respectively.

Table 13. Pairwise correlation matrix for 1 month Asian Government bond returns in terms of US dollar

	Singapore	Thailand	Malaysia	Philippines	Indonesia	Korea	Hong Kong	China	Japan
Singapore	1.0000	0.5946	-0.0535	0.3486	0.3076	0.4203	0.1060	0.1626	0.5449
Thailand	0.5946	1.0000	-0.0848	0.6382	0.3444	0.4245	-0.0183	0.1259	0.2808
Malaysia	-0.0535	-0.0848	1.0000	-0.0092	0.1418	-0.0982	0.3295	0.2159	-0.0831
Philippines	0.3486	0.6382	-0.0092	1.0000	0.2945	0.1739	0.0036	0.1552	0.1306
Indonesia	0.3076	0.3444	0.1418	0.2945	1.0000	0.3026	0.1946	0.2635	0.0809
Korea	0.4203	0.4245	-0.0982	0.1739	0.3026	1.0000	0.1017	0.1023	0.3954
Hong Kong	0.1060	-0.0183	0.3295	0.0036	0.1946	0.1017	1.0000	0.4358	0.0910
China	0.1626	0.1259	0.2159	0.1552	0.2635	0.1023	0.4358	1.0000	-0.0965
Japan	0.5449	0.2808	-0.0831	0.1306	0.0809	0.3954	0.0910	-0.0965	1.0000

Author's calculation

Table 14. Pairwise correlation matrix for 6 month Asian Government bond returns in terms of US dollar

	Singapore	Thailand	Malaysia	Philippines	Indonesia	Korea	Hong Kong	China	Japan
Singapore	1.0000	0.2848	-0.0576	-0.0037	-0.5217	0.5050	-0.1326	0.0653	0.8201
Thailand	0.2848	1.0000	-0.5065	0.7084	-0.1620	0.4801	-0.4753	0.1519	0.2645
Malaysia	-0.0576	-0.5065	1.0000	-0.2357	0.1929	-0.3150	0.6806	-0.1344	-0.0719
Philippines	-0.0037	0.7084	-0.2357	1.0000	0.8133	0.1773	-0.2250	0.6002	-0.0654
Indonesia	-0.5217	-0.1620	0.1929	0.8133	1.0000	0.0944	-0.4720	-0.1560	-0.6802
Korea	0.5050	0.4801	-0.3150	0.1773	0.0944	1.0000	-0.0600	0.2846	0.6343
Hong Kong	-0.1326	-0.4753	0.6806	-0.2250	-0.4720	-0.0600	1.0000	0.8772	-0.0579
China	0.0653	0.1519	-0.1344	0.6002	-0.1560	0.2846	0.8772	1.0000	-0.2712
Japan	0.8201	0.2645	-0.0719	-0.0654	-0.6802	0.6343	-0.0579	-0.2712	1.0000

Author's calculation