

# **Integration and Market Discipline of ASEAN Government Bond Markets\***

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## **Abstract**

The aim of this study is twofold. First, we investigate government bond market integration in four ASEAN countries. We find that regional markets have been integrated in the sense that their yields are driven by a common regional factor. We also find that the global factor has asymmetric effects. Second, we investigate the determinants of government bond spreads to analyze whether the integration has advanced or obstructed market discipline. We find that public interest payment is an important determinant and there exists a threshold that depends on public interest payments.

*JEL Classification:* E43, G12, G15

*Keywords:* Government bond markets integration, Market discipline, ASEAN countries

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## **Introduction**

Some Asian countries experienced a serious currency crisis in 1997. It is recognized that the “double mismatch in currency and maturity” in financing were among the main causes of the crisis. The Asian countries depended on short-term foreign currency-denominated bank loans from foreign banks to finance longer-term domestic investment. It is also said that Asian countries have accumulated domestic savings since the crisis. However, a considerable amount of them have flowed out to overseas, especially to the U.S., and then flowed back to the Asian countries. As a result, the Asian countries have accumulated huge foreign reserves, a large portion of which was in the form of US Treasury securities and other dollar-denominated assets, while at the same time they have received foreign direct and portfolio investments to finance domestic firms. It means that intraregional high savings have not been utilized to finance intraregional investment.

Therefore, the development of the financial intermediary function, especially the development of regional bond markets, is becoming an important policy issue in Asia. At each country level, it is necessary to remove policy distortions to enhance market infrastructure and to reform the regulation in accordance with international standards. Much progress might be achieved through regional initiatives so as to harmonize regulations in each country and then to facilitate regional bond market integration. Based on this recognition, the Asian Bond Markets Initiative (ABMI) was launched by the ASEAN+3 Finance Ministers’ Meeting in August 2003. EMEAP (Executives’ Meetings of East Asia and Pacific Central Banks) also launched the Asian Bond Fund (ABF) in June 2003. As a result of such domestic and regional efforts, bond markets in Asian countries have grown rapidly and are said to be in a stage of regional integration. Figure 1 shows the amount of outstanding local currency-denominated (LCY) government bonds in four ASEAN countries (Indonesia, Malaysia, the Philippines, and Thailand). We can see that the government bond markets in the region have grown rapidly from about 130 billion US dollars in 2000 to about 660 billion US dollars in 2017.

The bond market integration among Asian countries facilitates greater capital mobility, which can improve the efficient allocation of capital and hence enhance financial development and economic growth in the region. It also enables investors to diversify their

portfolio at a low cost, which can eliminate country-specific risks.

The first aim of this study is to investigate whether the government bond markets are integrated in four ASEAN countries (Indonesia, Malaysia, the Philippines, and Thailand). The reason why we choose these four countries is that they seemed to have some similarities in their economic structures such as GDP per capita and financial development. The reason why we will focus on the government bond market integration is that it is a pre-requisite for the development of regional bond markets including corporate bond markets. Government bond markets provide a risk-free benchmark yield curve for corporate bonds and they also support the market for derivatives including futures, options, and swaps.

Although the integration of regional government bond markets can bring us several benefits, it might cause some problems at the same time. First, if regional bond markets will be highly integrated, diversification will be less effective because markets would move together. Second, highly integrated markets with high capital mobility may increase the risk of cross-border financial contagion. As a result, the financial instability in one economy could be transmitted to other economies more rapidly. Lastly, as pointed out in Manganello and Wolswijk (2007), the ongoing process of government bond market integration might eliminate the market's ability or willingness to discriminate between the creditworthiness of national fiscal policies. Market discipline in the context of the government bond market means that the bond issued by a government with unsound fiscal policies is priced to offer a higher yield to compensate for a higher default risk. Thus, negative assessments by the financial market are reflected in the higher interest burden and thus force a government to avoid unsound fiscal policy. If government bond market integration could facilitate an accurate assessment of the risk-return profile of government bonds, it might have improved market discipline. On the other hand, if government bond yields commoved together in spite of differences in fiscal soundness, the market integration might have obstructed market discipline.

Therefore, the second aim of this paper is to investigate the determinants of government bond yield spreads in 4 ASEAN countries. If fiscal-soundness variables could explain the movements in the yields, we can say that the government bond markets in the 4

ASEAN countries being studied have maintained market discipline.

The remainder of this paper is organized as follows. In the next section, we will provide an overview of related studies that empirically investigate financial market integration and the determinants of government bond yield spreads. The third section presents the estimation methodology and results. The last section concludes the study.

Insert Figure 1 around here

## **Related Literature**

### ***Financial market integration***

The definition of a “financially integrated market” in Baele et al. (2004, 6) is commonly adopted in many studies: “*the market for a given set of financial instruments (services) is fully integrated if all potential market participants with the same relevant characteristics (1) face a single set of rules when they decide to deal with those financial instruments (services); (2) have equal access to the above-mentioned set of financial instruments and/or services; (3) are treated equally when they are active in the market.*” However, the indicator considered as an evidence of market integration varies depending on the focus of the study. Some studies focus on price convergence and others focus on the sensitivity, mutual causality, cointegration relationship, and correlation. Table 1 summarizes the related literature with regard to estimation methods<sup>1</sup>.

Adam *et al.* (2002), Baele *et al.* (2004), Yu, Fung, and Tam (2007), and Park (2013) employed  $\beta$ -convergence and  $\sigma$ -convergence measures, which are borrowed from the economic growth literature. In fully integrated financial markets, assets with the same risk should have the same expected returns, thus the law of one price must hold. This is because

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<sup>1</sup> There are in general three approaches to analyze international financial integration. The first approach is a price-based approach. The second approach is called a quantity-based approach. This approach is based on the idea that a current account deficit (surplus) will be balanced by a corresponding capital inflow (outflow) and a country’s decisions will be separated from its investment decisions in perfectly integrated financial markets. Therefore, correlations between saving and investment ratios (Feldstein-Horioka criterion) are examined. The third approach is called a risk-sharing approach. In perfectly integrated financial markets, cross-border capital flows raise the chance of risk-sharing thus enable countries to smooth out consumption over time. Therefore, cross-country consumption-growth correlations are examined. In this paper, we focus on the price-based approach.

all agents will be free to exploit any arbitrage opportunities.  $\beta$ -convergence is based on the idea that the yields in countries with relatively high level have a tendency to decrease more rapidly than in countries with relatively low level and it examines the speed of convergence. On the other hand,  $\sigma$ -convergence examines the cross-sectional dispersion in interest rates to measure the degree of financial integration at any point in time.

Serletis and King (1997), Kim, Lucey, and Wu (2006), and Yu, Fung, and Tam (2007) employed the Kalman filter-based method proposed by Haldane and Hall (1991). In fully integrated financial markets, yield changes in the benchmark asset should be a good proxy for the correct reaction of yields across countries. Therefore, if we regress the yield changes in one country ( $\Delta i_{it}$ ) on those in benchmark country ( $\Delta i_{bt}$ ), the time-varying intercept ( $\alpha_t$ ) might converge to zero and the time-varying coefficient on  $\Delta i_{bt}$  ( $\beta_t$ ) might converge to one. This is because  $\Delta i_{it}$  should not be systematically larger or smaller than  $\Delta i_{bt}$  ( $\alpha_t$  might converge to zero) and conditional covariance  $Cov_t(\Delta i_{it}, \Delta i_{bt})$  should converge to the conditional variance  $Var_t(\Delta i_{bt})$  ( $\beta_t = Cov_t(\Delta i_{it}, \Delta i_{bt}) / Var_t(\Delta i_{bt})$  might converge to one). Moreover, because country-specific error should shrink in fully integrated markets, the proportion of conditional variance  $Var_t(\Delta i_{it})$  explained by  $Var_t(\Delta i_{bt})$  should increase toward one. Therefore, the variance ratio is another measure for integration.

Mills and Mills (1991), Kasa (1992), Clare, Maras, and Thomas (1995), Serletis and King (1997), Manning (2002), Click and Plummer (2005), Yu, Fung, and Tam (2007), Vo (2009), and Calvi (2010) employed Johansen's (1988) cointegration method. In integrated financial markets, the yields cannot diverge arbitrarily from each other; therefore, there must be a stable long-run relationship among yields across countries. Moreover, the number of common stochastic trends will equal the dimension of the system ( $n$ ) minus the number of linear independent cointegrating vectors, namely, cointegration rank ( $r$ ). Therefore, if the cointegration rank is  $n-1$ , there is a single common stochastic trend, which is the evidence of a fully integrated financial market. It means that the yields in the process of integration are expected to show an increase in the number of cointegrations. Based on this idea, Rangvid (2001), Yu, Fung, and Tam (2007), and Kim, Lucey, and Wu (2006)

employ Hansen and Johansen's (1992) dynamic cointegration method to detect the time-varying number of cointegration ranks by rolling the estimation window.

Kim, Lucey, and Wu (2006), Yu, Fung, and Tam (2007), and Tsukuda, Shimada, and Miyakoshi (2017) employ the dynamic conditional correlation (DCC) method proposed by Engle (2002). This method is based on the idea that the higher the correlation between markets, the larger the return comovement and the greater the market integration.

In this paper, we will employ the DCC method. This is because  $\beta$ - and  $\sigma$ -convergence measures and Kalman-filter approaches are not suitable for our study. This is because benchmark countries to which the yields in the examined countries converge cannot be chosen *a priori* and arbitrarily. In addition, the cointegration method has some faults in the sense that the existence of cointegration relationship does not necessarily mean that their yields commove together. For example, a perfect negative correlation between the yields in two countries may be reflected by the cointegration vector [1, -1]

Insert Table 1 around here

### ***Determinants of government bond yield spreads***

Many studies investigate the determinants of government bond yield spread. Bernoth, von Hagen, and Schuknecht (2004) showed that the important determinants of government bond yield spreads are credit risk, liquidity risk, and investors' risk aversion. As shown in Table 2, many variables and indicators are used to measure these three risks.

As for credit risk, Barrios *et al.* (2009) point out that there are three types of credit risk; (i) default risk, (ii) credit-spread risk, and (iii) downgrade risk. The default risk is defined as the probability that the issuer fails to meet the obligations either on coupon payments or repayment of principal at maturity. Credit-spread risk is defined as the probability that the market value of the bond will decline more than the value of other comparable quality bonds. Downgrade risk is defined as the possibility of a downgrade by the credit rating agency. Therefore, fiscal variables, including budget deficits to GDP ratio, government debt to GDP ratio, and debt service (interest payments) to budget revenue ratio,

are used to measure the fiscal positions. An alternative way to assess the default risk is to look at credit default swaps (CDS).

Liquidity risk is defined as the possibility that investors cannot trade their portfolios quickly enough in the market at a low cost without impacting the market price. The factors that determine liquidity risk include transaction costs, speed of transactions, market depth, and market breadth. Therefore, the variables such as bid-ask spread (transaction costs), the size of trading volumes (market depth), and size of bonds' outstanding amount (market breadth) are usually used. Credit risk and liquidity risk are interconnected. An increase in the supply of government bonds might decrease liquidity risk; on the other hand, it is also associated with increased budget deficits and public debt, and might increase credit risk.

Investors' risk aversion is associated with their willingness to take a risk. Even if the amount of risk embedded in a government bond remains unchanged, the demanded risk premium might vary due to the change in the investors' risk aversion. The investors' risk aversion is usually measured by the spreads between the US Treasury Bond and BBB-corporate bonds, and implied volatility index (VIX) for bonds, stocks, and exchange rates.

Moreover, some literature finds evidence that the effects of country-specific variables such as fiscal variables are non-linear. Therefore, the interaction terms between fiscal variables and risk aversion and/or quadratic terms are included in the estimation equation.

Insert Table 2 around here

## **Empirical Methods**

### ***Government bond market integration***

In this paper, we use the DCC – generalized autoregressive conditional heteroscedasticity (DCC-GARCH) method to investigate the government bond market integration in Asian countries.

We assume that the  $3 \times 1$  vector  $Y_t \equiv [i_{i,t} \ f_t^g \ f_t^r]'$  follows the VAR( $p$ ) model,

$$Y_t = A_0 + \sum_{i=1}^p A_i Y_{t-i} + \varepsilon_t, \quad \varepsilon_t = H_t^{\frac{1}{2}} v_t, \quad \varepsilon_t | I_{t-1} \sim N(0, H_t), \quad (1)$$

where  $i_{i,t}$  is a government bond yield in country  $i$ ,  $f_t^g$  is a global factor that affects yields globally, and  $f_t^r$  is an Asian regional factor that affects the yields in Asian countries but is not explained by the global factor.  $H_t$  is a  $3 \times 3$  conditional covariance matrix and  $v_t$  is an  $3 \times 1$  innovation vector following an *i.i.d.* standard normal distribution.

We can decompose the conditional covariance matrix  $H_t$  as

$$H_t = D_t^2 R_t D_t^2, \quad (2)$$

where  $D_t$  is a  $3 \times 3$  diagonal matrix of time-varying standard deviations with  $h_{ii,t}$  ( $i = 1, \dots, 3$ ) as the  $i$ th element of the diagonal, and  $R_t$  is a  $3 \times 3$  symmetric time-varying correlation matrix,

$$D_t = \begin{bmatrix} h_{11,t} & 0 & 0 \\ 0 & h_{22,t} & 0 \\ 0 & 0 & h_{33,t} \end{bmatrix}, \quad R_t = \begin{bmatrix} 1 & h_{12,t} / \sqrt{h_{11,t} h_{22,t}} & h_{13,t} / \sqrt{h_{11,t} h_{33,t}} \\ h_{12,t} / \sqrt{h_{11,t} h_{22,t}} & 1 & h_{23,t} / \sqrt{h_{22,t} h_{33,t}} \\ h_{13,t} / \sqrt{h_{11,t} h_{33,t}} & h_{23,t} / \sqrt{h_{22,t} h_{33,t}} & 1 \end{bmatrix}.$$

The DCC model is estimated by a two-step procedure. In the first step, we will obtain  $D_t$  by assuming that  $h_{ii,t}$  follows GARCH(1, 1) model,

$$h_{ii,t} = \alpha_i + \beta_{i1} \varepsilon_{i,t-1}^2 + \gamma_{i1} h_{ii,t-1}. \quad (3)$$

In the second step, we will standardize residuals as  $\tilde{\varepsilon}_t = D_t^{-\frac{1}{2}} \varepsilon_t$ , namely as  $\tilde{\varepsilon}_{i,t} = \varepsilon_{it} / \sqrt{h_{ii,t}}$ , and use them to estimate dynamic correlation. From equation (2), we can see that

$$E_{t-1}[\tilde{\varepsilon}_t \tilde{\varepsilon}_t'] = (D_t)^{-\frac{1}{2}} H_t (D_t)^{-\frac{1}{2}} = R_t. \quad (4)$$

The correlation matrix  $R_t$  can be estimated by specifying matrix  $Q_t$  as the following exponential smoother equation, which is used solely to provide  $R_t$ ,

$$Q_t = (1 - \delta_1 - \delta_2) \bar{R} + \delta_1 \tilde{\varepsilon}_{t-1} \tilde{\varepsilon}_{t-1}' + \delta_2 Q_{t-1}. \quad (5)$$

$Q_t$  is a  $3 \times 3$  symmetric positive definite matrix,  $\bar{R} = E[\tilde{\varepsilon}_t \tilde{\varepsilon}_t']$  is the unconditional covariance matrix of the standardized residuals (unconditional correlation) and  $\delta_1$   $\delta_2$  are non-negative parameters that satisfy  $0 \leq \delta_1 + \delta_2 < 1$ . The conditional correlation matrix  $R_t$  is obtained by



$$R_t = \text{diag}(Q_t)^{-\frac{1}{2}} Q_t \text{diag}(Q_t)^{-\frac{1}{2}}, \quad (6)$$

where  $\text{diag}(Q_t)^{1/2}$  is a diagonal matrix of the square root of the diagonal element of  $Q_t$ . For  $R_t$  to be positive definite, the only condition to be satisfied is that  $Q_t$  is positive definite.

We will extract the global factor  $f_t^g$  and Asian regional factor  $f_t^r$  by using the static factor model. We will decompose an  $(n+1) \times 1$  vector  $X_t = [\tilde{i}_{1,t} \cdots \tilde{i}_{n,t} \tilde{i}_{us,t}]'$  as

$$X_t = \alpha + \begin{bmatrix} \lambda_1^g & \cdots & \lambda_n^g & \lambda_{us}^g \\ \lambda_1^r & \cdots & \lambda_n^r & \lambda_{us}^g \end{bmatrix}' \begin{bmatrix} f_t^g \\ f_t^r \end{bmatrix} + \varepsilon_t = \alpha + \Lambda' f_t + \varepsilon_t, \quad (7)$$

where  $\tilde{i}_{i,t}$  and  $\tilde{i}_{us,t}$  are standardized government bond yields in country  $i$  and in the U.S., respectively,  $\varepsilon_t$  is an  $(n+1) \times 1$  vector of idiosyncratic shock and  $\Lambda$  is an  $(n+1) \times 2$  factor loading matrix. We will extract the first two principal components and identify one component with a higher correlation with the US yield as the global factor and the other component as the Asian regional factor.

### ***Determinants of government bond yield spreads***

We employ the pooled mean group (PMG) method proposed by Pesaran, Shin, and Smith (1999). Because this model allows the short-run parameters to vary across individual countries while restricting long-run parameters to be identical across countries, it has several advantages. First, it assumes a dynamic model, which could capture the nature of the data. Second, it imposes homogeneity of long-run coefficients, which leads to more stable estimates. Third, it allows separating short-term dynamics and the adjustment towards the long-run equilibrium so that it could consider the heterogeneity in short-run responses across countries.

We start from the ARDL  $(p, q, \dots, q)$  model,

$$s_{i,t} = \alpha_i + \sum_{j=1}^p \beta_{i,j} s_{i,t-j} + \sum_{j=0}^q \gamma_{1i,j} X_{i,t-j} + \sum_{j=0}^q \gamma_{2i,j} Z_{i,t-j} + \varepsilon_{i,t}, \quad (8)$$

where  $s_{i,t}$  denotes the government bond yield spread of country  $i$ ,  $X_{i,t}$  and  $Z_t$ ,  $k_1 \times 1$  vector of country-specific variables which are expected to affect credit risk and liquidity risk, and  $k_2 \times 1$  vector of global variables which are expected to reflect investors' risk

aversion, respectively.  $\gamma_{1i,j}$  and  $\gamma_{2i,j}$  are  $k_1 \times 1$  and  $k_2 \times 1$  vector of coefficients.

Equation (11) can be arranged to obtain the error correction equation:

$$\Delta s_{i,t} = \phi_i \left[ s_{i,t-1} - \alpha_i^* - \delta_{1i}' X_{i,t} - \delta_{2i}' Z_t \right] + \sum_{j=0}^{p-1} \beta_{i,j}^* \Delta s_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{1i,j}^* \Delta X_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{2i,j}^* \Delta Z_{t-j} + \varepsilon_{it}, \quad (9)$$

where

$$\phi_i = - \left( 1 - \sum_{j=1}^p \beta_{i,j} \right), \quad \alpha_i^* = \frac{\alpha_i}{1 - \sum_{j=1}^p \beta_{ij}}, \quad \delta_{1i} = \frac{\sum_{j=1}^q \gamma_{1i,j}}{1 - \sum_{j=1}^p \beta_{i,j}}, \quad \delta_{2i} = \frac{\sum_{j=1}^q \gamma_{2i,j}}{1 - \sum_{j=1}^p \beta_{i,j}},$$

$$\beta_{i,j}^* = - \sum_{m=j+1}^p \beta_{i,m} \quad (j=1, \dots, p-1), \quad \gamma_{1i,j}^* = - \sum_{m=j+1}^q \gamma_{1i,m} \quad \text{and} \quad \gamma_{2i,j}^* = - \sum_{m=j+1}^q \gamma_{2i,m} \quad (j=1, \dots, q-1)$$

By imposing homogeneity restrictions on the long-run coefficients ( $\delta_{1i} = \delta_1$ ,  $\delta_{2i} = \delta_2$ ), we obtain

$$\Delta s_{i,t} = \phi_i \left[ s_{i,t-1} - \alpha_i^* - \delta_1' X_{i,t} - \delta_2' Z_t \right] + \sum_{j=0}^{p-1} \beta_{i,j}^* \Delta s_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{1i,j}^* \Delta X_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{2i,j}^* \Delta Z_{t-j} + \varepsilon_{it}. \quad (10)$$

By setting  $p = q = 1$ , we estimate the following equation;

$$\Delta s_{i,t} = \phi_i \left[ s_{i,t-1} - \alpha_i^* - \delta_1' X_{i,t} - \delta_2' Z_t \right] + \gamma_{1i}^* \Delta X_{i,t} + \gamma_{2i}^* \Delta Z_t + \varepsilon_{it}. \quad (11)$$

At first, we assume that the US government bond is risk-free so that we calculate the government bond yield spreads as the premium paid by the 4 ASEAN countries over a US government bond with comparable maturities (10 years).

We adopt explanatory variables on the basis of previous literature. We use the following country-specific variables as  $X_{i,t}$ ; (i) government budget balance to GDP ratio (*BB*), (ii) public debt to GDP ratio (*PD*), (iii) government interest payments on public debt to budget revenue ratio (*PIP*), and (iv) the expected depreciation rates of exchange rate in terms of local currency par US dollars (*EX*). The expected depreciation rates of exchange rate are employed to control the effects of the fluctuations in exchange rate, and they are approximated by *ex-ante* realized values.

As for the liquidity risk, we cannot obtain relevant variables such as bid-ask spread and the size of trading volumes or turnover rates. Therefore, we use public debt to GDP

ratio ( $PD$ ) as the measure not only for the credit risk but also for the liquidity risk. If the coefficient on  $PD$  is estimated to be positive and significant, we will interpret that the effects of credit risk dominate those of liquidity risk, and *vice versa*.

As for global variables  $Z_t$ , which are expected to reflect investors' risk aversion, we will extract the first principle component of the following three variables; (i) the spreads between US Treasury Bond and BBB-corporate bonds, (ii) implied volatility index (VIX) for US stocks, and (iii) implied volatility index for yen-euro exchange rates. We will call the first principal component as RISK.

Note that we do not employ data on the money market rate, which is usually recognized as an important determinant, because of multi-collinearity between the money-market rate and investors' risk aversion. This may be because central banks in ASEAN countries decrease their short-term interest rates when investors' risk aversion increases following negative market shocks. We do not also employ the credit default swap (CDS) data as credit risk variables. This is because it would reflect the investors' subjective assessment of credit risk. However, one of the aims of this study is to investigate whether bond market integration would advance or obstruct investors' ability or willingness to discriminate between the creditworthiness of national fiscal policies. In other words, we will examine whether investors' subjective assessment of credit risk would reflect the relevant fiscal fundamental variables precisely. Therefore, using CDS data should cause tautology.

## **Data**

Our sample includes four ASEAN countries (Indonesia, Malaysia, the Philippines, and Thailand).

In the analysis of government-bond-market integration, our sample period runs from January 2<sup>nd</sup> 2001 to June 30<sup>th</sup> 2018, and we use daily data. We calculate the government bond yields from the 10-year government bond total index data denominated in LCY. The data for ASEAN countries are sourced from *AsiaBondsOnline* and the data for the U.S. are from *Datastream*.

In the analysis of the determinants of government bond yield spreads, our sample

period runs from 2001Q1 to 2017Q4 with quarterly data. In some countries, fiscal variables are only available from annual data. In this case, we follow the Chow and Lin (1971) method of interpolating from annual to quarterly data. For example, the annual public debt is interpolated to a quarterly series by using quarterly budget balance as the related variable, and the annual public interest payments are interpolated by using both quarterly budget balance and public debt.

As explained above, we construct a variable for investors' risk aversion by extracting the first principle component of (i) the spreads between US Treasury Bond and BBB-corporate bonds, (ii) implied volatility index of US stocks, and (iii) implied volatility index of yen-euro exchange rates. We use daily data and then convert to quarterly data by taking averages over each quarterly period. The results are shown in Table 3. The cumulative contribution rate of the first principal component is above 80% and three eigenvectors (factor-loadings) are about 0.6. Figure 2 displays annual data of BB, PD, and PIP, and quarterly data of RISK.

Insert Table 3 and Figure 2 around here

## **Empirical Results**

### ***Government bond market integration***

As the first step, we extract the global factor and the Asian regional factor by using principal component analysis. Table 4 shows the results. We extracted the first two principal components whose eigenvalues are greater than one. The correlation coefficient between the second principal component and US government bond yield (0.683) is higher than that between the first principal component and US government bond yield (0.263). The eigenvectors (loading coefficient) of the first principal component in all countries have positive values, which indicate that the first principal component has a symmetric effect among ASEAN countries. Moreover, the eigenvector (loading coefficient) of the second principal component on US government bond yield (0.661) is higher than that of the first principal component (0.229). Thus, we identify the first principal component as the Asian regional factor  $f_t^r$  and the second principal component as the global factor  $f_t^g$ .

Table 5 shows the results of the DCC estimation. In the estimation, we set lag length  $p$  in equation (1) to be one based on Schwarz Bayesian Information Criterion (SBIC). We can see that both the autoregressive conditionally heteroscedastic (ARCH) effects and GARCH effects in each equation are statistically significant<sup>2</sup>. The table also presents the quasi-correlation  $\rho$ . We can see that the quasi-correlations between the regional factor and the yield in each country are significantly positive and high. It implies that the government bond yields in ASEAN countries are driven by the common regional factor so that regional government bond markets are integrated. On the other hand, the quasi-correlations between the global factor and the yield in each country are different in signs; a positive correlation in Malaysia and Thailand, while a negative correlation in Indonesia and the Philippines. It means that the effects of the global factor across countries are asymmetric.

Figure 3 shows the dynamic conditional correlation between each factor and the government bond yield in each country.

From the figure, we can see that the dynamic conditional correlation between the regional factor and the yield in each country is positive and high in all 4 ASEAN countries. However, the degree of correlation has not changed so much over time. These results mean that the government bond markets in the examined countries have already been integrated in the sense that their yields are driven by the common regional factor, but the degree of the integration has not increased in the sense that correlations have not increased so much. On the other hand, the dynamic conditional correlation between the global factor and the yield in each country shows quite different patterns among countries. It has been positive in Thailand (full sample average is 0.389), positive but close to zero in Malaysia (0.059), and negative in Indonesia (-0.332) and the Philippines (-0.494). The correlation between the global factor and US government bond yield is very high and stable (0.706). The negative correlations between the global factor and the yield in Indonesia and the Philippines indicate the prevalence of “flight to quality” in these countries. Namely, when investors’ risk aversion increases following events such as the global financial crisis, investors are reluctant to hold riskier government bonds issued by Indonesia and the Philippines so that

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<sup>2</sup> Null hypothesis that  $\lambda_1 = 0$  and  $\lambda_2 = 0$  can be rejected, which means that the constant conditional correlation (CCC) model is incorrect.

they changed their portfolio from these government bonds to US government bonds. As a consequence, the government bond yield in the U.S. decreases while those of Indonesia and the Philippines increase. In this case, the global factor should decrease, because it has a positive correlation with the US yield. These results show that the global factor has different impacts on the ASEAN countries asymmetrically. Therefore, we have another question; why the effects of the global factor are asymmetric among the 4 ASEAN countries, namely, which variables discriminate the creditworthiness of government bonds.

Insert Tables 4, 5 and Figures 3 around here

### ***Determinants of government bond yield spreads***

Table 6 shows the results of PMG estimation. It shows not only the long-run coefficients that are restricted to be homogeneous among countries but also the short-run coefficients that are allowed to vary across countries. From the table, we can see that BB is not a significant determinant in all specifications and PD is also not significant except for specification (2) in the long-run. On the contrary, PIP has positive and significant effects on government bond yield in the long-run. It means that PIP is an important determinant of government bond spreads over the 4 ASEAN countries. These results are consistent with Bernoth, von Hagen, and Schuknecht (2004), who find that fiscal imbalances are better captured by a measure of debt service than either deficit to GDP ratio or debt to GDP ratio. Moreover, PIP is positive and significant in Indonesia and the Philippines in the short-run (in specifications (4) and (10)). As shown in Figure 2, the levels of PIP are higher in Indonesia and the Philippines than in the other two countries. Therefore, we can say that the government bond markets in the examined countries have maintained market discipline in the sense that investors discriminate between the creditworthiness of each country by focusing on the public interest payments. These results might give us insights about the reason why the effects of the global factor are asymmetric among ASEAN countries, and why the correlation between the global factor and the government bond yield are negative in Indonesia and the Philippines. The investors' risk aversion (RISK) is positive and significant for all specifications. These results mean that following the events in which

investors' risk aversion increases, investors are reluctant to hold more risky assets so that they changed their portfolio from ASEAN countries' government bonds to those of the advanced countries such as the U.S.. This is known as "flight to quality."

Insert Table 6 around here

### ***Extensions***

In the previous PMG estimation, we found that PIP is a significant determinant of government bond spread in ASEAN countries, and it is also significant in the short-run in Indonesia and the Philippines, during which their levels of PIP are higher and their yields are negatively correlated with the global factor.

Combining these results, we can infer that investors would discriminate between the creditworthiness of each government bond by focusing on the level of public interest payments; and there might exist a threshold value that would trigger the investors' decision. When investors' risk aversion increases (thus, the global factor decreases), investors decide to sell the government bond issued by countries whose public interest payments are higher than the threshold value. This would then increase the government bond yields in these countries and cause negative correlation between their bond yield and the global factor.

Therefore, we employ the fixed-effects panel threshold method proposed by Hansen (1999) to investigate whether there exists a threshold effect in the global factor, in which the PIP level determines the threshold value. We specify the estimation equation as follows:

$$i_{i,t} = \alpha_i + \beta_1 BB_{i,t} + \beta_2 PD_{i,t} + \beta_3 PIP_{i,t} + \gamma_1 f_t^r + \gamma_{2,below} f_t^g (PIP_{i,t} < \theta) + \gamma_{2,above} f_t^g (PIP_{i,t} \geq \theta) + \varepsilon_{i,t}, \quad (12)$$

where  $\alpha_i$  is a fixed effect in country  $i$ ,  $\theta$  is a threshold parameter to be estimated.  $\gamma_{2\_below}$  and  $\gamma_{2\_above}$  are coefficients in each regime. We assume that the threshold variable is  $PIP_{i,t}$  and regime-dependent variable is  $f_t^g$ .<sup>3</sup>

Table 7 shows the estimation results. The threshold parameter is estimated to be 0.1064 with 95% confidence interval [0.1051 0.1065]. We plot the threshold value of PIP in Figure 2. We see that the PIP in Indonesia and the Philippines are higher than the threshold

values in most of the sample periods. The null hypothesis of no threshold can be rejected at a 99% significance level<sup>4</sup> <sup>5</sup>. From the estimation results, we find that PIP and  $f_t^r$  are positively significant. We also find that the global factor  $f_t^r$  is not significant when the value of PPP is below the threshold value, but it is negatively significant when it is above the threshold value.

These results confirm our inference that when investors' risk aversion increases (thus, the global factor decreases), investors decide to sell the government bond issued by Indonesia and the Philippines, whose public interest payments exceed the threshold value (0.1064). This in turn increases the government bond yields in these countries and causes negative correlation between their bond yields and the global factor.

Insert Table 7 around here

## Conclusions

In this paper, we mainly examined whether the government bond markets in 4 ASEAN countries are integrated and whether government bond market integration has advanced or obstructed the market discipline in the region.

To answer the first question, we employed the DCC method to investigate the time-varying correlations between the government bond yield in each country and both the regional and global factors. Our results show that the government bond markets in the examined countries are integrated in the sense that their yields are driven by a common regional factor, but the degree of integration has not increased, as correlations have not increased. We also find that the global factor has asymmetric effects on government bond yields among the 4 ASEAN countries, namely, the correlation between the global factor and the government bond yields is positive in Malaysia and Thailand but negative in Indonesia and the Philippines.

To answer the second question, we investigated the determinants of government bond

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<sup>3</sup> We exclude *RISK* from our regression, because it has multi-collinearity with the global factor.

<sup>4</sup> The critical values of *F* statistics to test the significance of the threshold effects are based on bootstrapping procedure.

<sup>5</sup> We fit a double-threshold model, but the null hypothesis of a double-threshold model can be rejected.



spreads by using PMG estimation methods, which allows the heterogeneity in short-run responses across countries. We find that public interest payments are an important determinant, and have positive and significant effects on government bond yield in the long-run. Moreover, they also have positive and significant effects in the short-run in Indonesia and the Philippines where the level of public interest payments are higher. We also find that the investors' risk aversion has positive and significant effects, which means "flight to quality."

We also use the fixed-effects panel threshold method to investigate whether there exists a threshold effect that depends on public interest payments. We find that the global factor is not significant when public interest payments are below the threshold value, but it is negatively significant when above.

Combining these results, we can conclude that market discipline still has been operating in the 4 ASEAN government bond markets in the sense that investors discriminate between the creditworthiness of each government bond by focusing on the public interest payments.

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## Tables and Figures

**Table 1. Related Literature: Financial Market Integration**

Author	Countries or Regions Sample periods / Frequency Markets	Estimation methods	Findings
Haldane and Hall (1991)	USA, Germany, UK 1976M1 - 1989M8 / daily foreign exchange markets	Kalman filter approach	The relationship between sterling and the dollar has weakened in a fairly systematic way since the 1970s.
Mills and Mills (1991)	USA, West Germany, UK, Japan 1986M4 - 1989M12 / daily government bond (less than 5 years) markets	Johansen's cointegration analysis	Bond yields are not cointegrated, and in the long run they are determined by their own domestic fundamentals.
Kasa (1992)	USA, Germany, UK, Japan, Canada 1974M1 - 1990M8 / monthly, 1974Q1 - 1990Q3 / quarterly stock markets	Johansen's cointegration analysis	A single common stochastic trend lies behind the long-run comovement of the equity markets.
Clare, Maras and Thomas (1995)	USA, Germany, UK, Japan 1978M1 - 1990M4 / monthly government bond markets	Engle and Granger's cointegration analysis	During the 1980s, there were low correlations between bond markets in the long run and hence diversification benefits will have been available over this period.
Serletis and King (1997)	Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Spain, UK 1971Q1 - 1992Q1 / quarterly stock markets	Johansen cointegration analysis, Kalman filter approach	The link between the EU stock markets has been strengthening, but the convergence is still in the process of being achieved.
Rangvid (2001)	France, Germany, UK 1960Q1 - 1999Q1 / quarterly stock markets	dynamic cointegration analysis	The degree of convergence among three major European stock markets has been increased during the 1980s and 1990s.
Adam <i>et al.</i> (2002)	12 euro area countries 1995M1-2001M9 / daily inter-bank, government bond, credit (mortgage, corporate loan) markets	$\beta$ -convergence measure, $\sigma$ -convergence measure	$\beta$ -convergence measure implies that convergence accelerates after the adoption of the Euro in 1999. The speed of convergence increase after 1999 in inter-bank loan rate, government bond yield and mortgage interest rate, while it is lower in the corporate-loan rates. $\sigma$ -convergence has taken place in all four markets.
Manning (2002)	USA, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan, Thailand 1988M1 - 1999M2 / weekly, 1988Q1 - 1999Q1 / quarterly stock markets	Johansen cointegration analysis Kalman filter approach	Equity markets in South East Asia have shown signs of converging during the 1990s. This process appears to have been abruptly halted and somewhat reversed by the Asian financial crisis.

Author	Countries or Regions Sample periods / Frequency Markets	Estimation methods	Findings
Baele <i>et al.</i> (2004)	11 euro area countries (excl. Luxembourg) 1994M1 - 2003M7 for money markets /daily, 1993M1 - 2003M5 for government bond markets / monthly, 1998M1 - 2003M5 for corporate markets / monthly, 1990M1 - 2004M1 for bank credit markets / monthly, 1973M1 - 2003M1 for equity markets / monthly money markets, government bond markets, corporate bond markets, bank credit markets, equity markets	$\beta$ -convergence measure, $\sigma$ -convergence measure	In the euro area, the money market is found to be the most integrated market. The degree of integration in the government bond market has been very high since the introduction of the euro. The euro area corporate bond market seems reasonably well integrated. The state of integration in euro area banking markets varies in different segments. For euro area equity markets, a rising degree of integration has been found.
Click and Plummer (2005)	Indonesia, Malaysia, Philippines, Singapore, Thailand 1998M7 - 2002M12 / daily, 1998M7 - 2002M12 / weekly stock markets	Johansen cointegration analysis	The ASEAN-5 stock markets are integrated in the economic sense, but that integration is not complete.
Kim, Lucey and Wu(2006)	Belgium, Czechoslovakia, France, Germany, Hungary, Ireland, Italy, Netherlands, Poland, UK 1998M7 - 2003M12 / daily government bond markets	dynamic cointegration analysis, Kalman filter approach, dynamic conditional correlation approach	The evidence for strong contemporaneous and dynamic linkages between existing EU member bond markets with that of Germany has been found, while for the UK and the three accession countries of Czech republic, Poland and Hungary, such linkages are relatively weak but stable.
Yu, Fung and Tam(2007)	Japan, China, Hong Kong, Taiwan, Korea, Singapore, Malaysia, the Philippines, Thailand, Indonesia 1996M1 - 2006M1/ daily government bond markets	$\beta$ -convergence measure, $\sigma$ -convergence measure Kalman filter approach, Johansen cointegration analysis, dynamic cointegration analysis, dynamic conditional correlation approach	There is only weak bond market integration in the region and very little progress has taken place since 2003. The apparent lack of progress may be due to the “local” or “idiosyncratic” factors in some Asian economies.
Vo(2009)	Australia, USA, Hong Kong, Indonesia, Japan, South Korea, Malaysia, New Zealand, the Philippines, Singapore, Taiwan, Thailand 1990M2 - 2005M3 / daily government bond markets	Johansen cointegration analysis, Granger causality analysis	The level of financial integration between countries is found to be low. Low level of correlations and cointegrations indicates that considerable diversification benefits can be obtained by Australian (US) investors contemplating investing in Asian markets.
Calvi (2010)	7 Europe: Belgium, France, Germany, Italy, the Netherlands, Spain, UK, 10 East Asia: China, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore, South Korea, Taiwan, Thailand 1989M12 - 2009M7 / daily stock markets	Johansen cointegration analysis, Granger causality analysis	Financial integration in Europe is significantly more advanced than in East Asia. The level of integration between bond markets is found to be higher than between equity markets within Europe, while it is the opposite in the East Asian region.
Park(2013)	China, Hong Kong, India, Indonesia, South Korea, Malaysia, the Philippines, Singapore, Taipei, Thailand 2000M8 - 2011M8 for bonds / weekly, 1991M9 - 2011M11 for stocks / weekly government bond markets, stock markets	$\beta$ -convergence measure, $\sigma$ -convergence measure, principal component analysis	The pace of regional integration of financial markets in Asia's emerging economies has accelerated. Integration of the region's domestic local-currency bond markets with their regional and global counterparts lags the pace of integration of its equity markets. Spillover effects of regional and global financial crises have a significant impact on both domestic equity and bond markets.
Tsukuda, Shimada and Miyakoshi(2017)	USA, Japan, Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, South Korea, Hong Kong 2001M1 - 2012M12 / weekly government bond markets	dynamic conditional correlation approach	Low levels of integration between the local bond markets in the ASEAN4(Indonesia, Malaysia, Philippines, and Thailand) and the external markets have been found. However, Hong Kong and Singapore are highly integrated with the external markets. The Japanese market has minimal effects on the East Asian markets.

**Table 2. Related Literature: Determinants of Government Bond Spreads**

Author	Countries / Bench mark countries Sample periods / Frequency	Variables	Findings
Bernoth, von Hagen and Schuknecht (2004)	13 EU countries/Germany, U.S. 1991-2002/annual	(i) debt/GDP, (ii) fiscal balance/GDP (iii), debt service payments to total revenue ratios, (iv) corporate bond spread, (v)time to maturity of the government bond, (vi)country's outstanding of government bonds/EU outstanding of government bonds, (vii) business cycle variable	Yield spreads of EU countries reflect positive default and liquidity risk premia. The default risk premium is positively affected by the debt and debt service ratios of the issuer country. Liquidity risk premia are reduced with EMU membership, which points to an increase in financial market integration.
Manganelli and Wolswijk (2007)	10 euro area countries (excl. Luxembourg)/Germany 1999M1-2006M5/monthly	(i) interaction term between main refinancing operations minimum bid rate and rating dummies(AA+, AA, AA-, A+ and A), (ii) AAA rating (liquidity premiums), (iii) country's outstanding/euro area outstanding of government bonds	Spreads tend to be driven by the level of short-term interest rates. Sovereigns with lower credit ratings are forced to pay a higher credit risk premium, which means that market discipline still operating in EMU.
Barrios <i>et al.</i> (2009)	Austria, Belgium, Spain, France, Germany, Greece, Italy, Portugal 2003M3 - 2009M4 / weekly	(i) CDS spread, (ii)bid-ask spread, (iii)risk aversion indicator, (iv) global financial crisis <i>dummy</i>	Euro area sovereign bond interest rates are strongly influenced by conditions in global financial markets. Domestic factors like liquidity and credit risk have become more important in the financial crisis to explain yield differentials.
Haugh, Ollivaud and Turner (2009)	Austria, Belgium, Finland, France, Greece, Italy, Netherlands, Portugal, Spain / Germany 2005Q4-2009Q2/semi-annual	(i) gross and net debt/GDP, (ii) debt service ratio, (iii) expected future fiscal deficits, (iv) corporate bond spread, (v) expected future public pension expenditures, (vi) country's outstanding government bonds/euro-area total outstanding government bonds	Fiscal policies, particularly their effect on future deficits, and the debt service ratio have an important role in explaining bond yield spreads.
Barbosa and Costa (2010)	10 euro area countries (excl. Luxembourg)/Germany 2007M1-2009M12 or 2010M5	(i) CDS spread, (ii) fiscal balance/GDP, (iii) public debt /GDP, (iv)international invest position, (v) bid-ask spread, (vi) volumes available for trade, (vii)trading volume, (viii)first principal component of BBB corporate bond spreads, CDS indices and stock and bond markets implied volatilities	Government bond spreads can largely be explained by differences between creditworthiness of national governments, liquidity in domestic bond markets, as well as by the risk premium in international financial markets.

Author	Countries / Bench mark countries Sample periods / Frequency	Variables	Findings
Bellas, Papaioannou, and Petrova (2010)	14 emerging market economies/U.S. 1997Q1-2009Q2/quarterly	(i) external debt/GDP, (ii) interest payments on external debt/reserves, (iii) short-term debt/reserves, (iv) external debt amortization/reserves, (v) fiscal balance/GDP, (vi) current account/GDP, (vi) trade openness, (vii) financial stress index, (viii) U.S. 3-month Treasury bill rate and 10-year government bond yield, (ix) VIX, (x) political risk	Financial fragility is a more important determinant of spreads than fundamental indicators in the short run. On the other hand, fundamentals are significant determinants in the long run. In addition, other factors, such as political instability, corruption, and asymmetry of information may also affect the spread.
Schuknecht, von Hagen and Wolswijk (2010)	15 EU countries/Germany U.S. 1999M1-2007M6	(i) debt to GDP, (ii) fiscal balance/GDP, (iii), time to maturity, (iv) size of bond issue, (v) corporate bond spreads, (vi) short-time interest rate, (vii) interaction term between fiscal variables and turmoil and crisis dummy, (viii) country's outstanding of government bonds/EU outstanding of government bonds, (ix) business cycle variable	Bond yield spreads can still largely be explained on the basis of economic principles during the crisis. Markets penalise fiscal imbalances much more strongly since the Lehman default in September 2008. In addition to fiscal deficits and debt, there is also a significant increase in the spread due to general risk aversion.
Belhocine, N. and S. Dell'Erba (2013)	26 emerging market economies 1994-2011/semi-annual	(i) VIX, (ii) international reserves/GDP, (iii) CPI inflation, (iv) real GDP growth, (v) primary balance/GDP, (vi) public debt/GDP, (vii) money market interest rate, (viii) difference between the debt stabilizing primary balance and actual primary balance	Debt sustainability measured by the difference between the debt stabilizing primary balance and actual primary balance is a major determinant of spreads. Spreads become significantly more sensitive to debt sustainability as public debt increases.
Csonto and Ivaschenko (2013)	18 emerging market economies 2001M1-2013M3/monthly	(i) Economic Risk Rating, (ii) Financial Risk Rating, (iii) Political Risk Rating (from International Country Risk Guide), (iv) VIX, (v) U.S. Federal Funds rate	In the periods of severe market stress, such as during the intensive phase of the Eurozone debt crisis, global factors tend to drive changes in the spreads and the misalignment tends to increase in magnitude and its relative share in actual spreads.
Afonso, Arghyrou, and Kontonikas (2015)	10 euro area countries (excl. Luxembourg)/Germany 1990M1-2010M12/monthly	(i) lagged spreads, (ii) VIX, (iii) bid-ask spread, (iv) expected fiscal balance /GDP, (v) expected debt/GDP, (vi) real effective exchange, (vii) annual growth rate of industrial production, (viii) potential heterogeneity between periphery and core countries (principal components of government bond yields spreads)	The determinants have changed significantly over time, and changes in the sensitivity of bond prices to fundamentals are also relevant to explain yields over the crisis period. More specifically, during the pre-crisis period macro- and fiscal-fundamentals are generally not significant in explaining spreads. By contrast, since summer 2007 the movements of macro- and fiscal- fundamentals explain spread movements well.



**Table 3. Principal Component Analysis for RISK**

Number	Eigen Value	Proportion	Cumulative Proportion	Eigen Vector(Loadings)		
				BBB_GV	VIX_STOCK	VIX_FX
1	2.438	0.813	0.813	0.582	0.601	0.548
2	0.392	0.131	0.943	-0.530	-0.231	0.816
3	0.170	0.057	1.000	0.617	-0.765	0.184

(1) BBB\_GV: The spreads between US Treasury Bond and BBB-corporate bonds

VIX\_STOCK: Implied volatility index of US stocks

VIX\_FX: Implied volatility index of yen-euro exchange rates.

**Table 4. Principal Component Analysis for Government Bond Yields**

Number	Eigen Value	Proportion	Cumulative Proportion	Eigenvectors (loadings):					Correlation				
				Indonesia	Mayaisia	The Philippines	Thailand	U.S.	Indonesia	Mayaisia	The Philippines	Thailand	U.S.
1	1.324	0.265	0.265	0.516	0.516	0.379	0.522	0.229	0.594	0.593	0.436	0.600	0.263
2	1.068	0.214	0.478	-0.354	0.064	-0.535	0.384	0.661	-0.366	0.067	-0.553	0.397	0.683
3	0.949	0.190	0.668	0.124	-0.623	0.485	-0.117	0.589	0.121	-0.607	0.473	-0.114	0.574
4	0.856	0.171	0.839	0.658	0.098	-0.476	-0.515	0.256	0.609	0.091	-0.441	-0.476	0.237
5	0.803	0.161	1.000	-0.400	0.576	0.328	-0.549	0.315	-0.359	0.516	0.294	-0.492	0.282

**Table 5. Dynamic Conditional Correlation**

		Indonesia	Malaysia	The Philippines	Thailand
$i$	ARCH ( $\beta_1$ )	0.124*** (0.012)	0.135*** (0.010)	0.184*** (0.015)	0.082*** (0.005)
	GARCH ( $\gamma_1$ )	0.870*** (0.013)	0.876*** (0.008)	0.831*** (0.013)	0.916*** (0.005)
$f^S$	ARCH ( $\beta_1$ )	0.076*** (0.008)	0.067*** (0.007)	0.073*** (0.006)	0.063*** (0.006)
	GARCH ( $\gamma_1$ )	0.907*** (0.009)	0.917*** (0.009)	0.912*** (0.008)	0.921*** (0.008)
$f^r$	ARCH ( $\beta_1$ )	0.139*** (0.010)	0.112*** (0.008)	0.156*** (0.013)	0.093*** (0.007)
	GARCH ( $\gamma_1$ )	0.858*** (0.009)	0.881*** (0.008)	0.844*** (0.012)	0.900*** (0.007)
Corr( $i, f^S$ )		-0.311*** (0.028)	0.047 (0.034)	-0.495*** (0.024)	0.405*** (0.027)
Corr( $i, f^r$ )		0.588*** (0.021)	0.618*** (0.022)	0.442*** (0.025)	0.618*** (0.020)
$\lambda_1$		0.044*** (0.004)	0.047*** (0.003)	0.048*** (0.003)	0.045*** (0.003)
$\lambda_2$		0.924*** (0.007)	0.924*** (0.006)	0.918*** (0.006)	0.923*** (0.005)

(1) Standard errors are in parentheses.

(2) The asterisks \*\*\* denote significance at the 1 % level.

**Table 6. Pooled Mean Group Estimation**

		<i>BB</i>	<i>PD</i>	<i>PIP</i>	<i>EXD</i>	<i>RISK</i>	<i>EC</i>			<i>BB</i>	<i>PD</i>	<i>PIP</i>	<i>EXD</i>	<i>RISK</i>	<i>EC</i>		
(1)	long-run	0.0631 (0.1016)	0.0080 (0.0089)	0.1332*** (0.0506)	0.0029 (0.0541)	0.0023* (0.0012)		(6)	long-run		0.0123 (0.0077)		0.0144 (0.0552)	0.0023** (0.0011)			
	Indonesia	-0.0497 (0.2724)	0.0089 (0.5472)	0.1808* (0.1074)	0.0332 (0.0773)	0.0005 (0.0053)	0.7811*** (0.1283)		Indonesia		0.1736 (0.3994)		0.0311 (0.0786)	0.0014 (0.0054)	0.7673*** (0.1255)		
	Malaysia	0.3558 (0.7440)	-0.1062 (0.1810)	0.4729 (0.9186)	-0.0469 (0.0568)	-0.0002 (0.0022)	1.2244*** (0.1379)		Malaysia		-0.0399 (0.1764)		-0.0377 (0.0556)	0.0000 (0.0022)	1.1850*** (0.1383)		
	The Philippines	-0.2296 (0.2802)	-0.6394* (0.3656)	0.1076 (0.1953)	0.2702* (0.1381)	0.0005 (0.0041)	0.8685*** (0.1453)		The Philippines		-0.5146 (0.3466)		0.3580** (0.1381)	0.0020 (0.0042)	0.8260*** (0.1383)		
	Thailand	-0.1012 (0.2920)	-0.0336 (0.0323)	0.6090* (0.3643)	0.0312 (0.0915)	-0.0004 (0.0039)	1.0980*** (0.1340)		Thailand		0.0034 (0.0080)		0.0775 (0.0913)	0.0004 (0.0039)	1.1452*** (0.1331)		
(2)	long-run	0.0559 (0.1027)	0.0150* (0.0083)		0.0082 (0.0553)	0.0021* (0.0013)		(7)	long-run			0.1537*** (0.0436)	0.0181 (0.0536)	0.0027*** (0.0009)			
	Indonesia	-0.1114 (0.2755)	0.3475 (0.5571)		0.0325 (0.0788)	0.0014 (0.0054)	0.7813*** (0.1277)		Indonesia			0.1788* (0.1036)	0.0321 (0.0760)	0.0008 (0.0052)	0.7842*** (0.1266)		
	Malaysia	0.2611 (0.7609)	-0.0685 (0.1795)		-0.0393 (0.0565)	-0.0001 (0.0022)	1.1916 (0.1394)		Malaysia			0.2731 (0.8686)	-0.0428 (0.0553)	0.0001 (0.0020)	1.2139*** (0.1361)		
	The Philippines	-0.3459* (0.1834)	-0.7886** (0.3596)		0.3247** (0.1353)	0.0009 (0.0042)	0.7709*** (0.1362)		The Philippines			0.1903 (0.1197)	0.2865** (0.1397)	0.0010 (0.0042)	0.9487*** (0.1429)		
	Thailand	-0.2421 (0.2906)	-0.0265 (0.0329)		0.0674 (0.0917)	0.0003 (0.0040)	1.1329*** (0.1333)		Thailand			0.1297 (0.1673)	0.0761 (0.0890)	0.0011 (0.0037)	1.1476*** (0.1308)		
(3)	long-run	0.0179 (0.0944)		0.1518*** (0.0449)	0.0136 (0.0539)	0.0024** (0.0012)		(8)	long-run		-0.0356 (0.0926)			0.0020* (0.0012)			
	Indonesia	-0.0660 (0.1976)		0.1879* (0.1065)	0.0363 (0.0771)	0.0006 (0.0052)	0.7834*** (0.1264)		Indonesia			-0.0167 (0.1966)		0.0014 (0.0053)	0.7675*** (0.1194)		
	Malaysia	0.3805 (0.7376)		0.2274 (0.8695)	-0.0423 (0.0562)	0.0001 (0.0021)	1.2151*** (0.1368)		Malaysia			0.3005 (0.7445)		0.0004 (0.0019)	1.1401*** (0.1282)		
	The Philippines	-0.1727 (0.2834)		0.0861 (0.1982)	0.2952** (0.1400)	0.0009 (0.0042)	0.9359*** (0.1439)		The Philippines			-0.2901 (0.1884)		0.0013 (0.0045)	0.9873*** (0.1294)		
	Thailand	0.1713 (0.1304)		0.5458 (0.3580)	0.0457 (0.0910)	0.0002 (0.0039)	1.1108*** (0.1322)		Thailand			0.0026 (0.0791)		0.0007 (0.0039)	1.1552*** (0.1305)		
(4)	long-run		0.0050 (0.0085)	0.1422*** (0.0486)	0.0102 (0.0540)	0.0026** (0.0010)		(9)	long-run		0.0125 (0.0077)			0.0022** (0.0011)			
	Indonesia		-0.0845 (0.3972)	0.1795* (0.1064)	0.0319 (0.0768)	0.0006 (0.0052)	0.7796*** (0.1279)		Indonesia			0.1923 (0.3955)		0.0015 (0.0053)	0.7833*** (0.1200)		
	Malaysia		-0.0734 (0.1777)	0.4463 (0.9191)	-0.0457 (0.0559)	-0.0002 (0.0022)	1.2188*** (0.1369)		Malaysia			-0.0623 (0.1755)		0.0002 (0.0021)	1.1446*** (0.1291)		
	The Philippines		-0.5588 (0.3639)	0.2498** (0.1244)	0.2619* (0.1383)	0.0004 (0.0041)	0.8942*** (0.1447)		The Philippines			-0.6003* (0.3610)		0.0022 (0.0044)	0.9913*** (0.1290)		
	Thailand		-0.0212 (0.0142)	0.6594* (0.3496)	0.0365 (0.0908)	-0.0005 (0.0038)	1.1018*** (0.1330)		Thailand			0.0031 (0.0080)		0.0000 (0.0039)	1.1531*** (0.1334)		
(5)	long-run	-0.0307 (0.0948)			0.0249 (0.0553)	0.0020* (0.0012)		(10)	long-run			0.1504*** (0.0404)		0.0028*** (0.0010)			
	Indonesia	-0.0295 (0.1984)			0.0432 (0.0787)	0.0014 (0.0054)	0.7467*** (0.1234)		Indonesia			0.1770* (0.1035)		0.0008 (0.0052)	0.8006*** (0.1211)		
	Malaysia	0.1902 (0.7540)			-0.0290 (0.0558)	0.0002 (0.0020)	1.1769*** (0.1371)		Malaysia			0.2824 (0.8550)		0.0005 (0.0019)	1.1619*** (0.1262)		
	The Philippines	-0.2469 (0.1788)			0.3739*** (0.1378)	0.0013 (0.0043)	0.8178*** (0.1375)		The Philippines			0.2346* (0.1211)		0.0009 (0.0043)	1.0938*** (0.1281)		
	Thailand	0.0034 (0.0797)			0.0786 (0.0909)	0.0011 (0.0039)	1.1433*** (0.1304)		Thailand			0.1367 (0.1674)		0.0008 (0.0037)	1.1578*** (0.1308)		

(1) Standard errors are in parentheses.

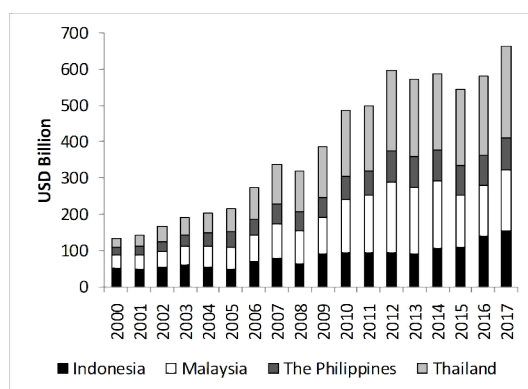
(2) The asterisks \*\*\*, \*\*, \* denote significance at the 1, 5, 10 % level, respectively.

**Table 7. Fixed-effects Panel Threshold estimation**

Threshold Value	0.1064			
[95% confidence interval]	[0.1051 0.1065]			
F	43			
(P-value)	(0.000)			
	Coefficient	S.E.	t-value	P-value
BB ( $\beta_1$ )	-0.0089	0.0592	-0.1500	0.8810
PD ( $\beta_2$ )	-0.0081	0.0067	-1.2100	0.2280
PIP ( $\beta_3$ )	0.0773***	0.0264	2.9200	0.0040
$f^r$ ( $\gamma_1$ )	0.0825***	0.0050	16.6600	0.0000
$f^s$ ( $\gamma_{2,below}$ )	0.0177	0.0121	1.4600	0.1470
$f^s$ ( $\gamma_{2,above}$ )	-0.1066***	0.0128	-8.3500	0.0000
constant ( $\alpha$ )	0.0145	0.0046	3.1800	0.0020

(1) The asterisks \*\*\* denotes significance at the 1 % level.

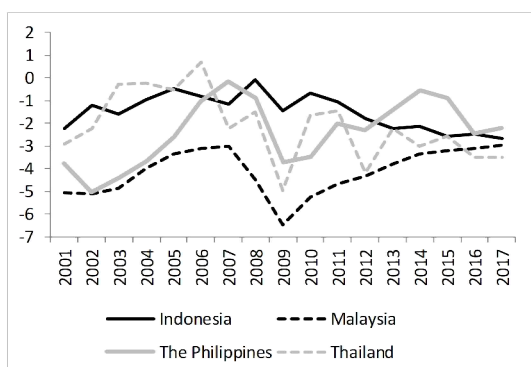
**Figure 1. LCY Government Bond Size in 4 ASEAN Countries**



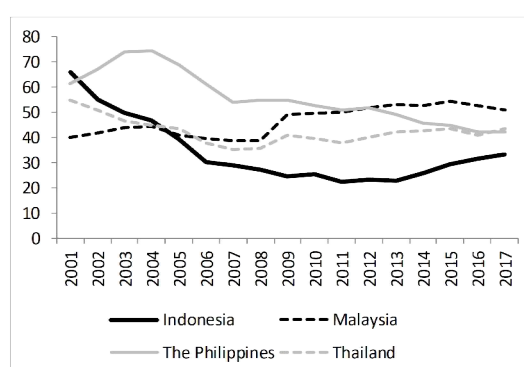
Sources: *Asian Bond Online*

**Figure 2. Data**

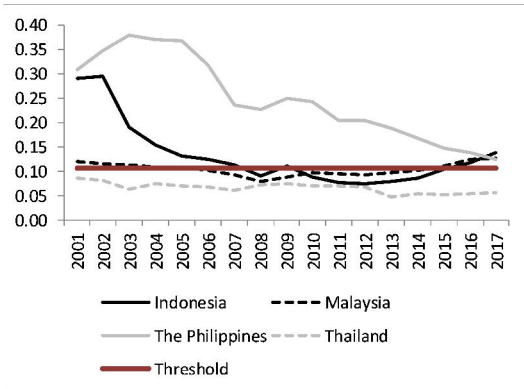
(a) Budget Balance (BB)



(b) Public Debt (PD)



(c) Public Interest Payments (PIP)



(d) RISK

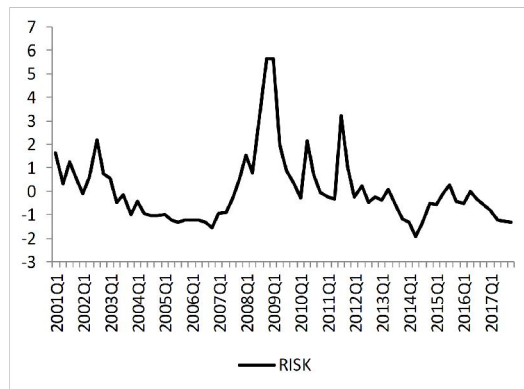


Figure 3. Dynamic Conditional Correlations

