The Empirical Evidence on Government Bond Market Integration in East Asia

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This research intends to investigate the progress made in East Asian bond market integration thus far. Price-based measures (AAD indicator and beta-convergence measure), quantity-based measures and econometric techniques (co-integration test, error correction model based Granger causality test) are employed in the analysis. Even though East Asian government bond markets have become more integrated since 2001, the differentials among the markets still remain significantly high. The bond market integration process seems slow. The convergence of bond markets sped up in 2003 and after the 2008 world financial crisis, implying the important role of government policies in integrating the regional bond markets. East Asian bond market integration may need more government-directed measures.

Keywords: Bond Market Integration, East Asia, Beta-convergence, Yield Differential, Intra-regional Investment
JEL classification: G11, G15, E44, F68

I. INTRODUCTION

Since the 1997 Asian financial crisis, bond market development has been the central pillar of financial cooperation in East Asia. Many scholars argue that while individual countries strive to develop the domestic bond markets, it is also necessary to build a regional bond market, where governments, corporates or other institutions can finance themselves through the regional capital pool in a minimum cost (Shimizu, 2007; Rhee, 2003). From the perspective of investors, bond market integration enables them to diversify the country-specific risks through holding a wide range of bonds both inside and outside the country in a very low cost. (Baele et al., 2004). From the perspective of bond issuers, entrepreneurs with little initial

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capital or facing credit constraint in small economies can turn to broader capital markets, which implies a strong correlation between the bond market integration and economic growth (Levine, 1997). Less dependency on the long- term borrowing from overseas banks offers East Asia the potential to migrate the double mismatch problem and enhances the region's resilience to negative external shocks.

To this end, a number of initiatives have been pursued to promote the regional bond market development in East Asia. Asian Bond Markets Initiative (ABMI) in 2003 is the milestone for the regional governments' cooperation to develop the regional bond market. In the following years, ASEAN+3 economies have continued to move forward through upgrading arrangements, harmonizing institutions and regulations within the region to promote the regional bond market integration. For example, Credit Guarantee and Investment Facility (CGIF) was launched, under the framework of ABMI, to facilitate East Asian corporations to issue local currency denominated bonds by providing credit enhancement in 2010.

Asian Bond Fund is another major initiative to promote regional bond market development. The Executive Meetings of East Asia and Pacific Central Banks (EMEAP) launched the ABF 1 with a capitalization of USD 1 billion in 2003. However, due to its small size, ABF 1 had little effect on the market for dollar-denominated government bonds in East Asia. Later, ABF 2, introduced in 2004 with a capital of USD 2 billion, was implemented to purchase local currency bonds from Asian countries. One of their aims is to increase the demand for the regional bonds by investing in a large pool of US dollar denominated government bonds issued by local governments or organizations in eight EMEAP economies, namely, China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand.

Furthermore, because the bond markets in East Asian economies are relatively independent due to different regulations and currencies, to build a regional bond market, East Asian countries try to harmonize bond standards and practices at the national levels to encourage more intra-regional issuance and transaction. As a result, ASEAN+3 Bond Market Forum (ABMF) was established under the framework of ABMI to harmonize the market regulations concerning cross-border transactions in September 2010. The ABMF is constituted of two sub-forums. Sub-Forum 1 (SF1) collects and compares bond market regulations in East

Asia, in the meanwhile, Sub-Forum 2 (SF2) tries to standardize regional transaction procedures and harmonize market regulations.

Despite the numerous benefits bond market integration may bring to East Asia, the potential risks should not be ignored, such as the financial contagion. The financial instability in one country can be transmitted to the neighboring countries quickly. For example, the Asian financial crisis in November 1997 started in Thailand with the collapse of the Thai baht and rapidly swept over Indonesia, Malaysia, Korea and beyond, generating serious impact on the world economy as a whole. Another example is the outbreak of the European debt crisis, which also reveals the potential risks from the financial integration in the Eurozone. The European debt crisis started in Greece at the end of 2009. But because the currency union in Eurozone limits the ability of European leaders to respond to crisis timely, the crisis spreads to Portugal, Ireland, Spain and Italy. Thus, financial integration is gradual process stretching over many years with merits and demerits. Given the various governments' efforts to promote the regional bond market integration, it is crucial for policymakers to monitor the process of bond market integration and consider how to maximize the benefits of financial integration and meanwhile minimum the risks it brings about. Thus, the progress of bond market integration deserves particular attention and the research on it may give important policy implications.

This analysis intends to gauge the progress made in the bond market integration thus far. The specific research questions are: (1) whether the bond market integration has taken place in East Asia. (2) to what extent the East Asia bond markets have become integrated. (3) at what speed the bond markets have converged? (4) whether the East Asian bond markets have a more closed causal relations with each other and whether there is a leading bond market in East Asia?

This research differs from existing literature in three ways. First, East Asian governments have implemented packages of government measures to integrate regional bond markets since the 1997 Asian financial crisis. The government policies were concentrated during the period of 2003-2004 and in the aftermath of the 2008 world financial crisis. It is necessary for policymakers to obtain timely feedbacks from market and understand the effectiveness of government policies. Consequently, this study makes more detailed research by comparing the bond market integration under four sub-periods (2001-2002, 2003-2006, 2007-2008, 2009-2013), which reveals the effectiveness of government initiatives and the

impact of the 2008 world financial crisis. Second, during the financial integration process, the financial markets in the region may become more correlated with each other. However, the researches on the causal relations between the East Asian bond markets are limited. Even though Calvi (2010) has conducted Granger causality test for ASEAN-5 to find a leading market, his study did not contain all the East Asian economies under the ASEAN+3 framework. This research tries to contribute to the literature by using the Granger causality test to examine the causal relations between the East Asian bond markets. Third, given the massive variation of the economic development across the East Asian economies, country risk is taken into consideration in the analysis of the extent of bond market integration, which may reveal how much discrepancy in bond yields are resulted from the disparity in the economic development in East Asia.

The remainder of this paper is organized as follows. The section 2 reviews the literature on the financial market integration. The section 3 sets out the methodology and describes the data. The section 4 presents the empirical results. The final section concludes and gives some suggestions.

II. LITERATURE REVIEW

Previous literature does not provide a universal definition on financial integration. The most commonly adopted definition of "integrated financial market" is that of Baele et al. (2004) "*the market for a given set of financial instruments (services) is fully integrated if all potential market participants with the same relevant characteristics:*

(1) They face a single set of rules when they decide to deal with those financial instruments (services);
(2) They have equal access to the above-mentioned set of financial instruments and/or services;
(3) They are treated equally when they are active in the market."

This definition implies the Law of One Price (LOP), which states that any identical goods engaged in trade should be sold for the same price anywhere in the world. As Adam et al. (2002) argued, financial integration is a gradual process where the financial markets in the region or the whole world become more and

more correlated with each other and finally the LOP obtains among the regional (global) financial markets. If identical assets are priced differently in the integrated financial markets, the difference in the prices will be arbitraged away immediately. Lack of integration signals the existence of impediments to cross-border capital flows.

1. Measures of Financial Integration

European countries have experienced rapid financial market integration, especially since the introduction of the euro in 1999. The process of financial integration within the European countries has been analyzed widely in the literature (Kasa, 1992; Adam et al., 2002; Baele et al., 2004; Kim, Lucey and Wu, 2004). A complex array of measures and econometric methodologies have been developed to monitor the process of European financial market integration, which may give some inspirations on the study of the East Asian bond market integration.

The price-based measure relies on the Law of One Price (LOP). The financial markets are integrated when the LOP holds. Given this consideration, price-based measure examines the financial integration based on the discrepancies in the asset prices and returns. In practice, price-based measures, such as asset price differentials and cross-sectional dispersion of interest rates, are used to investigate the extent of financial market integration. They are constructed through comparing the prices or returns of identical assets that are issued in different countries but generate identical cash flows. Beta-convergence measure, which is borrowed from growth literature, is used to examine the speed of financial market convergence. Earlier empirical evidence on price-based measure are documented as follows.

Adam et al. (2002) firstly proposed the cross-sectional standard deviation of yields and beta-convergence measure to assess the financial integration in all European Union (EU) member countries. Cross-sectional standard deviation of yields measures the degree of financial integration, while beta-convergence offers the speed of financial integration. Their results revealed that the interest rate differentials in bond markets decreased substantially among EU member countries. However, the significant reduction of nominal interest rate differentials may be ascribed to the decrease in cross-country inflation differentials to a large extent. The cross-sectional standard deviation of yields and beta-convergence measure were also applied by Baele et al. (2004) to measure financial market

integration in the euro area. The results suggested that since the adoption of the euro, the government bond markets in the euro area became more and more integrated. However, there was still scope for further integration of government bond markets, since the difference in interest rates was resulted from the difference in liquidity and credit risks.

Quantity-based measure accesses financial integration through asset quantity and flows, which has been divided into two categories. Financial markets in a group of economies become more and more correlated with each other through the process of financial integration, where cross-border capital flows increase and the prices of identical financial assets converge (Brouwer, 2005). Based on cross-border asset holdings, European Central Bank (2010) indicates that the level of financial integration among the EU countries is rising. Stavarek, Repkova and Gajdosova (2011) investigate the equity market integration in the euro area through measuring the cross-border holdings of regional equities. The indicator shows the cross-border holdings increase, implying the integration in equity markets has taken place in the euro area.

On a basis of the conception that financial markets become more correlated with each other in the process of financial integration, several econometric techniques, such as correlation matrix, co-integration technique and Granger causality test, are widely applied in the literature to assess the extent of financial market integration. Co-integration technique and Granger causality test can reveal the long-term and short-term relations between the financial markets respectively.

Co-integration technique was first introduced by Kasa (1992) to assess the equity market integration in Canada, Japan, England, Germany and United States. The results revealed a long-term integration relationship among the five equity markets, implying that there was a single common stochastic trend driving the movement of those equity markets. The research by Worthington, Katsura and Higgs (2003) applied both the co-integration technique and Granger causality test to detect the interaction among the European equity markets before, during and after the adoption of the euro in January 1999. According to the results, the European financial markets have become more integrated since 1999. In addition, the French equity market turned out to be most influential among regional equity markets before and after 1999. The research on the short-term correlations between the bond markets has great practical implications on international portfolio diversification. As previous studies suggested low correlation between

the market returns enables investors to diversify assets risks and maximize their risk-adjusted returns. Co-integration analysis and Granger causality test are further applied in the researches by Ceylan (2006) and Click and Plummer (2003).

2. Studies on East Asian Financial Integration

The study on East Asian financial integration started relatively late. A substantial body of literature on East Asian financial integration have focused on the equity markets. Few empirical studies have been conducted for the bond markets convergence in East Asia. The research on bond market is mainly hampered by the data limitation, however, the regional bond market integration merits investigation, as it has important implications for policymakers.

Yu, Fung and Tam (2007) provide a survey of indicators and measures in different dimensions (cross-country return dispersion, Dynamic co-integration analysis, market cycle synchronization, beta-convergence of bond return and Dynamic conditional correlation) to determine the extent to which economies are financially integrated in East Asia before 2007. Government bonds with maturities of 2-year, 5-year and 10-year are examined. Their empirical results broadly show that financial integration in East Asia is still in its infancy and very little progress has taken place since 2003. The yield convergence in the bond markets of Japan, Korea, Singapore and Hong Kong appears to be more complete.

Asian Bond Monitor (2005) develops a new indicator, named Average Absolute Cross-Market Differentials (AAD), to assess the degree of Asian bond market integration before 2005. According to the results, cross-market differential of bond yields has been declined over the sample period, which indicates increased level of financial integration in Asia. However, the differentials among the Asian bond market still remain significantly high. Calvi (2010) employs co-integration and Granger causality test to investigate the long-run and short-run cross-country price relationship in East Asian financial markets respectively. Despite of the implementation of regional initiatives to promote regional financial integration, co- integration test does not find the existence of long-term equilibrium relationship between the bond markets in East Asia. According to the results of Granger causality test, there seems to be a lack of short-term relationships among the regional bond markets. Moreover, it's impossible to figure out a bond market leader in East Asia.

Park (2013) applies beta-convergence measure and cross-country bond return dispersion to monitor the bond market integration process in emerging Asia. The study uses principal component analysis to construct the benchmark yield for the bond markets in the region. The convergence of government bond yields has increased since late 2005. The speed of convergence increased substantially during the 2008 world financial crisis. However, the speed was still much smaller than that of equity market. Furthermore, divergence took place at some time points.

III. DATA AND METHODOLOGY

1. Data

East Asia, defined here, includes the ten Association of Southeast Asian Nations (ASEAN) countries plus Republic of Korea (Korea), People's Republic of China (China), Hong Kong and Japan. Because the bond markets in Brunei Darussalam, Cambodia, Laos PDR, Vietnam and Myanmar are planned to be created or in the early stages of development, they are excluded in the analysis. Nine economies in the East Asian region are finally covered in this study, namely, China, Japan, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand.

Even though ASEAN+3 has been involved in developing local currency corporate bond markets along with the ABMI, corporate bond[1] markets are much less developed than government bond[2] markets in East Asia and the data for corporate bonds are not readily accessible for some markets. Thus, this research focuses on the government bond market integration in East Asia. Moreover, the highly liquid 10-year government bonds[3] are chosen as the representative yields

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[1] "*Corporates comprise both public and private companies including financial institutions and international organizations. Financial institutions comprise both private and public sector banks and other financial institutions.*" The definition is cited from AsianBondsOnline website. http://asianbondsonline.adb.org/regional/data/bondmarket.php?code=LCY_Bond_Market_USD

[2] "*Government bonds include obligations of the central government, local governments, the central bank, and state-owned entities.*" The definition is cited from AsianBondsOnline website. http://asianbondsonline.adb.org/regional/data/bondmarket.php?code=LCY_Bond_Market_USD

[3] In several developing economies, the bond yield curves are not complete before 2005.

for government bond markets. In order to analyze the evolving process of bond market integration in East Asian bond markets, four sub-periods (2001-2002, 2003-2006, 2007-2008, 2009-2013)[4] are analyzed in the research.

In 2003, Asian Bond Market Initiative(ABMI) was introduced to develop East Asian bond markets. This year is a historic milestone for regional bond market development in East Asia. As a consequence, this research makes a comparison of the extent of East Asian bond market integration between the period before 2003 and after 2003. The first sub-period 2001-2002 presents the integration process after Asian financial turmoil and before the implementation of ABMI. The second sub-period 2003-2006 presents the period after the inauguration of ABMI and before the world financial crisis. The third sub-period is from 2007 to 2008, capturing the integration progress during the world financial crisis. The last sub-period is from 2009 to 2013, depicting the integration process after the 2008 global financial crisis. This is because in response to the 2008 world financial crisis, ASEAN+3 governments have taken steps to consolidate the regional bond markets, such as upgrade of ABMI roadmap, introduction of Credit Guarantee and Investment Facility (CGIF). It is necessary to examine the effectiveness of such measures on the regional bond market integration and make timely adjustment.

10-year nominal government bond yield data are extracted from Thomson Reuters database. Figure 1 plots the nominal 10-year government bond yields of nine East Asian bond markets. The bond yields in the East Asian have generally shown a downward trend since the 2001. The highest bond yields appear in Indonesia and the Philippines, while the bond yields in Japan and Singapore remain lowest in the region. Due to the substantial decrease in the bond yields in Indonesia and the Philippines, the regional bond yields seem more converged than before.

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[4] Since the data before 2001 are not available, the analysis restricted the sample period after 2001.

Figure 1: 10-year Nominal Government Bond Yield, 2001-2013

(in percent)
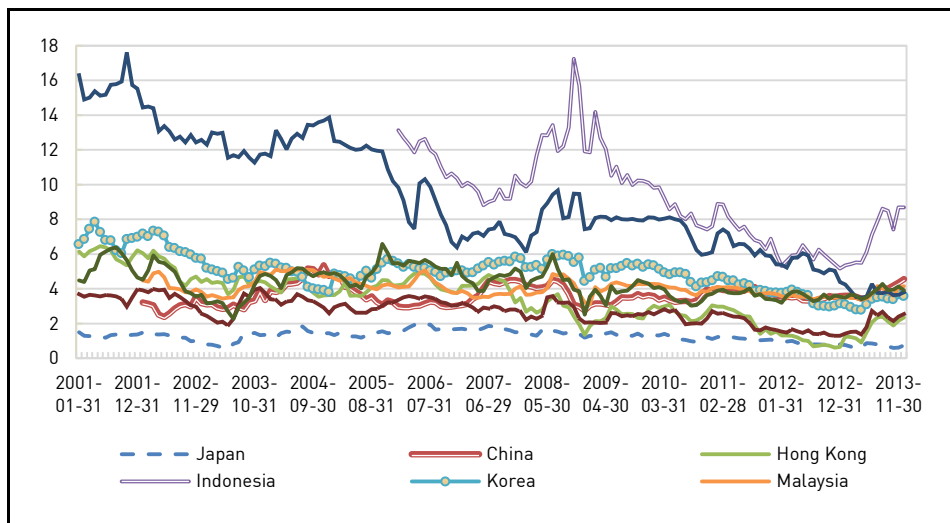
Source: Data are extracted from Thomson Reuters database (accessed on April 8, 2014).
Note: End of period

   Garcia-Herrero and Wooldridge (2007) demonstrate that country-specific factors have a significant impact on asset returns. The economic development differs greatly among the East Asian economies. To capture the role of country-specific risk in the bond yields, country risk is taken into consideration to explore the regional discrepancy, which have caused by the diverse country risks in East Asia. The calculation of country risk premium is based on the sovereign rating[5] by Moody's and default spreads by Damodaran (2010)[6]. Figure 2 presents the trend of the new 10-year government bond yields, which are calculated though removing the premium for country risk from nominal 10-year government bond yields. There are several noteworthy points as shown in the figure. The new 10-year

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[5] The calculation of sovereign ratings by Moody's considers four broad rating factors: economic strength, institutional strength, fiscal strength and susceptibility to event risks. See (2013), "Sovereign Bond Ratings".

[6] Based on the default spread in the credit default swaps (CDS), Damodaran has calculated the default spreads for sovereign ratings by rating agencies. See Damodaran (2010), "Equity Risk Premiums (ERP): Determinants, Estimation and Implications".

government bond yields in East Asia have become more converged than 10-year government nominal bond yields, especially during the period from 2010 to 2012, implying that the large differences in nominal bond yields may partly be attributed to the uneven development of East Asian economies.

Figure 2: 10-year Bond Yield without Premium for Country-Specific Risk

(in percent)
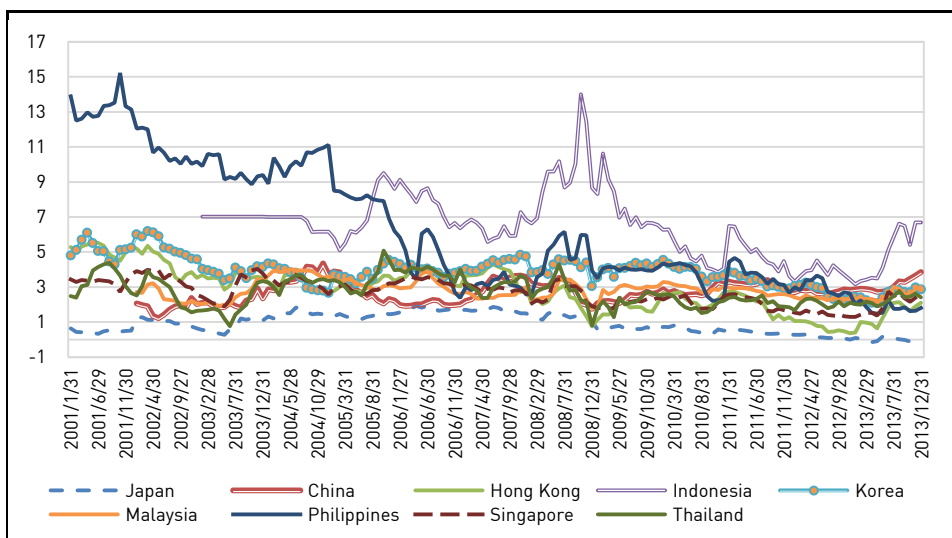
Source: Author's calculation based on the data from Thomson Reuters database
          (accessed April 8, 2014) and national official website in each economy.
Note: End of period

2. Methodology

This section presents the methodology that will be used in the empirical analysis. In order to comprehensively investigate the extent to which East Asian bond market integration has evolved, price-based measures (AAD indicator and beta-convergence measure), quantity-based measure and econometric techniques (co-integration test and Granger causality test) are employed in the analysis. The multifaceted nature of financial integration deserves the all kinds of methods with different emphases. The methods used in the analysis are detailed as follows:

In the first place, quantity-based measure is used to figure out whether the East

Asian bond market integration has taken place. This measure is based on the intra-regional foreign bond holdings. In the integrated bond markets where international bonds can be traded freely and at a low cost, investors are more willing to take advantage of the cross-border bond investment to diversify their portfolio. Different from price-based measure, quantity-based measure may not reveal the level of bond market integration, but it can answer the question whether or not the bond market integration process has taken place and complement the priced-based measure (ADB, 2005).

Second, the price-based measure is used to investigate the extent of bond market integration, as well as the speed of bond market convergence. Price-based measures rely on the notion that when bond markets are fully integrated, the Law of One Price (LOP) holds. Identical assets, regardless of the domicile of the issuers or holders, should be priced the same. This analysis employs the average absolute cross-market differentials (AAD), developed by Asian Development Bank (2005), to monitor the yield differentials among the East Asian bond markets. Lower value of AAD suggests higher level of financial integration. The formula for AAD indicator is shown in the equation (1):

$$AAD_t = \frac{1}{n(n-1)} \sum_{i \neq j=1}^{n} \sum_{i=1}^{n} |r_{it} - r_{jt}| \qquad (1)$$

Here, r_{it} stands for the 10-year government bond yield of market i at time point t, while r_{jt} stands for the 10-year government bond yield of market j at time point t. n stands for the total number of bond markets. As East Asia under analysis consists of a diverse group of nine economies with different levels of financial and economic development. Country risk may be a not negligible factor leading to the dispersion in the government bond yields in the region. Under such circumstances, the analysis calculates two separate AADs: the first one is based on the nominal bond yields and the other one is based on the bond yields without premium for country risk. Here, the calculation of the premium for country risk is based on the sovereign rating by Moody's and default spreads calculated by Damodaran (2010).

Another price-based measure in this analysis is beta-convergence measure. It is widely applied in the literature to assess the speed of financial market integration. Beta-convergence measure was first used in the growth theory and later applied to financial integration by Adam et al. (2002), Rizavi et al. (2011). A negative

correlation between the yield spread change and its initial level signals the occurrence of bond market convergence. The absolute beta-convergence measure is realized by estimating the equation (2):

$$\Delta Y_{i,t} = \alpha_{i,t} + \beta_{i,t} Y_{i,t-1} + \sum_{l=1}^{L} r_l \Delta Y_{i,t-l} + \varepsilon_{i,t} \qquad (2)$$

Here, $Y_{i,t}$ denotes the difference between the 10-year government bond yield in country i and the regional benchmark bond yield. $\Delta Y_{i,t}$ denotes the change in two successive periods. $\alpha_{i,t}$ is a time-varying intercept. L represents the lag length. A negative β signals the occurrence of convergence and the magnitude of β denotes the speed of convergence. Because there is not a leading bond market in East Asia, the benchmark bond yield in this analysis is calculated using the Principal Component Analysis (PCA) based on the 10-year government bond yields in the nine East Asian bond markets. PCA was first created by Pearson (1901) and later independently developed by Hotelling (1933). It uses an orthogonal transformation to transform a set of observations into a set of principal components (PC), which are linearly uncorrelated with each other. The first PC explains the largest possible variance in the original data. This method has also been used by Park (2013) and Fratzscher (2001) to calculate the benchmark bond yields in East Asia and European countries.

Further, because of the uneven development of East Asian countries, this analysis also applies conditional beta-convergence measures in the research. The conditional beta-convergence measure includes other factors affecting the change of regional 10-year government bond yield differences. Hereby, GDP per capita is chosen as the control variable, as indicated by the equation (3), where $GDPP_{i,t}$ stands for GDP per capita.

$$\Delta Y_{i,t} = \alpha_{i,t} + \beta_{i,t} Y_{i,t-1} + \sum_{l=1}^{L} r_l \Delta Y_{i,t-l} + \delta_{i,t} GDPP_{i,t} + \varepsilon_{i,t} \qquad (3)$$

Finally, two econometric techniques are applied in the analysis: co-integration test, error correction model (ECM) based Granger causality test. They are used to assess the long-term and short-term relationship between the East Asian bond markets. Chen and Knez (1995) suggest that the financial assets need to share common stochastic factors to become integrated. Co-integration test is the tool to detect the presence of a long-term equilibrium relationship among the East Asian

bond markets in this analysis. The existence of co-integration relationship implies the existence of a common stochastic trend among the regional bond yields and that the yields do not deviate each other too much.

However, co-integration test only reveals the correlations between the East Asian bond markets, but does not identify the causality direction among them. As a result, Granger causality test is applied to detect the causal relations between the bond markets (Granger, 1969). Besides, the test can detect the leading bond market in the region by specifying the direction of the causal relation. In case of co-integration relationships, Granger causality test is accomplished based on the error correction model (ECM) in order not to lose long-run information and avoid spurious problem[7]. The lagged error correction term of the long-run equation is added into the short-run dynamic model as shown in equation (4):

$$\Delta Y_t = \alpha + \sum_{i=1}^{m} \alpha_i \, \Delta X_{t-i} + \sum_{j=1}^{n} \gamma_j \, \Delta Y_{t-j} + \beta_y ecm_{t-1} + \mu_t \qquad (4)$$

Here, ecm_{t-1} stands for the error correction term at time t-1. The rejection of null hypothesis "$\alpha_1=\alpha_2=\cdots=\alpha_i=0$" implies that Y_t is Granger-caused by X_t in the short run, while the rejection of null hypothesis "$\beta_1=\beta_2=\cdots=\beta_j=0$" implies that Y_t is Granger-caused by X_t in the long run.

IV. EMPIRICAL RESULTS

The data in this analysis span from January 2001 to December 2013. Because time series data tend to exhibit trend, cycles, random-walking or other non-stationary behaviors, they may cause the spurious regression. As a preliminary step, Augmented Dickey-Fuller (ADF) unit root test is used to examine the stationary properties of all bond yield time series. If the time series are not stationary, one can obtain stationary data by differencing the data set. The lag length of ADF unit root test is determined by Schwarz Information Criterion (SIC). Table 1 contains the results of ADF test with the null hypothesis that there exists a single unit root in the 10-year government bond yield. Analysis of the bond yield level series indicates that all the time series are non-stationary. However, the ADF statistics suggest stationary in first differenced of bond yield time series, indicating that

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[7] See Toda and Phillips (1993), Toda and Yamamoto (1995).

they are integrated of order one I(1).

Table 1: Results of ADF Unit Root Test

Variable	Level		First difference	
	Statistic	P-value	Statistic	P-value
China	-2.123	0.236	-11.499[***]	0.000
Hong Kong	-2.157	0.223	-10.515[***]	0.000
Indonesia	-1.283	0.589	-10.606[***]	0.000
Japan	-1.758	0.400	-11.916[***]	0.000
Korea	-2.381	0.149	-12.440[***]	0.000
Malaysia	-0.452	0.518	-9.860[***]	0.000
Philippines	-1.307	0.625	-11.319[***]	0.000
Singapore	-1.074	0.255	-10.056[***]	0.000
Thailand	-0.662	0.429	-12.011[***]	0.000

Source: The data are calculated by author using Eviews 6.0 and tabulated with Excel.
Note: *, ** and *** mean significance at 10%, 5% and 1% level respectively.

1. Quantity-based Measure

To address the issue of whether bond market integration has taken place in East Asia, quantity-based measure is applied in the analysis. Figure 3 displays the pattern of aggregate intra-regional foreign bond holdings in East Asia. The more regional investors are, the more integrated the regional bond markets become. The total foreign bond holdings have increased significantly from USD 50.63 billion in 2001 to USD 405.27 billion in 2013. In the meanwhile, as a share of the region's total foreign bond investment, intra-regional foreign bond investment has also risen from 4% in 2001 to more than 10% in 2013. The upward momentum was temporarily interrupted by the 2007-2008 world financial crisis, but recovered soon and witnessed a more rapid growth from 2008 to 2013. All of the facts suggest that the East Asian bond markets have become integrated than before.

Despite the recent progress made during the past decade, the extent of bond market integration is still very limited, far lagging behind the financial integration in European countries. Only a small share of the region's total foreign bond investment is directed in the East Asian bond markets (11% in 2013). By contrast, the share of intra-regional portfolio investment in total cross-border portfolio

investments for EU 15 countries records around 60%[8]. This is partly because some East Asian capital markets are still much more closed than the fully open capital markets in Europe. Furthermore, the introduction of Euro has promoted the European financial integration greatly. By contrast, the instable exchange rates among the Asian currencies discourage the regional investors to make intra-regional investment to some extent. As the largest regional investors, Japanese institutional investors have directed only 1% of its total foreign bond investment in East Asia. Consequently, one of the priorities to build a well-functioning regional bond market is to encourage more bond investment in East Asian bond markets from Japanese institutional investors.

Figure 3: Intra-regional Foreign Bond Holdings in East Asia
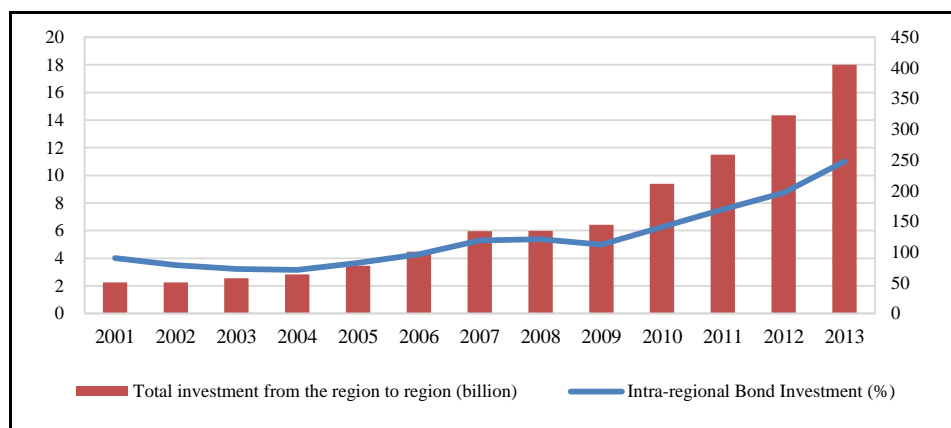
Source: Author's calculation based on the data from IMF's Coordinated Portfolio Investment
          Survey (CPIS) (accessed on Sep. 28, 2014)
Note: 1. Intra-regional investment share $= \dfrac{Total\ bond\ investment\ from\ the\ region\ to\ the\ region}{Total\ foreign\ bond\ investment\ from\ the\ region}$
      2. Information on the outward investment of China, Mainland is not available,
         but the inward investment is included in the calculation.

In general, all East Asian economies have continuously raised their intra-regional bond investment, which signals the occurrence of regional financial integration. In absolute terms, Hong Kong tops the intra-regional bond holdings, followed by Singapore and Japan. The investment from the largest three economies constitutes 93.77% of total intra-regional bond holdings. The intra-regional bond

[8] The data are obtained from Asian Economic Integration Monitor (AEIM), November 2014

investment from other economies is inactive. Figure 4 illustrates relative size of intra-regional foreign bond holdings in each economy. The intra-regional bond investment exhibits diverse circumstances. The intra-regional bond investment in Hong Kong, Malaysia and the Philippines, measured by the intra-regional bond holding as a percentage of total foreign bond holdings, has increased a lot, especially after the 2008 world financial crisis. For example, the ratio of intra-regional foreign investment from Hong Kong rose from 17.76% in 2009 to 46.45% in 2012. The share of foreign investment directed in the region from the Philippines increased fourfold from 8.82% to 35.63% over the same period. The intra- regional bond investment in Japan, Korea and Singapore is quite stable during the last decade. Although Japan is among the largest economies in terms of absolute value of intra-regional foreign bond holdings, it ranked last as measured by the relative share of intra-regional foreign bond holdings in the total foreign bond investment. Finally, the intra-regional bond investment from Thailand seems most volatile.

Figure 4: Share of Intra-regional Bond Holdings in Each Economy

(in percent)

Source: Author's calculation based on the data from IMF's Coordinated Portfolio Investment Survey (CPIS) (accessed on Sep. 28, 2014)

Note: 1. Intra-regional investment share = $\frac{Total\ bond\ investment\ from\ country\ i\ to\ the\ region}{Total\ foreign\ bond\ investment\ from\ country\ i}$

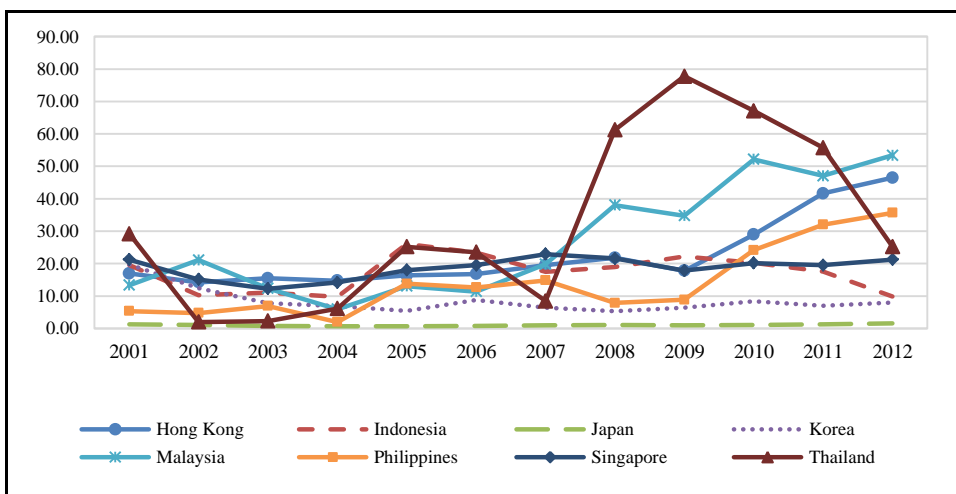2. Information on the outward investment of China, Mainland is not available, but the inward investment is available.

2. *Average Absolute Cross-market Differentials (AAD)*

The average absolute cross-market differentials (AAD) is used to measure the difference between the regional 10-year government bond yields. Country risk is a not negligible factor driving up the government bond yields. Since the economic development in the nine East Asian economies varies a lot, this analysis makes a comparison between the AAD indicators of nominal bond yields and the bond yields removing the effects of country risk. The comparison reveals how much discrepancy in the East Asian government bond yields are caused by the country risk. The AAD indicators of 10-year government bond yields in East Asia are displayed in the Figure 5. The line in red signals the AAD for nominal 10-year government bond yield, while the line in blue signals the AAD for bond yields without the premium for country risk.

Figure 5: Average Absolute Cross-market Differentials of 10-year Government Bond Yields
(in percentage point)
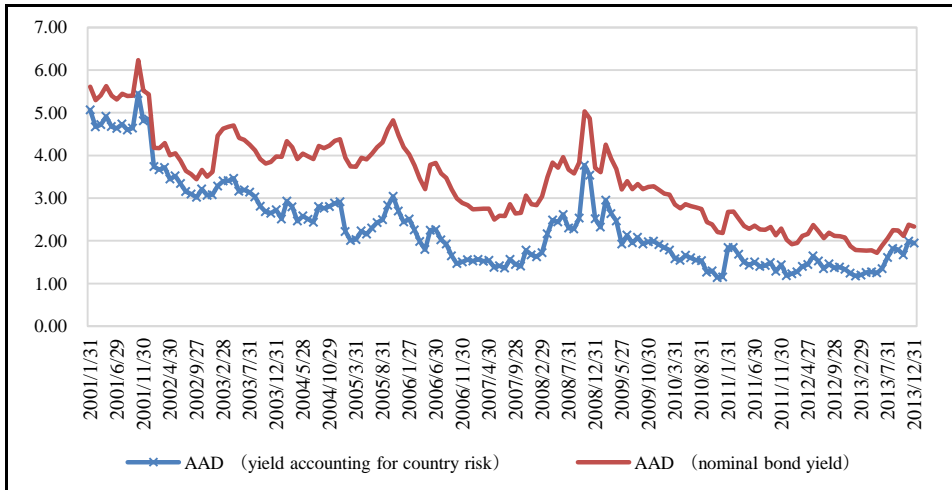
Source: The data are calculated by author using Excel and graphed with Excel

Note: 1. Six economies are contained in 2001, that is, Japan, Hong Kong, Korea, the Philippines, Singapore and Thailand.

2. Eight economies are contained in 2002, that is, Japan, Hong Kong, Korea, the Philippines, Singapore, Thailand, China and Malaysia.

3. Nine economies are contained during the period 2003-2013, that is, Japan, Hong Kong, Korea, the Philippines, Singapore, Thailand, China, Malaysia and Indonesia.

There are several noteworthy points as shown in the figure. First, the cross-market differentials in bond yields have displayed a downward trend during the past years, implying the occurrence of bond market integration in East Asia. This is consistent with the results of quantity-measure. The current dispersion in nominal 10-year government bond yields is around 200 basis points, which is lower than the dispersion in 2001 by about 350 basis points. Second, AAD indicator hiked suddenly in 2007 and the AAD in nominal bond yields surged to 500 basis points at the peak of the world financial crisis, but declined again from the end of 2008. The volatile AAD indicator implies that bond markets in East Asian are sensitive to the world market sentiment. Third, the differentials between the 10-year government bond yields remain high, suggesting that the degree of bond market integration in the East Asia is still low. The differential among the European bond yields almost approached to zero (Baele et al., 2004). Forth, the differentials in the bond yields are partly attributed to the country disparity in the region. The regional sovereign ratings vary a lot, ranging from Baa3 in Indonesia and Thailand to Aa1 in Hong Kong. On average, the variation of country risk among East Asian economies accounts for 30% of the difference in their nominal bond yields. The disparity of the economic and financial development in East Asia may hinder the process of regional bond market integration.

3. Johansen-Juselius (JJ) Co-integration Test

The bond yield level series are integrated of order one I(1), so there is possibility for East Asian bond yields to be co-integrated if the linear combina tion of the bond yield time series has I(0) process. Johansen-Juselius (JJ) Co-integration test is applied to detect the presence of the long-term equilibrium relationship among the East Asian bond markets since 2001. Table 2 and Table 3 detail the trace and maximum eigenvalue statistics of co-integration tests, respectively, which can be used to determine the number of co-integration vectors. The first column is the number of co-integration correlations. The third and fourth column report the test statistics and p-value respectively.

Both the trace and maximum eigenvalue statistics are significant at the 1% level for the null hypothesis of r = 0 and r ≤ 1, therefore, the null hypotheses

are rejected. The null hypothesis for $r \leq 2$ is fail to be rejected, indicating that two co-integration vectors are detected. The co-integration test finds the presence of a stationary long-term equilibrium relationship between the bond yields in the selected nine East Asian economies.

Table 2: Results of Unrestricted Co-integration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.
None	0.084	292.708***	0.000
At most 1	0.056	182.852***	0.001
At most 2	0.032	110.765	0.279
At most 3	0.024	70.237	0.715
At most 4	0.013	39.666	0.952
At most 5	0.010	23.506	0.952
At most 6	0.006	10.595	0.970
At most 7	0.002	3.332	0.950

Source: The results are calculated by author using Eviews 6.0 and tabulated with Excel

Note: *, ** and *** mean significance at 10%, 5% and 1% level respectively.

Table 3: Results of Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Prob.
None	0.820	109.856***	0.000
At most 1	0.774	72.086***	0.000
At most 2	0.725	40.529	0.180
At most 3	0.557	30.570	0.387
At most 4	0.401	16.161	0.950
At most 5	0.180	12.911	0.890
At most 6	0.075	7.263	0.943
At most 7	0.036	2.617	0.969

Source: The results are calculated by author using Eviews 6.0 and tabulated with Excel

Note: *, ** and *** mean significance at 10%, 5% and 1% level respectively.

4. Granger Causality Test based on ECM

Based on the view that financial integration process involves deepening links between the financial markets (Garcia-Herrero and Wooldridge, 2007). Granger causality test is implemented to detect the causal relations between individual bond markets and the presence of one or more leading bond markets in East Asia. Given the co-integration relationships among the nine East Asian bond markets,

Granger causality test is based on error correction model in this analysis. This causality test makes it possible to consider long-term and short-term causality among the East Asian bond markets separately. In this procedure, this analysis first investigate whether two selected bond markets are co-integrated with each other and then perform the ECM based Granger causality test. The lag length is selected mainly based on Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC)[9].

During the first sub-period 2001-2002, the bond markets in East Asia are relatively independent, as indicated by the few causal relations among the markets. Only 4 short-term causal relations are found among the East Asian bond market, while 2 for long-term causal relations. The causal relations between the East Asian bond markets have enhanced significantly during the second sub-period 2003-2006. The short-term and long-term causal relations are 10 and 5, respectively. However, affected by the 2008 world financial crisis, both the short-term and long-term causal links among the nine bond markets decreased to 4. But in the last sub-period 2009-2013, stimulated by the package of measures in the aftermath of the world financial crisis, the causal links among the nine East Asian bond markets increased significantly. The short-term and long-term causal relations record 20 and 16, respectively.

In sum, despite that the East Asian bond market integration process was temporarily interrupted by the 2008 world financial crisis, recent years have witnessed an enhanced causal relations between the East Asian bond markets. Given the significant increase of causal relations right after the implementation of ABMI in 2003 and the adoption of various governments' measures to integrate regional bond markets in the aftermath of the 2008 world financial crisis, it is reasonable to claim that the package of measures during 2003-2004 and stimulating policies in the aftermath of the 2008 world financial crisis are efficient.

In all four sub-periods, it is impossible to identify a leading bond market within East Asia, despite the fact that the causal relations between the regional bond markets has enhanced. Even though Japan is the most advanced economy in

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[9] When selecting the lag length for the Granger Causality Test, if the AIC and SIC agree, this research adopts the lag length suggested by AIC and SIC. If the AIC and SIC indicate different lag lengths, this research refers to other three criterion for lag length selection, namely, Hannan-Quinn information criterion (HQ), Final prediction error (FPE), sequential modified LR test statistic (LR). This research selects the lag length which is most recommended.

the region and embraces the largest bond market, the impact from Japanese bond market on the remaining regional bond markets seems minimal. Japanese bond market has different features from other countries' bond markets in the sense that the government bond market is more developed and much larger in market size (nine times larger) than corporate bond market in Japan. Thus, this result makes sense and consistent with previous research by Tsukuda, Shimada and Miyakoshi (2013). The results for the Granger causality test during the last sub-period 2009-2013 are detailed in Table 4 and Table 5.

Table 4: Results of Granger Causality Test (2009-2013, short-term)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Granger-cause
(1) China										0
(2) Hong Kong						-0.02***		-0.02***		2
(3) Indonesia						-0.02***			-0.03***	2
(4) Japan					-0.01**		-0.02**			2
(5) Korea				-0.01**		0.01***	-0.02***			3
(6) Malaysia		-0.01***			-0.01**			-0.02***	-0.04***	4
(7) Philippines				-0.01**		-0.01***				2
(8) Singapore		-0.03***				-0.03***			-0.04***	3
(9) Thailand						-0.01**		-0.01**		2
Caused by	0	2	0	2	2	6	2	2	3	

Source: analyzed using Eviews 6.0, tabulated by author with Excel
Note: *, ** and *** mean significance at 10%, 5% and 1% level respectively.

Table 5: Results of Granger Causality Test (2009-2013, long-term)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Granger-cause
(1) China										0
(2) Hong Kong						0.03*		0.33***		2
(3) Indonesia						0.03***			0.06***	2
(4) Japan					0.52***					1
(5) Korea				0.10***		0.05**				2
(6) Malaysia		0.09*	0.37***		0.09**			0.12***		4
(7) Philippines										0
(8) Singapore		0.60***				0.08***			0.30***	3
(9) Thailand			0.17***					0.14***		2
Caused by	0	2	2	1	2	4	0	3	2	

Source: analyzed using Eviews 6.0, tabulated by author with Excel
Note: *, ** and *** mean significance at 10%, 5% and 1% level respectively.

5. Beta-convergence Measure

Beta-convergence measure is employed to investigate the speed of bond market convergence in East Asia. This study uses daily data to capture time-variation in the bond yields[10]. The regional benchmark bond yield are derived by Principal Component Analysis (PCA), based on the bond yields from the nine East Asian bond markets. The results for PCA are presented in Table 6 and Table 7:

Table 6: Result of Principle Component Analysis

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	6.0438	4.8776	0.6715	6.0438	0.6715
2	1.1662	0.5659	0.1296	7.2100	0.8011
3	0.6003	0.0540	0.0667	7.8102	0.8678
4	0.5463	0.2684	0.0607	8.3565	0.9285
5	0.2779	0.0864	0.0309	8.6344	0.9594
6	0.1915	0.1124	0.0213	8.8259	0.9807
7	0.0791	0.0157	0.0088	8.9050	0.9894
8	0.0634	0.0317	0.0070	8.9683	0.9965
9	0.0317	-	0.0035	9.0000	1.0000

Source: Author's calculation based on Eviews 5.0
Note: Number in the first column refers to the principal components.

Table 7: Result of Principle Component Analysis

Eigenvectors (loadings):									
Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8	PC 9
China	-0.003	0.883	0.229	0.316	0.023	0.030	0.230	0.094	-0.071
Hong Kong	0.359	0.165	-0.468	-0.109	-0.289	-0.257	0.243	0.001	0.636
Indonesia	0.345	-0.222	0.242	0.235	0.677	-0.347	0.217	0.254	0.167
Japan	0.374	-0.042	-0.349	0.213	-0.147	0.251	-0.177	0.688	-0.319
Korea	0.367	0.029	0.099	0.487	-0.089	-0.074	-0.654	-0.402	0.122
Malaysia	0.307	0.014	0.680	-0.446	-0.357	-0.061	-0.149	0.278	0.117
Philippines	0.355	-0.276	0.194	0.265	-0.248	0.450	0.570	-0.306	-0.088
Singapore	0.379	0.106	-0.152	-0.273	-0.022	-0.482	0.109	-0.293	-0.646
Thailand	0.337	0.232	-0.122	-0.455	0.488	0.553	-0.155	-0.188	0.087

Source: Author's calculation based on Eviews 5.0

[10] Bond yields refer to nominal bond yield in the calculation of price-based measures and quantity-based measures unless otherwise noted.

Before proceeding with the beta-convergence measure, the property of each variable in the regression has been examined through ADF unit test. Table 8 presents the test statistics and p-value of ADF test. The first column shows the variables used in the regression, which represents the difference between the nominal bond yield in one country and regional benchmark bond yield. As evidenced from the results, all the variables are stationary.

Table 8: Results of ADF Unit Root Test

| Variable	Level		First difference	
	Statistic	P-value	Statistic	P-value
d(China)	-5.152[***]	0.000	-2.866[**]	0.049
d(Hong Kong)	-5.775[***]	0.000	-3.315[**]	0.014
d(Indonesia)	-7.674[***]	0.000	-3.558[***]	0.007
d(Japan)	-5.948[***]	0.000	-2.873[**]	0.049
d(Korea)	-6.978[***]	0.000	-3.840[***]	0.003
d(Malaysia)	-5.395[***]	0.000	-3.383[**]	0.012
d(Philippines)	-5.596[***]	0.000	-3.981[***]	0.002
d(Singapore)	-6.291[***]	0.000	-3.914[***]	0.002
d(Thailand)	-6.485[***]	0.000	-3.452[***]	0.009

Source: analyzed using Eviews 6.0, tabulated by author with Excel
Note: *, ** and *** mean significance at 10%, 5% and 1% level respectively.

Following Fratzscher (2001) and Park (2013), rolling estimation method is applied in the analysis. The estimation takes three months a window from January 1th 2001 to December 31th 2013 and moves the window one month forward once. Figure 6 and Figure 7 plot the results of absolute and conditional beta-convergence measures, respectively. There are several noteworthy points as shown in the results. First, both the absolute and conditional beta-convergence coefficients take negative signs at most of the time, which highlights the fact that bond market integration has taken place in the East Asia. Second, the speed of regional bond market convergence is quite volatile. The beta-convergence coefficients turn positive in some points, which signals divergence of the bond markets. Divergence was most prominent right after the collapse of collapse of Lehman Brothers in

2007, which is consistent with the results of AAD indicator. The East Asian bond markets remain susceptible to sudden shifts in global market sentiments. Third, in general, East Asian bond market integration process is very slow, as evidenced by that the small magnitude of beta-convergence coefficients. The bond market convergence lags behind the equity market integration, because the beta-convergence coefficient of Asian equity market convergence which is around-1 (Park, 2013). Fourth, bond market integration accelerated in the period of 2003-2004 and in the aftermath of the world financial crisis, indicating the effectiveness of governments' cooperative efforts. Fifth, the conditional beta-convergence is slightly higher than the absolute beta-convergence, implying that not all the bond markets converge to the same steady state.

Figure 6: Results of Absolute Beta-convergence of 10-year Government Bond Yields
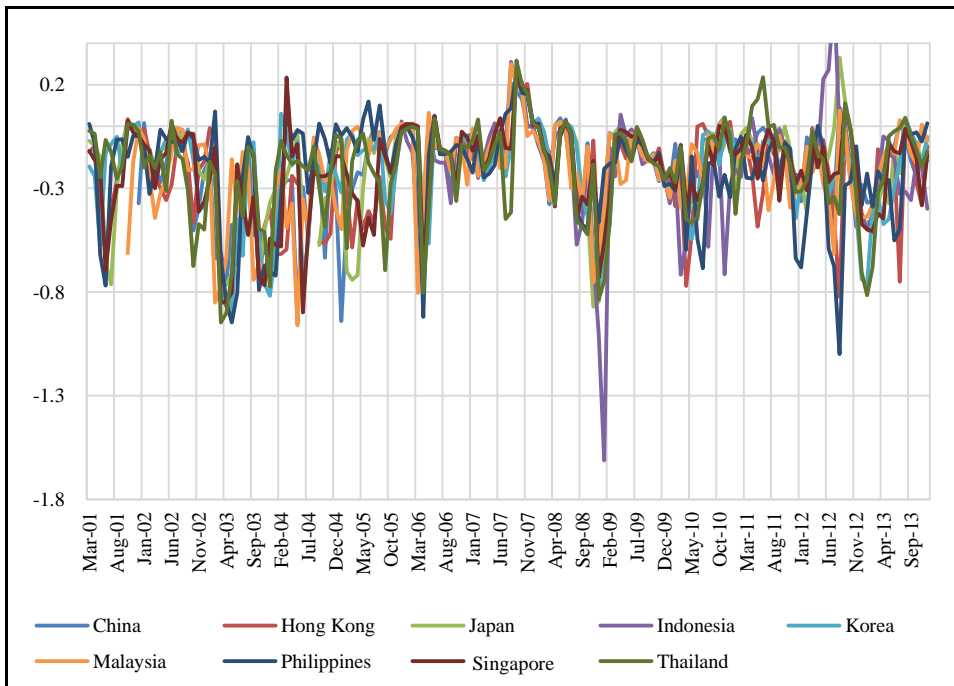
Source: Author's calculation based on the data from Thomson Reuters database with Stata 6.0, plotted with Excel

Figure 7: Results of Conditional Beta-convergence of 10-year Government Bond Yields
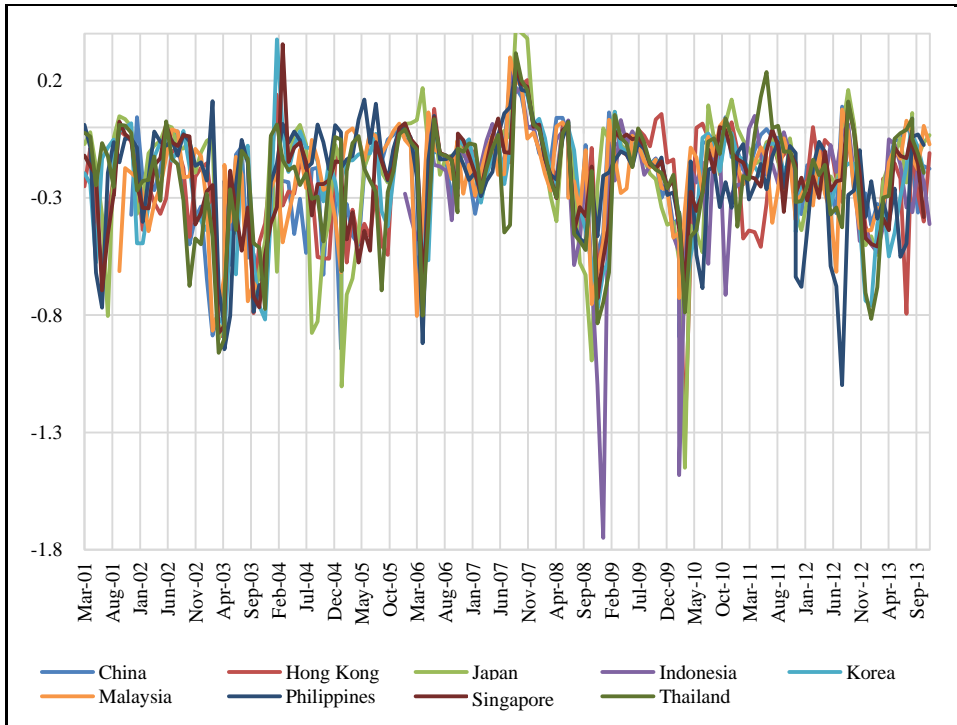
Source: Author's calculation based on the data from Thomson Reuters database with Stata 6.0, plotted with Excel

V. CONCLUSION

Since the 1997 Asian financial crisis, East Asian governments and various working groups have made concerted efforts to promote the regional bond market integration. This research aims to assess the progress made in East Asian bond market integration thus far. The key findings are summarized as follows:

First, this research confirms the results of earlier studies that the East Asian bond markets have become more integrated than before. There have been incremental intra-regional cross-border bond holdings in the region over the period 2001-2013. The cross-market bond yield differentials have presented a downward trend. Furthermore, in the long run, there is an equilibrium relationship among the nine East Asian bond markets. Both the long-term and short-term causal relations

between the East Asian bond markets have enhanced during the last decades. Such findings demonstrate the occurrence of East Asian bond market integration.

Second, the differentials among the bond markets in East Asia remain significantly high and the regional bond market integration process is slow. The cross-market nominal bond yield differentials remained around 200 basis points in 2013, which fell short of the bond yield differentials in European bond market (almost approached zero). The beta-convergence coefficients turned positive in some points, which divergence of the bond markets, especially at the beginning of the world financial crisis in 2007. The disparity in the economic and financial development in East Asia may take part of the responsibility for slow bond market integration process. On average, the disparity of regional country risks accounts for 30% of the difference in the regional government bond yields. Furthermore, despite the enhanced causal relations between the regional bond markets, it is still impossible to identify a leading bond market within East Asia.

Third, the East Asian bond markets remain susceptible to sudden shifts in global investor confidence and market expectations, as suggested by the rising cross-market bond yield differentials, decreased intra-regional cross-border investment, reduced causal relations and positive beta-convergence measures in 2007. But the quick recovery from the 2008 world financial crisis of East Asian economies has shown that, with the concerted efforts to develop regional bond markets, East Asia has built more resilient and healthier financial sectors than before.

Fourth, government policies are crucial for the East Asian bond market integration process. The convergence of bond markets speeded up during two periods. The first one is during the period right after the implementation of ABMI in 2003. The second one is the period 2009-2013, when the East Asian govern ments put forward packages of stimulus measures to further integrate regional bond markets and tackle the adverse effects of the world financial crisis. This can be evidenced by the increased causal links and beta-convergence measure. The fact implies that the regional cooperative initiatives and dialogues are crucial for integrating the regional bond markets and East Asian bond market integration may need more government-directed measure.

In short, East Asian bond market integration process has achieved encouraging progress during the past years and more government-directed measures are needed to further strengthen the regional bond market integration. A lot still

remains to be done to harmonize rules across the region, strengthen markets infrastructure, overcome remaining market impediments, and tighten legal and regulatory framework.

REFERENCES

Adam, K., Jappelli, T., Menichini, A., Padula M., Pagano, M. 2002. *Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union*. Centre for sutdies in Economics and Finance (CSEF), Dept. of Economics and statistics, Univ. Of Salerno. <http:// ec.europa.eu/internal_market/economic-reports/docs/020128_cap_mark_int_en.pdf> (accessed Jan. 21, 2016)

Asian Development Bank. 2005. *Asia Bond Monitor: November, 2005.*

Asian Development Bank. 2014. *Asian Economic Integration Monitor: November. 2014.*

Baele, L., Ferrando, A., Hordahl, P., Krylova E., Monnet C. 2004. Measuring Financial Integration in the Euro Area. European Central Bank Occasional Paper No.14.

Brouwer, G. 2005. "Monetary and Financial Integration in Asia: Empirical Evidence and Issues, chapter 10" In Asian Development Bank (ed.). *Asian Economic Cooperation and Integration: Progress, Prospects and Challenges*, Manila: Asian Development Bank. pp. 269-296.

Calvi, R. 2010. Assessing Financial Integration: a Comparison between Europe and East Asia. Economic Papers No. 423. European Commission.

Ceylan, O. 2006. "A Co-integration Analysis Approach to European Union Integration: The Case of Acceding and Candidate Countries," *European Integration online Papers (EioP),* vol. 10, no. 7.

Chen, Z. and P. J. Knez. 1995. "Measurement of Market Integration and Arbitrage," *Review of Financial Studies,* vol. 8, no. 2, pp. 287-325.

Click, R., Plummer, M. G. 2003. Stock Market Integration in ASEAN after the Asian Financial Crisis. the International Centre for Study of East Asian Development, Kitakyushu, Working Paper Series vol. 2003-06.

Damodaran, A. 2010. *Equity Risk Premiums (ERP): Determinants, Estimation and Implications. The 2010 Edition.* <http://pages.stern.nyu.edu/~adamodar/pdfi les/papers/ERP 2010.pdf.> (accessed Jan. 21, 2016)

European Central Bank. 2010. *Financial Integration in Europe.* European Central Bank.

Fratzscher, M. 2001. Financial Market Integration in Europe: On the Effects of EMU on Stock Markets. ECB Working Paper No. 48. Frankfurt am Main: European Central Bank.

Garcia-Herrero, A., Wooldridge, P. 2007. "Global and Regional Financial Integration: Progress in Emerging Markets," *BIS Quarterly Review. September*. pp. 57-70.

Granger, C. W. J. 1969. "Investigating Causal Relations by Econometric Models and Cross-spectral Methods," *Econometrica*, vol. 37, no. 3, pp. 424-438.

Hotelling, H. 1933. "Analysis of a Complex of Statistical Variables into Principal Components," *Journal of Educational Psychology,* vol. 24, no. 6, pp. 417-441.

Kasa, K. 1992. "Common Stochastic Trends in International Stock Markets," *Journal of Monetary Economics,* vol. 29, no. 1, pp. 95-124.

Kim, S. J., Lucey, B., Wu, E. 2004. Dynamics of Bond Market Integration between Establi shed and Accession EU Countries. IIIS Discussion Paper No. 25.

Levine, R. 1997. "Financial Development and Economic Growth: Views and Agenda," *Journal of Economic Literature,* vol. 35, no. 2, pp. 688-726.

Park, C-Y. 2013. Asian Capital Market Integration: Theory and Evidence. ADB Economics Working Paper Series No. 351.

Pearson, K. 1901. "On Lines and Planes of Closest Fit to Systems of Points in Space," *Philosophical Magazine*, vol. 2, no. 11, pp. 559-572.

Rhee, S. G. 2003. Regional Bond Markets: Rationale, Concerns and Roadmap. 15th Pacific Economic Cooperation Council General Meeting, Brunei Darussalam. <http://www.pecc. org/resources/1444-regional-bond-markets-rationale-concerns-and-roadmap?path=> (accessed Jan. 21, 2016)

Rizavi, S., Naqvi, B., Rizvi, S. 2011. "Global and Regional Financial Integration of Asian Stock Markets," *International Journal of Business and Social Sciences,* vol. 2, no. 9, pp. 82-93.

Shimizu, S. 2007. "Priorities for the Promotion of Intra-regional Cross-Border Bond Transact ions in East Asia," *Pacific Business and Industries*, vol. 7, no. 24, pp. 2-36.

Stavarek, D., Řepkova, I. and K. Gajdosova. 2011. Theory of Financial Integration and Achievements in the European Union. Munich Personal RePEc Archive Paper No. 34393.

Toda, H. and P. Phillips. 1993. "Vector autoregression and causality," *Econometrica*, vol. 61, no. 6, pp. 1367-1393.

Toda, H., Yamamoto. T. 1995. "Statistical inference in vector auto-regressions with possibly integrated processes," *Journal of Econometrics*, vol. 66, no.1-2, pp. 225-250.

Tsukuda,Y., Shimada J. and T. Miyakoshi. 2013. Bond Market Integration in East Asia: A Multivariate GARCH with Dynamic Conditional Correlations Approach. Singapore Economic Review Conference August 2013.

Worthington, A. C., Katsuura M. and H. Higgs. 2003. "Financial Integration in European Equity Markets: The Final Stage of Economic and Monetary Union (EMU) and its Impact on Capital Markets," *Economia,* vol. 54, no. 1, pp. 79-99.(in Japanese)

Yu, I-W., Fung, L.and C. S. Tam. 2007. Assessing Bond Market Integration in Asia. Hong Kong Monetary Authority Working Papers No. 10/2007.