Regional integration of the East Asian stock markets: An empirical assessment

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ABSTRACT
The aim of this paper is to study the dynamics of regional financial integration in East Asia over the 1990:01–2012:08 period. To this end, we use the international capital asset pricing model (ICAPM) to assess the evolution of financial market integration through time and evaluate their risk premia. We also construct an Asian currency basket in order to obtain a reference currency in this area. Our empirical analysis is based on the multivariate GARCH-DCC approach with time-varying correlations. Our results show that the East Asian stock markets were partially segmented (except for Japan) within their region until approximately 2008. However, the last years are characterized by an upward trend in the regional integration of stock markets. Our findings also show that the risk premium related to regional stock markets is significant for all countries.

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1. Introduction
At a global level, financial integration arguably has many benefits, such as better inter-temporal consumption smoothing, international risk-sharing and more efficient allocation of capital for investment, although conversely it has the potential to fuel troublesome reversals of capital flow and contagion effects in the case of crisis (Forbes and Rigobon, 2002). At a regional level, financial integration is able to meet the same aims, while bearing less risk of reversals if completed by adequate regional cooperation agreements. It can also be viewed as a strategic choice to enhance trade and firm cooperation within a geographical area.

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A number of empirical studies on financial integration deal with the global level, centered around either developed or emerging markets (for example, Bekaert and Harvey, 1995; Carrieri et al., 2007; Gérard et al., 2003; Karolyi and Stulz, 2002). Recently, several papers have tackled the regional level, for example, Adler and Qi (2003) on North America; Hardouvelis et al. (2006) on the euro area; and Chi et al. (2006) and Park and Lee (2011)1 on East Asia.

International financial market liberalization has substantially raised the degree of capital mobil- ity in East Asian countries since the 1990s (Guillaumin, 2009). In particular, since the 1997 Asian crisis, East Asian countries have accelerated regional financial cooperation and integration – in part to safe- guard the region’s financial market development locally. However, whether or not the existent literature has been agreed with respect to the higher levels of integration among other regions, such as European Union countries, the degree of regional financial integration in East Asia remains a matter for vigorous debate. Indeed, according to Kim et al. (2006), the East Asian financial markets are somewhat less integrated with one another than to the global market. In this paper, we aim to assess regional financial integration among East Asian stock markets.

In general, a broad range of definitions for financial integration is frequently cited in literature, such as: financial openness, free movement of capital, integration of financial services and relaxation of capital controls. Moreover, there is a vast body of literature on the evaluation of financial integration, ranging from investigating the return co-movements, to assessing the international capital flows, and to studying the spillovers of market shocks and volatilities. For instance, Barr and Priestley (2004) provide studies related to time-varying expected bond returns using an asset pricing model, and illustrate time-varying financial integration in bond markets. Furthermore, Fratzscher (2002) and Christiansen (2007) have studied the volatility and return spillovers on the European stock markets by using a multivari- ate generalized autoregressive conditional heteroscedasticity (GARCH) model, in order to assess the regional integration of European equity markets. Similarly, our study sits in the group investigating the time-varying level of financial integration by investigating the return co-movements and using a multivariate GARCH model, developed by De Santis and Gérard (1997), to accommodate time variations of the returns covariance process and, hence, the risk exposures. The existent literature, such as Gérard et al. (2003), documents the time-varying nature of expected returns and risk exposures, both in a purely domestic setting and in international markets. To take into account this specification, we estimate a conditional version of the international capital asset pricing model, in which both the risk exposures and the East Asian degree of financial integration change over time.

The international version of the capital asset pricing model (CAPM) takes into account purchasing power parity (PPP) deviations and assumes that local inflation is volatile. In fact, some international investors can gain access to goods at a price lower than others because the law of one price is not held (see, for example, Lamont and Thaler, 2003; Pippenger and Phillips, 2008). Thus, in the interna- tional capital asset pricing model (iCAPM), the expected return in any country is affected by its covariance with the exchange rate market, in addition to the “classical” risk premium measured by the covariance between asset returns on the market portfolio.

We consider the stock indices of the nine main countries of the area: the People’s Republic of China, the Republic of Korea, Hong Kong, Indonesia, Japan, Malaysia, the Philippines, Singapore and Thailand. Our study contains several contributions compared to the previous literature on East Asian financial regional integration. First, we improve upon previous papers by evaluating the currency risk premium in order to better capture the total risk premium for the different countries. Second, we consider the evolution of integration over a long period, from the first steps of market liberalization in 1990 to 2012. This long time span allows us to gauge evolution in the integration process in relation to the financial regional agreements set up in the aftermath of the Asian crisis of 1997–8 and the global one of 2008–9. Finally, we implement several processes to estimate the ICAPM, such as a multivariate GARCH- DCC model, in order to obtain the terms of variance–covariance between the local and East Asian stock markets. Our results show that the East Asian stock markets were partially segmented (except for Japan) within their region until approximately 2008. However, the recent period, since 2008, is

1 We can also quote the paper of Bekaert et al. (2005), which studies the regional aspect of financial integration and the con- tagion effect (not only in Asia).
characterized by an upward trend in regional financial integration. Our findings also show that the
risk premium related to regional stock markets is significant for all countries.

The remainder of the paper is organized as follows. Section 2 provides some stylized facts on the
measures that have been taken to improve financial cooperation between these countries, as well as
a brief review of the previous literature related to the subject. Section 3 presents the method used.
Section 4 describes the data and its statistical properties. Section 5 is devoted to commenting on the
results found and specification tests. Section 6 concludes.

2. Financial liberalization process and literature survey

The liberalization of capital movements in the East Asian area began in the late 1980s, spreading
out at different rates across countries. The process, fostered by the International Monetary Fund (IMF),
was initiated earlier in the most advanced countries of the area – Japan, South Korea, Hong Kong, Sin-
gapore – postponed to the early nineties for Indonesia, Malaysia, the Philippines and Thailand, and is
still ongoing in the case of China. As soon as the market was liberalized, international investors pressed
themselves to invest in this booming region and there was a huge influx of capital. The violent re-
versal of capital flows observed in 1997–8 during the so-called “Asian crisis” cast serious doubts on
the benefits of the financial opening without specific institutions monitoring the situation (Park, 2013;
Yu et al., 2010). To find a remedy, governments in the area started to foster financial cooperation by
creating several arrangements, while others, such as Malaysia, chose to completely close their financial
borders.

In the aftermath of the 1997–8 crisis, a first wave of initiatives took place to implement cooper-
ative devices between East Asian countries: the Chiang Mai Initiative (CMI), the Asian Bond Markets
Initiative (ABMI), the Asian Bond Fund Initiative (ABF), SEANZA and EMEAP. Indeed, the ASEAN + 3
countries initiated a process of institutional cooperation in monetary and financial order to accom-
pany an already well-advanced de facto regionalization (Plummer and Wignaraja, 2006). Despite these
arrangements, several studies indicate that regional financial integration remained weak, as these econo-
 mies were still linked to the global market rather than being integrated with one another (Kim and
Lee, 2012; Kim et al., 2006, 2011; Ng and Yarcia, 2014).

As the 2008 crisis sparked volatility and instability in emerging markets through spillovers from
advanced countries (Park, 2013; Park and Lee, 2011), East Asian governments saw the issue of re-
gional integration as an alternative to monitor their financial openness. After the Lehman Brothers’
collapse, the authorities signed a new agreement to implement the multi-lateralization advocated by
the Chiang Mai Initiative announced in early 2009. This created a $120 billion fund to prevent a li-
quidity crisis in one of the signatory countries (Aizenman and Pasricha, 2010). It is yet to be determined
whether these new measures will have a greater impact on regional financial integration than those
taken in the wake of the 1997 crisis.

Several papers have been interested in assessing both real and financial integration in East Asia
(Chi et al., 2006; Jeon et al., 2006; Kim et al., 2006; Park and Lee, 2011). They evidence a growing
regional convergence within the area concerning the real economy, although financial markets are
integrated to a greater degree with global markets than with one another. Other recent studies, such
as Yu et al. (2010), Hinojales and Park (2011) and Park (2013), show that (i) regional financial inte-
gration has accelerated in recent years; (ii) the East Asian integration process is promoted in order to

2 SEANZA (South East Asia, New Zealand and Australia) was formed to promote cooperation among central banks by provid-
ing intensive and systematic training courses for central bank staff. Training courses are held biennially with a rotating system
of host members. EMEAP (Executives’ Meeting of East Asia and Pacific) is a forum of central banks in the East Asia and Pacific
region that aims to strengthen cooperation among its 11 members (Australia, China, Hong Kong SAR, Indonesia, Japan, South
Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand).

3 ASEAN + 3 is made up of the following countries: Indonesia, Malaysia, Singapore, Thailand, the Philippines, Brunei, Vietnam,
Myanmar, Laos, Cambodia, Timor, China, Japan, and Korea.

4 See, for example, Devereux et al. (2011) for an extensive literature review. The paper of Capannelli et al. (2009) is also very
interesting because they developed several indicators (economic, cultural, social, etc.) in order to assess the degree of eco-
nomic integration and cooperation between East Asian countries.
mitigate world external shocks and ensure financial stability in the East Asian area; (iii) the crisis of 2008 was a turning point for two reasons: first, this crisis has once again raised the issue of the vulnerability of East Asian countries to external fluctuations; and, second, despite this crisis, regional financial integration in East Asian countries has accelerated; and (iv) East Asian equity markets are increasingly integrated, both regionally and globally, but the influence of both regional and global factors in these markets suggests that they are integrated more globally than regionally. Moreover, the real economic interdependence has increased significantly since the Asian post-crisis (Kim et al., 2011) and these countries are influenced more by real external shocks than by monetary and financial external shocks (Allegr et al., 2012).

Various empirical methods have been used to measure financial integration\(^5\): \textit{de jure} measures (based on legal restrictions),\(^6\) \textit{de facto} measures (as a quantity-based approach),\(^7\) a price-based approach (based on deviations to the uncovered interest rate parity),\(^8\) and the saving–investment approach of Feldstein and Horioka (1980). All of these approaches suffer from a variety of shortcomings.\(^9\) Specifically, none of these methods takes the impact of the volatility of equity markets or the importance of risk premium (especially the currency risk premium) into account. Indeed, it is now well known that financial integration and currency premium are singularly linked in the case of emerging markets (Phylaktis and Ravazzolo, 2004). These more specific measures for the financial integration of markets have included several comprehensive studies (Hardouvelis et al., 2006), with the inclusion of the concept of risk-sharing in equity and currency markets.

The aim of our paper is to provide a measure of East Asian financial integration, taking into account the weight of each source of risk, including those linked to regional financial markets and foreign exchange markets in the assessment of the expected equity return. To accommodate this feature, we estimate a conditional international capital asset pricing model, in which both the regional risk exposures and the East Asian degree of financial integration change over time and determine the excess return on a local equity.

3. Methodology

Financial integration presents two polar cases: perfect integration, in which capital is perfectly mobile; and market segmentation, which refers to a complete absence of capital mobility. The reality lies between these two extremes, as financial integration is generally partial. Therefore, the existent literature, based on an empirical asset pricing approach to assess the degree of financial integration, can be classified using three categories. The first examines the determinants of the expected excess return on equity market, based on the hypothesis of segmented markets (as CAPM of Lintner, 1965; Sharpe, 1964). The second tests the asset pricing model under the hypothesis of integrated markets (for example, Harvey, 1991; Tai, 2003). However, the disadvantage of the model used in most empirical work, based on the classical CAPM,\(^10\) is that it involves either a perfect integration or a strict segmentation of financial markets and therefore does not consider the intermediate situations. The third range of literature provides empirical studies, taking into account the situation between segmentation and integration of markets, the so-called mild segmentation model (see Adler and Dumas, 1983; Bekae and Harvey, 1995, 1997; Errunza and Losq, 1985; Gérard et al., 2003). While these studies have the advantage that the strictly segmented/integrated cases are not assumed, some of them find that the degree of partial

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\(^5\) See, for example, Baele et al. (2004) or Kose et al. (2006) for a literature review.

\(^6\) See, for example, the index initially developed by Chinn and Ito (2008) to measure capital account openness.

\(^7\) These measures usually draw upon the work of Lane and Milesi-Ferretti (2007).

\(^8\) See, for example, Baharumshah et al. (2011).

\(^9\) \textit{De jure} measures do not reflect the actual degree of integration of an economy into international capital markets (Kose et al., 2006). Quantity-based assessments and price-based approaches cannot measure regional financial integration based on the strong assumption of perfect market integration, which is an unrealistic hypothesis. Financial literature shows evidence of partial segmentation or time-varying integration of markets. Finally, the measure of Feldstein and Horioka (1980) is difficult to interpret and operationalize.

\(^10\) The classical CAPM of Sharpe (1964) and Lintner (1965) considers that the expected return excess of financial assets is proportional to the systematic risk of assets, measured by its covariance with performance of the market portfolio.
segmentation is fixed through time or is allowed to vary only between two extreme regimes: perfect integration and strict segmentation (as Bekaert and Harvey, 1995). Moreover, some of the previous studies have tried to test the degree of stock market integration using the empirical asset pricing approach, but noted the dilemma that this methodology cannot separate the test of market integration from the test for the efficiency market hypothesis. For example, Harvey (1991) showed that the rejection of the asset pricing model tested could be caused by the inefficiency of the market portfolio and/or rejection of market integration.

Accordingly, to study the dynamics of East Asian financial integration and the risk premia, we propose a variant of the ICAPM developed by Hardouvelis et al. (2006). This empirical approach offers two advantages: it allows a measure of financial integration to be derived that fluctuates less and is easier to interpret than the one offered by Bekaert and Harvey (1995); it also includes the currency risk premium in addition to the regional and local risk premia.

The econometric tools used to test the ICAPM differ according to the appropriate framework and have evolved over time to provide more robust results. Dumas and Solnik (1995) used the generalized method of moments (GMM) proposed by Harvey (1991). However, this method does not allow for matching of the expectations of investors regarding the temporal variation of the currency risk with their importance in relation to the total risk premium. The multivariate GARCH approach, used by De Santis and Gérard (1997, 1998), overcomes the problems raised previously by allowing international investors to study the dynamics of various risk factors and to quantify them in relation to the total risk on the stock market.

Accordingly, we allow conditionally expected returns on the local market to be affected by their covariance with the regional market and the exchange market and by the variance of the local return.

The model can be written as follows\(^\text{11}\):

\[
E_{t-1}(R_{it}) = R_{ft} - \phi_{i-1}[\lambda_{a1} \sigma_{it-1} \psi_{t-1}] + \lambda_{k1} \sigma_{it-1}(R_{it}, s_{kt} | \psi_{t-1})
\]

\[
+ (1 - \phi_{i-1})[\lambda_{l1} \sigma_{it-1}(R_{it} | \psi_{t-1})]
\]

where \(E_{t-1}(R_{it})\) is the conditionally expected return on the local stock market index, \(R_{ft}\) the risk-free rate, \(s_{kt}\) the excess return on the East Asian market index, and \(s_{kt}\) the variation of the real exchange rate against the reference currency. For the East Asian countries, even if exchange rates are fixed for some countries, following Obstfeld and Rogoff (1995), Rogoff (1996), Mitchener and Weidenmier (2006), we believe that currency risk exists. Moreover, Phylaktis and Ravazzolo (2004) show, for emerging Asian countries, that the modeling of an ICAPM is econometrically better with deviation from PPP than the model without currency risk. Thus, we apply a deviation from PPP. We choose a real exchange rate, overcomes the problems raised previously by allowing international investors to study the dynamics of various risk factors and to quantify them in relation to the total risk on the stock market.

The risk premia to be estimated are, respectively, \(\lambda_{a1} \sigma_{it-1}(R_{it}, s_{kt})\) the regional market risk premium; \(\lambda_{k1} \sigma_{it-1}(R_{it}, s_{kt})\) the currency risk premium; and \(\lambda_{l1} \sigma_{it-1}(R_{it})\) the local risk premium.

\(\phi_{i-1}\) corresponds to the degree of financial integration between the local and regional markets and ranges between 0 and 1. If \(\phi_{i-1} = 1\), it implies that only covariance with the world portfolio is priced. In this case, we can reject the hypothesis of market segmentation. If \(\phi_{i-1} = 0\), only the variance is priced. This is consistent with a segmented capital market. Finally, if \(\phi_{i-1} \in [0, 1]\), financial markets are partially integrated/segmented.

Estimating Equation (1) requires the use of a sequential procedure since it includes various variables that are not observable and need to be estimated. The following developments aim to describe

\(^{11}\) See for example, Carrieri et al. (2007), Errunza and Losq (1985), Hardouvelis et al. (2006). All of these studies provide an excellent survey of the main properties of the theoretical asset pricing model.
our methodology. Following Hardouvelis et al. (2006), Equations (2) and (3) below are used to retrieve respectively, the dynamics of regional and currency risk prices:

\[ r_{ea,t} = \lambda_{ea}^{ea} \text{Var}_{t-1}(r_{ea,t}) + \lambda_{ea}^{k} \text{Cov}_{t-1}(r_{ea,t}, s_{k,t}) + \epsilon_{ea,t} \]  
\[ s_{k,t} = \lambda_{k}^{k} \text{Var}_{t-1}(s_{k,t}) + \lambda_{k}^{ea} \text{Cov}_{t-1}(r_{ea,t}, s_{k,t}) + \epsilon_{k,t} \]

where \( \epsilon_t = (\epsilon_{ea,t}, \epsilon_{k,t}/X_{t-1}) - N(0, H_t) \), represents the vector of errors conditional to the matrix of instrumental variables \( X \) at time \( t-1 \) and \( H_t \) designates the conditional variance–covariance matrix of excess returns.

As Hardouvelis et al. (2006) state, the time-variant parameter \( \phi_{t-1}^{i} \) is conditioned on a set of variables that measure integration:

\[ \phi_{t-1}^{i} = \exp(-|g_t Z_{t-1}^{i}|) \]

where \( \exp(.) \) denotes exponentiation, \(|| \) denotes absolute value, \( Z_{t-1}^{i} \) is a vector of country-specific information variables related to convergence toward East Asian area, and \( g_t \) is the weight associated with each variable \( Z_{t-1}^{i} \). Observe that, by construction, \( \phi_{t-1}^{i} \) takes a value between zero and unity. By taking the absolute value of \( g_t Z_{t-1}^{i} \), we assume that deviations of the instrumental variables from zero, independent of their sign, reduce the degree of integration.

Equation (1) includes the price of regional market risk, the price of currency risk and the price of local market risk. De Santis and Gérard (1997) and Gérard et al. (2003) show that these prices vary over time. Adler and Dumas (1983), among others, show that the price of risk is the aggregate of all investors’ risk aversion, under the assumption that investors are indeed averse to risk. Following these authors, the risk prices of regional and local markets are described by an exponential function of macroeconomic and financial instrumental variables:

\[ \lambda_{ea}^{ea} = \exp(\delta_{ea} X_{t-1}) \]
\[ \lambda_{i}^{i} = \exp(\gamma_{i} Z_{t-1}^{i}) \]

where \( X_{t-1} \) denotes all instruments on regional variables available at \( t-1 \) and \( \delta_{ea} \) represents the weight associated with these variables; \( Z_{t-1}^{i} \) is the vector of local instrumental variables observable on the market \( i \) at \( t-1 \), and \( \gamma_{i} \) represents the weight associated with these variables.

The price of currency risk can theoretically take positive or negative values; it is supposed to vary as a linear function of instrumental variables.

\[ \lambda_{k}^{k} = (\delta_k X_{t-1}) \]

where \( \delta_k \) is the weight of each variable in the vector \( X_{t-1} \).

The time-varying conditional covariance matrix is parameterized using the Dynamic Conditional Correlation (DCC) extension of GARCH model, proposed by Engle (2002) and Tse and Tsui (2002). Their approach is written as follows:

\[
\begin{align*}
H_t &= D_t R_t D_t \\
D_t &= \text{diag}(\sqrt{h_{11,t}}, \sqrt{h_{22,t}}, \ldots, \sqrt{h_{NN,t}}) \\
R_t &= \text{diag}(Q_t) \frac{1}{2} Q_t (\text{diag}Q_t) \frac{1}{2}
\end{align*}
\]
\[ Q_t = (1 - \theta_1 - \theta_2) \bar{Q} + \theta_1 u_t, u_{t-1} + \theta_2 Q_{t-1} \]  

(9)

where \( Q_t \) denotes the unconditional matrix of variance-covariance of dimension \( (N \times N) \), symmetric and positive definite, and \( u_t = (u_{1t}, u_{2t}, \ldots, u_{Nt})' \) is a column vector of standardized residuals of the \( N \) assets in the portfolio at time \( t \): \( u_{it} = \frac{\varepsilon_{it}}{\sqrt{h_{it}}} \) for \( i = 1, \ldots, N \). The coefficients \( \theta_1 \) and \( \theta_2 \) are parameters to estimate. The sum of these coefficients must be less than 1 to satisfy the positivity of the matrix \( Q_t \).

The parameters of Equations (1) to (3) are estimated by quasi-maximum likelihood in order to avoid the problems due to non-normality in excess returns. Given the specificities of our model (large number of parameters, non-linearities), we estimate the system of equations in three steps. First, we estimate a multivariate GARCH-DCC model in order to obtain the terms of variance \( \text{Var}(R_{it}) \), \( \text{Var}(R_{it}, R_{jt}) \), \( \text{Var}(s_{it}) \) and covariance \( \text{Cov}(R_{it}, R_{jt}) \), \( \text{Cov}(R_{it}, s_{jt}) \), \( \text{Cov}(s_{it}, s_{jt}) \), which are necessary to estimate Equations (1), (2) and (3). Second, we estimate simultaneously, in a first time, Equations (2) and (5) and, in a second time, Equations (3) and (7). This second step allows us to obtain the estimated values for the price of regional market risk \( \text{Cov}(R_{it}, s_{jt}) \) and the price of currency risk \( \lambda_{it} \). To take into account the assumption that the price of regional risk is equal across countries, we then impose this constraint in the estimation of Equation (1) for each country. Finally, taking into account Equations (4) and (6), we can retrieve the price of the local risk \( \lambda_{it} \) and measure the degree of integration \( \phi_{it}. \)

Recall, as noticed by Hardouvelis et al. (2006) among others, the advantage of this step-by-step methodology is that it imposes the same regional risk price on each country.

4. Data and preliminary analysis

We consider three groups of data: (i) the series of stock market returns in each country and for the regional market, (ii) the series of real exchange rates expressed vis-à-vis the reference currency, and (iii) the instrumental variables used to condition the estimation of the risk prices and degree of integration. Among the Asian countries, we retain the main East Asian countries: the People’s Republic of China (CH), the Republic of Korea (KOR), Hong Kong (HK), Indonesia (IND), Japan (JAP), Malaysia (MAL), the Philippines (PHIL), Singapore (SING) and Thailand (THAI). Data are monthly and cover the period from January 1990 to August 2012 in order to include the main economic episodes that have characterized the integration process of East Asian countries (financial liberalization at the end of the 1980s, the 1997–8 crisis, the world crisis that appeared in 2008–9, and the setting-up of financial and monetary regional agreements). The only exception is the People’s Republic of China (thereafter China) for which data cover the period from January 1994 to November 2008, resulting from a problem of data availability, as explained below.

4.1. Stock returns

The monthly stock returns in each local market and in East Asia area are calculated including dividends, and extracted from Morgan Stanley Capital International (MSCI) database; the exception is China, for which we retain the Global International Finance Corporation (IFCG) index. However, the data are only available until 2008.

Stock market returns are defined as \( R_{it} = \ln(P_{it}/P_{it-1}) \), where \( P_{it} \) is the country’s stock market index at time \( t \) (including dividends). The excess return of each index is calculated from a risk-free rate at one month extracted from Datastream. Unit root tests show that all series of stock returns are stationary.
Some descriptive statistics are presented in Table 1, as usually, returns display high volatility and are negatively skewed. With the exception of Malaysia and the East Asian area, returns are autocorrelated, as indicated by the Q(z)12 statistics.

4.2. Exchange rates

To estimate our model, we need to determine a reference/anchor currency for East Asian countries. As we are in a regional framework, we need a regional anchor. The US dollar is not the appropriate reference currency. Indeed, if there is an abundant literature revealing the predominant role of the US dollar (Williamson, 2005) and the absence of a Yen Bloc (Shirono, 2009), it seems that, since the 1997–8 crisis, East Asian countries would like to be less peg to the US dollar (with some exceptions, as in China and Hong Kong), and this fact should be upgraded with the subprime crisis (Ma and McCauley, 2011; Park and Song, 2011).

For this reason, we decided to build an Asian currency basket. To do this, as in Ogawa and Shimizu (2006), we take up the countries incorporated in the Asian Currency Unit (ACU). However, the ACU starts only in 2000. As our study begins in 1990 and due to data availability issues for some countries, we decide to build a currency basket with the nine countries of our sample. We call this currency basket MACU for Modified Asian Currency Unit. The value of the MACU in terms of currency $i$ (the MACU rate of currency $i$) is defined as follows:

$$MACU_i = \sum_j \alpha_j/E_j$$  \hspace{1cm} (10)

where $\alpha_j$ is the amount of currency $j$ in the basket and $E_j$ is the price of currency $i$ in units of currency $j$ (the bilateral exchange rate). In order to determine the weight of each country (and therefore of each currency), we can choose three types of measure: GDP measured at purchasing power parity (PPP); GDP measured at current prices (in US dollar); and trade volume (the sum of exports and imports) in the total of sampled countries. We choose the MACU constructed from the GDP measured at PPP.

If, for example, we consider the US dollar to be the currency $i$ and assume that the weight is based on the share of GDP measured at PPP, Equation (10) becomes:

Table 1

<table>
<thead>
<tr>
<th></th>
<th>CH</th>
<th>KOR</th>
<th>HK</th>
<th>IND</th>
<th>JAP</th>
<th>MAL</th>
<th>PHIL</th>
<th>SING</th>
<th>THAI</th>
<th>EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>−0.12</td>
<td>0.42</td>
<td>0.49</td>
<td>1.35</td>
<td>−0.29</td>
<td>0.65</td>
<td>0.62</td>
<td>0.41</td>
<td>0.57</td>
<td>0.34</td>
</tr>
<tr>
<td>StdDev</td>
<td>10.34</td>
<td>8.70</td>
<td>7.54</td>
<td>8.84</td>
<td>5.69</td>
<td>7.05</td>
<td>7.74</td>
<td>6.58</td>
<td>9.39</td>
<td>7.51</td>
</tr>
<tr>
<td>Skewness</td>
<td>−0.02**</td>
<td>−0.05**</td>
<td>−0.21*</td>
<td>−0.36*</td>
<td>−0.04**</td>
<td>0.06**</td>
<td>−0.11**</td>
<td>−0.59</td>
<td>−0.27</td>
<td>−0.42</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.38</td>
<td>0.88</td>
<td>1.75</td>
<td>0.57**</td>
<td>0.03***</td>
<td>1.56</td>
<td>0.63*</td>
<td>1.95</td>
<td>1.10</td>
<td>0.75*</td>
</tr>
<tr>
<td>B-J</td>
<td>18.82</td>
<td>8.87*</td>
<td>36.66</td>
<td>9.66*</td>
<td>0.07***</td>
<td>27.6</td>
<td>4.96**</td>
<td>59.27</td>
<td>16.97</td>
<td>14.38</td>
</tr>
<tr>
<td>Q(z)12</td>
<td>18.81**</td>
<td>8.93***</td>
<td>18.66**</td>
<td>10.45**</td>
<td>9.38**</td>
<td>43.14</td>
<td>12.00**</td>
<td>12.70**</td>
<td>14.83**</td>
<td>27.48</td>
</tr>
</tbody>
</table>

Notes: Significant at 1% (**), 5% (*) and 10% (*). StdDev is the Standard Deviation. B-J: Bera-Jarque test statistic for normality. Q(z)12: Ljung–Box test statistic of order 12. EA corresponds to East Asian area which includes 9 countries (People’s Republic of China, India, Indonesia, Japan, Republic of Korea, Malaysia, the Philippines, Taiwan and Thailand).
$$\text{MACU}^j = \sum_j \alpha_j / E_j^j$$

(11)

where $\alpha_j$ is the amount of currency $j$ in the basket and $E_j^j$ is the price of the US dollar in units of currency $j$ (USD/$j$ exchange rate). $\alpha_j$ is defined as:

$$\alpha_j = \gamma_j E_j^j(b)$$

(12)

where $E_j^j(b)$ is the benchmark exchange rate19 and with:

$$\gamma_j = \frac{\text{GDP(PPP)}_j}{\sum \text{GDP(PPP)}_j}$$

(13)

with $\text{GDP(PPP)}_j$, as the GDP measured at purchasing power parity (PPP) of the country $j$.

Then, we express each East Asian currency against the MACU (nominal and real exchange rates) as in Equation (10). Fig. 1 displays our results.

All nominal exchange rates (against the US dollar) and the consumer price index data used for the construction of MACU come from IMF’s International Financial Statistics. GDP measured at PPP, GDP at current prices, and intra-regional trade data are extracted from the CHELEM (Cepii) database. Series are annual and we choose 2005 as the reference year.

### 4.3. Instrumental variables for the risk prices and regional integration degree

Many studies, such as Harvey (1991) or Bekaert and Harvey (1995), have documented the existence of predictable variation in equity market returns. In our estimations, we consider two sets of instrumental variables (regional and local) that have been widely used in previous research. The regional instrumental variables are: (i) the first lag of the regional market dividend yields in excess of the risk-free rate; (ii) the first lag of the monthly change in the term spread; (iii) the first lag of the monthly change of default spread; (iv) the first lag of the monthly change of the short-term interest rate. The term spread is the difference between the long-term interest rate (10-years) and a 1-month interest rate. Regarding the default spread, we computed it from the geometric mean for the 10-year Treasury bonds series in the most developed East Asian countries (Hong Kong, Japan, Korea and Singapore) weighted by the series of market capitalizations of the same countries. All of these instrumental variables are taken from Datastream and are used with a lag behind the series of excess returns.

The set of local variables includes: (i) the lagged change in the local exchange rate; (ii) the lagged local equity return in excess of the risk-free rate; (iii) the lagged monthly change in the short-term interest rate.

### 5. Empirical results

#### 5.1. Estimation results of the ICAPM

As indicated in Section 2, the ICAPM explains the excess return on the local stock market as a function of three premia: a regional risk premium, a currency risk premium and a local risk premium. It should be noted that the risk prices related to currency and regional markets were first estimated (Equations (5) and (7)). The estimation results of currency risk price ($\lambda_{t,1}$) are presented in Table A1 in the Appendix. The monthly change in the term spread (DTERM) and the regional market dividend yields in excess of the risk-free rate (XRMD) are the most significant variables for all countries, except China and Thailand.

---

19 The benchmark exchange rate (USD/$j$) is the average of the monthly USD/$j$ exchange rate in 2005.
Fig. 1. Nominal and real exchange rate of East Asian currencies against MACU (2005 = 100).
Note: Authors' own calculations. Solid lines indicate Nominal exchange rate and dotted lines indicate Real exchange rate.
Table 2 reports the estimation results of regional risk price ($\lambda_{t}^{r}$) and the residual diagnostic tests. We find that instrumental variables play an important role in explaining the evolution of the regional risk. While non-normality has not been eliminated from the residuals, Ljung–Box and White tests reveal the absence of auto-correlation and heteroscedasticity problems.

Table 3 reports the significance of the three components in ICAPM (regional, local and currency risk premia). In contrast to the existent literature (Bekaert and Harvey, 1995; Carrieri et al., 2007; Karolyi, 2004), which has neglected the currency risk premium for emerging markets, our results show that the currency risk premium is significant for seven of the nine East Asian countries studied (Hong Kong, Indonesia, Japan, Korea, Singapore, Philippines, and Thailand). Here we consider the fluctuation of the real exchange rate, which takes into account (i) the deviation to PPP (as demonstrated, for example, by Rogoff, 1996), and (ii) variation in the inflation rate, which often characterizes the case of emerging countries (this phenomenon is due to the Balassa–Samuelson effect).

The significance and importance of the currency risk premium are related to several factors, especially the exchange rate regime. Following the IMF de facto classification of exchange rate arrangements (Table A3 in the Appendix), we can distinguish countries with floating exchange rates (floating or free floating) from those with fixed exchange rates (currency board, crawling peg, etc.). There is evidence that a fixed exchange rate regime reduces the currency risk and a floating exchange rate increases currency risk and volatility. Our results show that the currency risk premium is significant for countries such as Japan, Korea and Singapore, which have floating exchange rates, while the currency risk premium is not significant for countries with fixed exchange rates (China for example). Moreover, the significance of currency risk can be explained by the degree of financial development and openness. Indeed, some countries, such as China, Malaysia or the Philippines, are less often confronted by various financial and monetary shocks (Allegret et al., 2012), and accordingly their currency risk is not significant or less important compared to other East Asian countries.

For the two other risk premia related to domestic and regional stock markets, the results reported in Table 3 show that they are significant for all countries. The last three columns of the table highlight the average weight of each component of risk in the total risk premium. We classify our sample into three groups, as follows: (i) China, Hong Kong, Indonesia, and Thailand, for which the local risk exceeds 50 percent of the total risk premium. For example, in the case of China, the local risk premium is approximately five times the premium of the regional market and seven times the currency risk premium. Indeed, if China has clearly demonstrated its commitment to internationalizing its currency (Cheung et al., 2011), the yuan, at present, does not have the status of international currency (Thimann,
Table 3
Significance and importance of each risk premium.

Table 3 reports the estimated coefficient of each risk premium and its significance level. The results derive from the estimation of the following equations:

\[ E_t(\psi_{t-1}) = \delta_1 + \delta_2 \Lambda_{t-1}^{\psi} \psi_{t-1} + \delta_3 \Lambda_{t-1}^{\psi} \psi_{t-1} + \delta_4 \Lambda_{t-1}^{\psi} \psi_{t-1} + \delta_5 \Lambda_{t-1}^{\psi} \psi_{t-1} + \epsilon_t \]

where \( E_t(\psi_{t-1}) \) is the conditionally expected return on the local stock market index, \( R_t \) the risk-free rate, \( \psi_t \) the excess return on the East Asian market index, and \( \epsilon_t \) the variation of the real exchange rate against the reference currency. \( \Lambda_{t-1}^{\psi} \) is the regional risk premium, \( \psi_t \) the corporate risk premium, \( \lambda_{t}^{R} \) the price of foreign exchange risk of currency \( k \) against the reference currency, and \( \lambda_{t}^{C} \) the price of local risk in market \( i \). \( \psi \) and \( \psi \) respectively denote the variance and covariance operators. All expectations are conditioned on \( \psi_{t-1} \), the data investors use to set prices at time \( t-1 \). \( \psi_{t-1} \) corresponds to the degree of financial integration between local and regional markets and ranges between 0 and 1.

\[ \epsilon_t = \begin{pmatrix} \epsilon_{t,1} \\ \epsilon_{t,2} \\ \epsilon_{t,3} \end{pmatrix} \sim N(0, \Sigma_t) \]

represents the vector of errors conditional to the matrix of instrumental variables \( X \) at time \( t-1 \) and \( H_t \) designates the conditional variance-covariance matrix of excess returns, and modeled as multivariate GARCH-DCC process.

<table>
<thead>
<tr>
<th>The significance of each risk premium</th>
<th>The average weight of each component of risk in the total risk premium</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RP</strong></td>
<td><strong>RP</strong></td>
</tr>
<tr>
<td>reg</td>
<td>cur</td>
</tr>
<tr>
<td>CH</td>
<td>0.23***</td>
</tr>
<tr>
<td>(7.34)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>HK</td>
<td>0.31***</td>
</tr>
<tr>
<td>(38.44)</td>
<td>(10.77)</td>
</tr>
<tr>
<td>IND</td>
<td>0.28***</td>
</tr>
<tr>
<td>(23.32)</td>
<td>(7.34)</td>
</tr>
<tr>
<td>JAP</td>
<td>0.27***</td>
</tr>
<tr>
<td>(24.74)</td>
<td>(6.94)</td>
</tr>
<tr>
<td>KOR</td>
<td>0.45***</td>
</tr>
<tr>
<td>(49.43)</td>
<td>(28.42)</td>
</tr>
<tr>
<td>MAL</td>
<td>0.35***</td>
</tr>
<tr>
<td>(2.83)</td>
<td>(0.44)</td>
</tr>
<tr>
<td>SING</td>
<td>0.39***</td>
</tr>
<tr>
<td>(45.97)</td>
<td>(14.11)</td>
</tr>
<tr>
<td>PHIL</td>
<td>0.22***</td>
</tr>
<tr>
<td>(5.21)</td>
<td>(4.16)</td>
</tr>
<tr>
<td>THAI</td>
<td>0.31***</td>
</tr>
<tr>
<td>(22.73)</td>
<td>(5.62)</td>
</tr>
</tbody>
</table>

Notes: Significant at 1% (**). t-stat are given in parentheses. \( \text{RP}_{\text{reg}} \) is the regional risk premium, \( \text{RP}_{\text{cur}} \) the currency risk premium, \( \text{RP}_{\text{local}} \) the local risk premium. \( \text{RP}_{\text{reg}} \), \( \text{RP}_{\text{cur}} \), and \( \text{RP}_{\text{local}} \) are, respectively, the average weight of each risk premium (regional, currency, and local) in the total risk premium.

2009). This situation is mainly a result of the insufficiency of financial openness and development. However, it should be noted that the potential for internationalization of the yuan is increasing (Angeloni et al., 2011). In financial terms, free movement of capital is restricted and financial markets are underdeveloped (Bénassy-Quéré et al., 2011). (ii) The second group includes countries such as Korea, Malaysia, the Philippines, and Singapore, where the average weight of local and regional premia is relatively similar (between 40% and 45% for each component). These countries are more developed than the previous group and their financial markets are more open than the Thai or Chinese markets, and then more confronted to the volatility of the global financial market. According to Park and Lee (2011), the share of international portfolio assets and liabilities held by emerging Asian economies is

23 If we only take the case of equity markets, they have existed since 1984 and, since 1990, two markets have been created: one in Shanghai and one in Shenzhen. Market capitalization is low and there are two compartments: “A” for domestic investors, and “B” for foreign investors. See, for example, Allen et al. (2012) for a complete review.
increasing over time. Hong Kong, Korea, and Singapore are the three largest investors among these emerging Asian countries. Moreover, the authors suggest that short-term capital flows such as bank lending and portfolio investments tend to be more volatile than long-term flows and represent the main source of risk, especially in times of financial stress. Overall, the regional market contains significant differences across individual Asian economies, as proven by the heterogeneity in terms of the importance of each risk premium (global or local) among our sample countries. (iii) Finally, Japan has a regional risk premium of approximately 68 percent, four times greater than the local premium.

Fig. 2 highlights a comparison between the regional and total risk premia. We note that the regional risk is economically and statistically significant for almost all countries and the associated premium changes over time and varies significantly in times of financial crisis (Asian 1997–8, world 2008–9). Results for the total premium are more significant. We note two peaks, the first in the mid-1990s, caused by the Asian crisis, and the second in 2008, as a result of the global crisis.

To investigate the impact of each crisis on East Asian countries, Fig. 2 includes two shaded areas corresponding to regional and world crisis periods. The choice of these two periods is the result of several detailed investigations because an animated debate exists about when the crisis began and when it ended. If the study of the Asian crisis has become easier with time, the crisis that began in 2007 with the US subprime issue has become more complex. Indeed, this crisis has experienced many episodes and twists, which initially affected the financial market, and then the real economy. In this study, we pay particular attention to the influence of the financial crisis rather than the issue of its transmission to the real economy. To do this, we decide to use the VIX (the implied volatility on the S&P500 stock index) to specify clearly the period of financial crisis. Indeed, the VIX is generally considered to be a good indicator of global risk aversion, as well as a gauge for the financial cycle, not only in the US but also worldwide (Rey, 2013). We define the Asian crisis and the global crisis when the VIX rises above the level of 25. We set this threshold following Coudert and Mignon (2013). Therefore, we determine the following periods:

- Asian financial crisis: from October 1997 to October 1998;

According to Fig. 2, we can see that all countries are clearly affected by the two crises: regional and world. However, there is a slight difference between the countries studied regarding the influence of each crisis on the risk premium. For example, some countries, such as China, Korea, Hong Kong, Malaysia and the Philippines, have been affected to a greater degree by the regional crisis than by the global crisis. Other countries, such as Indonesia, Japan, and Singapore, are similarly affected by both crises. Accordingly, these findings show that (i) East Asian countries are affected by both regional and world financial volatilities, and (ii) the comparison between the two crises shows that the regional risk is not negligible for East Asian countries and further strengthens the hypothesis of increasing regional risk-sharing, especially in recent years, since the 2008–9 global crisis.

The significance and importance of the risk premium could be related to a greater extent to the degree of monetary and financial cooperation, particularly within the regional market. In the next section we study the degree of regional financial integration in each country. More precisely, we assess the link between the estimation results of the risk premium and their impact on the degree of regional integration: Are the markets with a preponderance for local risk premium in the total risk premium strictly segmented? Otherwise, are the markets that have a significant and important share of the regional risk premium (i.e. East Asian stock market risk) regionally well integrated?

5.2. Time-varying integration

To account for the dynamics of financial integration, the degree of regional integration of each East Asian stock market is modeled using Equations (1) and (4). The integration coefficient \( \phi_{i,t-1} \) varies

See IMF (2013). Data are available from cpis.imf.org.
Fig. 2. Total and regional risk premia.

Notes: Authors’ own calculations. The total risk premium is the excess return \((E_{t-1}(R_t|y_{t-1}) - R_{t-1})\). The regional risk premium is the premium related to the regional market risk \(\lambda \psi_t \text{Cov}_{t-1}(R_t, r_{m,t}|y_{t-1})\). Shaded areas indicate crisis.
over time to account for the dynamics of financial integration and the convergence, or not, of each country toward the regional East Asian market.

Table A2 (in the Appendix) reports the estimation results of integration degree based on regional instruments. We note that these variables are globally significant, mainly those relating to the monthly change in the short-term interest rate (DSTI), and the regional market dividend yields in excess of the risk-free rate (XRMD). Indeed, XRMD goes a long way to explain the integration dynamic of all countries, except for Malaysia and the Philippines.

Table 4 indicates the regional integration degree of each East Asian market for the overall period and three sub-periods. The overall average varies from one country to another. Japan has the highest degree of integration (0.91 on average) and China has the lowest average (0.10). For the other Asian countries studied, we distinguish two groups, as follows: the first contains three countries (Hong Kong, Korea and Singapore), characterized by partial segmentation (approximately 0.45 on average). This result is consistent with the findings of the previous section. Indeed, for Korea and Singapore, the weight of the local risk premium is almost equal to the regional premium, which matches the case of partial segmentation/integration of markets. The second includes four countries (Indonesia, Malaysia, the Philippines and Thailand), characterized by a low degree of integration (approximately 0.2 to 0.25 on average).

Moreover, as shown in the previous section, for some countries such as Indonesia, the Philippines and Thailand, the local risk premium is the main component in the formation of the total risk premium (e.g. partial segmentation). Furthermore, according to income level, using the classification of the World Bank, Malaysia, the Philippines and Thailand are middle-income countries, and Indonesia is a low-income country. Guillaumin (2009) shows that the latter have lower financial integration links than high-income countries (such as Japan and Korea). Overall, these findings are consistent with the existing literature, which has often claimed that the level of financial market integration within East Asia is relatively low (Gan, 2014; Kim and Lee, 2012; Kim et al., 2006).

The previous analysis relies on the overall period. However, one of the contributions of this paper to the existing literature on regional financial integration in East Asia is to empirically assess how the degree of integration has evolved over time within East Asia. We thus propose (i) a detailed analysis of the dynamics of regional integration (e.g. between the two crises and after the global crisis), and (ii) a measure of the impact of various financial arrangements, made after the 1997–8 and 2008–9 crises, on the evolution of regional integration level. We divide the total period into three sub-periods. The results are reported in Table 4 and show that regional financial integration has increased significantly over time. The choice of three sub-periods was determined according to the dates of the crises (the 1997–8 Asian crisis and the 2008–9 global crisis). The first (January 1991 to September 1997), before the Asian crisis, is characterized by a low level of regional integration. Indeed, with the exception of Japan, all other markets are essentially segmented. The second, after the end of the regional crisis and the implementation of several monetary and financial initiatives (see Section 2), is marked by a significant increase in regional financial integration for all countries. This reflects the

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Time-varying regional financial integration.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CH</td>
</tr>
<tr>
<td>Overall average</td>
<td>0.09</td>
</tr>
<tr>
<td>StDev</td>
<td>0.09</td>
</tr>
<tr>
<td>Min</td>
<td>0.01</td>
</tr>
<tr>
<td>Max</td>
<td>0.41</td>
</tr>
<tr>
<td>Sub-periods average:</td>
<td></td>
</tr>
<tr>
<td>Jan. 1991–Sept. 1997</td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>StDev</td>
<td><strong>0.01</strong></td>
</tr>
<tr>
<td>Nov. 1998–Aug. 2008</td>
<td><strong>0.13</strong></td>
</tr>
<tr>
<td>StDev</td>
<td>0.07</td>
</tr>
<tr>
<td>Oct. 2009–Aug. 2012</td>
<td>–</td>
</tr>
<tr>
<td>StDev</td>
<td>–</td>
</tr>
</tbody>
</table>

Notes: Panel of Table 4 contains statistics for the integration indices (in bold) estimated from the ICAPM (Equations (1) and (4)). StDev (in italics) is the Standard Deviation.
positive impact of different arrangements on the development and opening of financial markets in
East Asia. However, despite this significant growth, the degree of regional integration remains below
0.5 (except for Japan) and corresponds to the partial segmentation/integration of markets. The global
crisis of 2008–9 has encouraged the authorities to a greater degree, to strengthen their financial co-
operation by signing an agreement making official the multilateralization step of the Chiang Mai Initiative
announced in early 2009. The severity of the global crisis and new initiatives seem to have had a sig-
nificant impact on the dynamics of regional integration. Indeed, the third sub-period indicates that
the degree of financial integration has increased significantly within East Asian countries compared
to the period before the global crisis (for example, from 0.45 to 0.71 for Hong Kong, 0.16 to 0.59 for
Indonesia, 0.19 to 0.51 for Malaysia, 0.46 to 0.79 for Singapore, and 0.25 to 0.62 for Thailand). All coun-
tries are thus marked by a level of regional financial integration greater than 0.5, with the exception
of the Philippines.

To highlight these findings we now also analyze the time-variations of the regional integration level,
as illustrated in Fig. 3, which portrays the time-varying process of financial market integration in East
Asian countries. Three phases of evolution can easily be distinguished and confirm the three sub-
periods of evolution studied above. During the global crisis, for several countries the integration measure
doubled in the last months of 2008. This result should be interpreted with caution. Indeed, the inte-
gration measure stems from the ICAPM, takes into account the volatility of the financial and exchange
rate markets, and reflects the impact of different external shocks. Therefore, it is likely that the high
level of integration included the impact of financial market fluctuations linked to the subprime crisis
and the bankruptcy of Lehman Brothers. This improvement in regional integration may reflect a common
move among East Asian countries, which may be a result of shock propagation from the financial crisis
rather than a move specific to each country. Furthermore, after the 2008–9 financial crisis, as demon-
strated by Table 4, the level of integration determined for each country reflects not only the measure
suggested by the ICAPM (dynamic covariance between equity stock returns of each local market and
the East Asian market), but also the contribution of macroeconomic and financial cooperation between
East Asian countries.

Fig. 3 also shows that, independently of the global crisis, the upward trend in the degree of finan-
cial integration is confirmed until the end of the study period (August 2012). We know that these East
Asian countries are, for the most part (excluding Japan), classified as emerging markets (Park and Lee,
2011) and therefore less exposed to the global crisis than more developed countries. In the context
of the crisis, and taking into account the difficulties of the US stock market and the euro area (sub-
prime crisis, sovereign debt crisis, etc.), East Asian countries seem to be moving toward trade with
neighboring countries, and thus promoting regional integration. In addition, a regional market ori-
nentation allows them to reduce the risk of short-term capital flows (such as bank lending), which tend
to be more volatile than long-term flows (such as foreign direct investment). Indeed, the short-term
flows are a source of volatility in East Asia, given the risk of sudden stop and withdrawal in times of
financial stress. Park and Lee (2011) find that the emerging Asian countries have been able to attract
stable foreign direct investment flows, which increased sharply in the 2000s. Accordingly, we can note
that the degree of integration, independent of the crisis effect, may also include a significant part re-
flexing a real increase in regional financial integration. Indeed, after the multiple crises that affected
the international markets, the East Asian countries seem to find “refuge” in their regional market, where
the interest of any exchange-rate agreement allows better growth in this intra-regional trade. This
result is also highlighted by the recent study of Park and Lee (2011), which indicated that emerging
Asian equity markets are increasingly integrated within their region.

Our findings are consistent with previous studies (Bekaert et al., 2005; Coudert et al., 2013; Park
and Lee, 2011) and support the idea of a growing process of regional financial integration on East Asian
stock markets. As in Hinojales and Park (2011), our results suggest that the degree of regional finan-
cial integration increases during stressful times (crisis times, for example). As such, the extent of regional
integration has important implications, particularly from a risk-sharing perspective (see, for example,
Fig. 3. Time-varying regional financial integration.

Notes: Authors' own calculations. Shaded areas indicate crisis. Solid lines indicate degree of regional financial integration and dotted lines indicate trend of the degree of regional financial integration. We use the HP filter to calculate the trend of the series.
Jeon et al., 2006 or Ng and Yarcia, 2014). Our results are also consistent concerning the significance of the currency risk premium. Indeed, the literature has often neglected this part of risk linked to the exchange market in the case of emerging countries. The significance of the currency risk premium reinforces the idea of a regional exchange-rate agreement to minimize this risk and to promote monetary and financial integration. A regional exchange-rate agreement would then strengthen all the regional economic agreements (commercial, financial and monetary) implemented since the crisis of 1997–8 in order to “protect” regional integration and accentuate the dynamics developed in recent years.

5.3. Specification test and diagnostics

This section aims to test the robustness of the previous empirical results regarding the regional financial integration in East Asian markets. To do this, we regress the model errors (excess returns minus the model fitted values) for each East Asian country on three components of global variables: (i) the covariance between the excess return of domestic and global markets for the global risk (GRP), (ii) the covariance of the equity local market with the US dollar for the currency risk (CRP) and (iii) the covariance between excess returns of regional and global markets (COV). This provides an adjusted R-squared ($R^2$ hereafter) and a heteroscedasticity consistent $X^2$ of Wald test. The $X^2$-statistic tests the hypothesis that the regression coefficients on the three global components are equal to zero. To perform our model diagnostics, we also present a Lagrange multiplier test of the alternative specification model.

These diagnostic tests are important for the interpretation of our results. Indeed, this type of ICAPM often suffers from misspecification problems. Bekaert and Harvey (1995) show that there are many reasons why the model diagnostics might present evidence against the specification, one of the main ones being that we choose to examine a single factor specification.

Table 5 reports the results of diagnostic tests. The model specification is rejected for Japan and Korea. There is mixed evidence for China, Hong Kong, Indonesia, Malaysia, Singapore and Thailand. The model specification is not rejected for the Philippines.

First, we analyze the countries where the model is rejected. Japan’s ICAPM model errors are highly correlated with the US currency market and the global equity return. Unsurprisingly, this result is expected. According to Park and Lee (2011), Japan holds very few Asian assets (2.4% of its total foreign assets in 2009) and invests heavily in the US (32.3% in 2009). The rejection for Korea follows similar patterns. While the adjusted R-squared is small (8%), both the Wald and LM tests reject the ICAPM specification.

Second, consider the countries where the evidence against the model is mixed. Singapore’s model errors are correlated with the US currency market (CRP) and determined by the covariance between regional and global equity returns (COV). While the Wald test presents evidence against the

<table>
<thead>
<tr>
<th>CH</th>
<th>HK</th>
<th>IND</th>
<th>JAP</th>
<th>KOR</th>
<th>MAL</th>
<th>PHIL</th>
<th>SING</th>
<th>THAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
<td>0.24</td>
<td>0.06</td>
<td>0.16</td>
<td>0.06</td>
<td>0.08</td>
<td>0.12</td>
<td>0.004</td>
<td>0.06</td>
</tr>
<tr>
<td>$W$</td>
<td>2.48</td>
<td>2.44</td>
<td>1.11</td>
<td>5.41</td>
<td>8.11</td>
<td>0.51</td>
<td>0.18</td>
<td>9.22</td>
</tr>
<tr>
<td>($0.117$)</td>
<td>($0.119$)</td>
<td>($0.292$)</td>
<td>($0.021$)</td>
<td>($0.004$)</td>
<td>($0.473$)</td>
<td>($0.669$)</td>
<td>($0.002$)</td>
<td>($0.426$)</td>
</tr>
<tr>
<td>$LM$</td>
<td>23.78</td>
<td>34.73</td>
<td>60.66</td>
<td>14.29</td>
<td>33.31</td>
<td>23.64</td>
<td>5.48</td>
<td>5.27</td>
</tr>
<tr>
<td>($0.000$)</td>
<td>($0.000$)</td>
<td>($0.000$)</td>
<td>($0.001$)</td>
<td>($0.000$)</td>
<td>($0.000$)</td>
<td>($0.064$)</td>
<td>($0.072$)</td>
<td>($0.000$)</td>
</tr>
<tr>
<td>$GRP$</td>
<td>$-0.07$</td>
<td>$-0.06$</td>
<td>$-0.06$</td>
<td>$-0.05$</td>
<td>$-0.13$</td>
<td>$0.03$</td>
<td>$-0.2$</td>
<td>$-0.13$</td>
</tr>
<tr>
<td>$CRP$</td>
<td>$-3.81$</td>
<td>$-4.28$</td>
<td>$-1.55$</td>
<td>$-1.02$</td>
<td>$-1.92$</td>
<td>$-1.74$</td>
<td>$-0.84$</td>
<td>$-1.87$</td>
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<tr>
<td>($0.000$)</td>
<td>($0.000$)</td>
<td>($0.000$)</td>
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<td>($0.000$)</td>
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<td>($0.000$)</td>
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</tbody>
</table>

Notes: Significant at 1% (**), 5% (*) and 10% (*). p-values are given in parentheses. The $R^2$ statistics are adjusted for degrees of freedom and result from a regression of the country asset pricing error on: (i) the covariance between the excess return of domestic and global markets, for the global risk (GRP), (ii) the covariance of equity local market with the US dollar for the currency risk (CRP) and (iii) the covariance between excess returns of regional (East Asia) and global markets (COV). The $W$-statistics are heteroscedasticity consistent Wald test. The p-values are based on a $X^2$ distribution with degrees of freedom equal to the number of included regressors. The LM tests are standard Lagrange multiplier tests of the alternative specification (e.g. including the three components of global markets, GRP, CRP, COV).
specification model, the Lagrange Multiplier test fails to reject completely the null hypothesis (p-value of 0.07), and the adjusted R-squared is very low (6%).

The other countries belonging to this second category appear more mixed than Singapore. Indeed, the Wald test fails to reject the specification model for China, Hong Kong, Indonesia, Malaysia, and Thailand. However, the LM test presents evidence against the ICAPM model. Moreover, China, Indonesia, and Malaysia are characterized by a significant adjusted R-squared (respectively 24%, 16% and 12%) compared to Hong Kong and Thailand (close to 5%). For all these countries the model errors are only correlated with the US currency market. This finding is explained by the predominant role of the US dollar and the absence of a Yen Bloc. However it seems that, since the 2008–9 global crisis, East Asian countries would like to be pegged less to the US dollar (with some exceptions, as in China and Hong Kong).

In contrast with all the other countries in our sample, there is no problem of misspecification for the Philippines. The adjusted R-squared is close to zero and both the Wald and LM tests fail to reject the model specification.

Globally, these diagnostics show that the ICAPM suffers from misspecification problems for a number of our East Asian countries. Similarly, Bekar2nt and Harvey (1995) find that the strength and source of rejection differ from one country to another. In the case of rejection, it does not imply that this type of ICAPM is not useful information. However, we should pay attention when interpreting the regional integration measure in those countries where there is a misspecification problem.

5.4. Regional integration vs international integration

Given the importance of the global risk premium and the financial interactions with global and regional markets, we suggest estimating the degree of global financial integration between our East Asian countries and the global market. This section aims to explain the previous results, which highlights that, even though global factors continue to determine local excess returns, regional factors become more significant and contribute to strengthening financial integration within East Asia, mainly in the aftermath of the 2008–9 global crisis.

Thus, we estimate the ICAPM in the global framework. The excess returns on the local market are determined by the risk premia on (i) covariance with the global market, (ii) covariance with the US currency markets, and (iii) variance of the local market. The aim is to assess the dynamics of the global financial integration of East Asia, especially during the last period (e.g. after the global crisis); also, to highlight that this global integration is caught up by the regional one.

We now use the US dollar as the reference currency to estimate global financial integration. The model can be written as follows:

\[
E(R_{it}|\psi_{t-1}) - R_{ft} = \phi_i \lambda_{i}^m \text{Cov}(R_{it}, r_{m,t}|\psi_{t-1}) + \lambda_k^s \text{Cov}(R_{it}, s_{kt}|\psi_{t-1}) + (1-\phi_i) \text{Var}_{t-1}(R_{it}|\psi_{t-1})
\]

(14)

where \( E(R_{it}|\psi_{t-1}) \) is the conditionally expected return on the local stock market index, \( R_{ft} \) the risk-free rate, \( r_{m,t} \) the excess return on the international stock market index, and \( s_{kt} \) the variation of the real exchange rate against the reference currency (in this case, the US dollar). \( \lambda_{i}^m \) is the price of global market risk, \( \lambda_k^s \) the price of foreign exchange risk of currency \( k \) against the reference currency, and \( \lambda_i^r \) the price of local risk in market \( i \). \( \phi_i \) corresponds to the degree of financial integration between the local and global markets and ranges between 0 and 1.

Fig. 4 depicts the time variation of the degree of financial integration of East Asian countries with the global market, and also the dynamics of regional integration in East Asian countries found in the previous section. Consistent with earlier studies on Asian financial integration, our results highlight that East Asian countries tend to be linked to the financial global markets rather than integrated with one another in the region, in particular during the period before the 2008–9 global crisis. Indeed, Fig. 4 shows a large gap between the two lines, representing the degree of regional (solid lines) and global (dotted lines) integration before the 2008–9 global crisis. At the end of the financial crisis (October
Fig. 4. Regional vs. international time-varying financial integration.
Notes: Authors' own calculations. Shaded areas indicate crisis. Solid lines indicate regional financial integration and dotted lines indicate international financial integration.
2009), the gap already exists but it is largely reduced in comparison with the beginning or middle of the study period.

Fig. 4 indicates that regional financial integration increased after each crisis (1997–8 and 2008–9). Indeed, the agreements developed by East Asian countries (CMI, multilateralization of CMI, ABF, ABMI and an Asian Monetary Fund) helped to increase regional financial integration, which gradually caught up with global financial integration. The financial globalization process goes hand-in-hand with strong regionalization, as also demonstrated by Coudert et al. (2013).

This low level of financial integration within East Asia (before 2008–9) can be explained by several factors, in particular by global integration, which dominates regional integration. Indeed, investors experience some difficulties accessing information on a regional scale as opposed to the easy access inherent on a global scale. This, therefore, makes the cost of transactions relatively favourable with global markets compared to the regional market. Furthermore, the Asian financial market is mainly oriented toward the banking system, which is largely managed by Western financial institutions. Consequently, this promotes the financial integration of East Asia with the global markets to the detriment of the regional market. According to Kim et al. (2006), the low incentives for portfolio diversification within East Asia, and instability in exchange-rate regimes are considered to be the main causes of low financial integration within East Asia.

However, in a recent study, Park and Lee (2011) find that the share of developed economies as a percentage of emerging Asia’s total foreign assets has dropped significantly. They also show that emerging Asia’s foreign portfolio assets are increasingly being invested in the region, with intraregional asset holdings rising from 15 percent of the region’s total foreign asset holdings in 2001 to 27.6 percent in 2009. These findings are compatible with our empirical results, which highlight the significant increase in the degree of financial integration within East Asia after the global crisis.

Overall, the results indicate that our previous findings are not simply due to sample selection and that the methodology can be equally informative across regional and global markets. Therefore, the robustness of our results should also concern the period of study after the 2008–9 global crisis. Indeed, they contribute to the existing literature by highlighting a new phase of evolution that has appeared since the global crisis of 2008–9. This result can be explained by the benefits arising from new initiatives signed in early 2009, allowing these countries to strengthen their financial and monetary cooperation and, in particular, to protect their region against external shocks. Furthermore, following the seminal work of Eichengreen and Park (2005), which indicates that financial integration follows trade integration, we can explain this increase by looking at the strong regional trade integration in East Asian countries. Indeed, Asia’s share in world trade has increased in the last 25 years. Much of this increase is due to intra-regional trade, particularly with the emergence of China and a slight slowing by Japan.

We note that regional trade integration has been made possible despite the great diversity of domestic exchange-rate strategies that still characterized the area in 2012 (Table A3 in the Appendix). These dispersion practices in the field of exchange rates came after the 1997 crisis (Patnaik and Shah, 2010). Previously, a de jure or de facto currency peg on the US dollar was the rule (see Williamson, 2005, for a review) and exchange rates of the region evolved fairly harmoniously.

6. Conclusion

In this paper, we examine financial integration within East Asian countries. The main objective is to understand the difference between the evolution of regional and global integration, as well as the factors that drive market integration in these countries and evaluate their risk premia. To this end, we use the ICAPM and construct an Asian currency basket in order to obtain a reference currency in this area. Our empirical analysis is based on the multivariate GARCH-DCC approach with time-varying correlations. Our results, obtained over the 1990:01–2012:08 period, show that the East Asian stock markets were partially segmented (except for Japan) within their region until approximately 2008.

26 These results are also confirmed by, for example, Devereux et al. (2011).
27 See Henning (2009) for a discussion.
28 Detailed trade statistics (trade dependency and trade intensity index) are available upon request from the authors.
However, the recent period is characterized by an upward trend in the regional integration of stock markets. Our findings also show that the risk premium related to regional stock markets is significant for all countries.

Regional financial integration is an important issue for the different authorities and institutions in East Asian countries. Compared to the existing literature, this paper highlights a significant increase in the degree of regional integration in East Asian countries, especially after the 2008–9 financial crisis. A possible explanation is the growing regional trade integration between these countries. The question now is whether regional integration will continue to grow in line with integration with global markets. As demonstrated by Capannelli et al. (2009) and Yu et al. (2010), in order to increase financial integration within the region, it will be necessary to strengthen financial stability, to promote macroeconomic policy coordination (including intra-exchange rate stability) and to develop regional institutions. East Asian countries have taken various steps to improve regional financial cooperation and integration since the crisis of 1997–8. Improved regional financial cooperation together with various measures to protect themselves from external shocks, have likely contributed to this increased role of regional financial markets. The crisis of 2008–9 has also contributed to this trend.

Acknowledgements

We are grateful to the anonymous referees for their helpful comments. All remaining errors are ours.

Appendix

Table A1

<table>
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<th></th>
<th>Constant</th>
<th>DSTI</th>
<th>DTERM</th>
<th>DTI</th>
<th>XRMD</th>
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<td>-0.010</td>
<td>0.171</td>
<td>0.010***</td>
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<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.110)</td>
<td>(0.003)</td>
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<tr>
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<td>0.021</td>
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<td></td>
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<td>(0.198)</td>
<td>(0.052)</td>
<td>(0.836)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>IND</td>
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<tr>
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<td>(0.015)</td>
<td>(0.234)</td>
<td>(0.003)</td>
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<tr>
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<td>0.061***</td>
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<td></td>
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<td>(0.023)</td>
<td>(0.074)</td>
<td>(0.398)</td>
<td>(0.011)</td>
</tr>
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<td>KOR</td>
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<td>0.335*</td>
<td>0.065</td>
<td>0.052***</td>
<td>0.012***</td>
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<td>(0.193)</td>
<td>(0.149)</td>
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<td>-0.149</td>
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<td>0.013***</td>
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<tr>
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<td>(0.010)</td>
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<td>(0.027)</td>
<td>(1.194)</td>
<td>(0.002)</td>
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<td>PHIL</td>
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<tr>
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<td>(0.776)</td>
<td>(0.005)</td>
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<td>-0.051***</td>
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<td>(0.011)</td>
<td>(0.220)</td>
<td>(0.155)</td>
<td>(0.298)</td>
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</tbody>
</table>

Notes: Significant at 1% (***) , 5% (**) and 10% (*). Standard Deviations are given in parentheses. DSTI is the first lag of the monthly change of the short-term interest rate, DTERM is the first lag of the monthly change in the term spread, DTI is the first lag of the monthly change of default spread and XRMD is the first lag of the regional market dividend yields in excess of the risk-free rate. For country codes, see section 4.
Table A2
Estimation of the degree of regional integration based on information variables.

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<th></th>
<th>Constant</th>
<th>DSTI</th>
<th>DTERM</th>
<th>DTI</th>
<th>XRMD</th>
<th>B-J</th>
<th>L-B</th>
<th>White</th>
<th>ARCH</th>
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<td>CH</td>
<td>0.167***</td>
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<td>−3.229</td>
<td>−0.852</td>
<td>0.031**</td>
<td>5.267</td>
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<td>5.230</td>
<td>6.528**</td>
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<tr>
<td>HK</td>
<td>0.557***</td>
<td>−5.44***</td>
<td>−0.745***</td>
<td>−0.837</td>
<td>0.230***</td>
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<td>7.674**</td>
<td>11.371***</td>
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<td>IND</td>
<td>0.320***</td>
<td>−0.912</td>
<td>−0.672</td>
<td>−0.262***</td>
<td>0.245**</td>
<td>29.621***</td>
<td>15.336***</td>
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<td>JAP</td>
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<td>−0.701</td>
<td>0.631***</td>
<td>−0.112**</td>
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<td>7.799</td>
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<td>−0.315**</td>
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<td>−0.089**</td>
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<td>7.198</td>
<td>12.645**</td>
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<td>0.155***</td>
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<td>16.225**</td>
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<td>13.611***</td>
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<td>5.253</td>
<td>13.765</td>
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Notes: Significant at 1% (***), 5% (**), 10% (*). Standard Deviations are given in parentheses. DSTI is the first lag of the monthly change of the short-term interest rate, DTERM is the first lag of the monthly change in the term spread, DTI is the first lag of the monthly change of default spread and XRMD is the first lag of the regional market dividend yields in excess of the risk-free rate. B-J and L-B are, respectively, the Bera–Jarque and the Ljung–Box statistics. For country codes, see section 4.

Table A3
De facto classification of exchange rate arrangements.

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<tr>
<td>Currency board</td>
<td>Hong Kong</td>
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<tr>
<td>Crawl-like arrangement</td>
<td>China</td>
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<tr>
<td>Other managed arrangement</td>
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<td>Indonesia, Korea, Philippines, Thailand</td>
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<tr>
<td>Free floating</td>
<td>Japan</td>
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References

Lane, P.R., Milesi-Ferretti, G.M., 2007. The external wealth of nations mark II. J. Int. Econ. 73 (2), 223–250.
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