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Internationalization Versus Regionalization in the Emerging Stock Markets

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INTERNATIONALIZATION VERSUS REGIONALIZATION IN THE EMERGING STOCK MARKETS

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NON-TECHNICAL SUMMARY

Financial integration may bring about significant benefits to emerging economies, in providing them with additional sources of financing. Nevertheless, increased dependence on international financial markets makes countries vulnerable to contagion effects and sudden reversals of capital flows. Consequently, most governments in emerging countries have been very careful not to head for financial integration too rapidly, taking a series of gradual measures instead. As a result, the process of financial integration is not yet achieved in a number of countries. Hence, we need to assess the evolution of the process in order to know to what extent emerging countries are financially interconnected with the rest of the world.

In this paper, we aim at appraising the evolution of financial integration at both the global and the regional level. We focus on a sample of twelve emerging stock markets: six among them are located in Asia (India, Indonesia, China, Singapore, South Korea, Thailand), three in Latin America (Argentina, Brazil, Mexico), three in other regions (Russia, South Africa, Turkey). For each market, we consider the centered daily returns on the stock market index as the shock on the market.

First, we resort to rolling window ordinary least square (OLS) regressions. This allows us to measure the impact of advanced countries' stock markets on a given emerging stock market. More precisely, we estimate the extent to which a shock on the advanced countries stock index is transmitted to the local stock market index. As this impact has been evolving continuously through time, we run estimations on a daily basis over rolling windows of two-years from 1997 to 2012. In these regressions, we also estimate the impact of the regional stock market index (Asian, Latin American or other) on the stock index of each country belonging to this region. Second, we estimate the dynamic correlations between the advanced countries' stock market, the regional and the local stock market of each country belonging to this region by estimating a trivariate model.

Our empirical results show the profiles of the integration process are quite different over the period 1997-2012 and depend on the region and even the countries themselves. On the whole, we evidence an increasing financial integration for most emerging stock markets. Results also display

that the financial globalization process goes hand in hand with a strong regionalization, as countries' stock markets are mostly affected by the shocks stemming from their own area.

ABSTRACT

Globalization has led financial markets to be more and more correlated across countries, especially between advanced and emerging countries. We propose to shed light on the issue of financial integration in emerging countries by resorting to complementary econometric approaches. For that, we draw a parallel between the results from a rolling window OLS regression - evaluating to what extent shocks on regional and developed stock markets are passed through to emerging markets - and the results from a trivariate BEKK-GARCH model assessing the dynamic of integration in emerging markets While regional integration is by and large a central characteristic of most emerging stock markets, the pattern of financial shocks transmission turns out to vary substantially across countries and over time.

JEL Classification: C32, F36, G15.

Keywords: time-varying integration, emerging markets, stock markets, multivariate BEKKGARCH.

INTERNATIONALISATION OU REGIONALISATION DES MARCHES BOURSIERS EMERGENTS

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RESUME NON TECHNIQUE

L'intégration financière peut procurer des bénéfices significatifs aux pays émergents en élargissant leur accès aux financements internationaux. Cependant, une dépendance accrue vis-à-vis des marchés financiers mondiaux expose ces pays aux effets de contagion et, en particulier, aux retraits brusques de capitaux. En conséquence, beaucoup de gouvernements des pays émergents sont attentifs à ne pas aller trop vite vers l'intégration financière et optent pour une ouverture graduée. Ainsi, dans de nombreux pays, le processus d'intégration financière n'est pas encore achevé.

Dans ce document, nous cherchons à évaluer l'évolution de l'intégration des pays émergents aux marchés financiers mondiaux et régionaux. Nous nous concentrons sur un échantillon de douze pays émergents : six en Asie (Inde, Indonésie, Chine, Singapour, Corée du Sud, Thaïlande), trois en Amérique latine (Argentine, Brésil, Mexique), trois dans d'autres régions (Russie, Afrique du Sud et Turquie). Sur chacun de ces marchés, nous considérons le rendement quotidien de l'indice boursier.

Il s'agit de mesurer l'impact des indices boursiers des pays avancés ainsi que celui des indices régionaux sur un marché local émergent. Premièrement, nous estimons la façon dont un choc sur l'indice boursier des pays avancés se répercute sur l'indice boursier du pays émergent. Comme cet impact varie continûment au cours du temps, nous faisons les estimations (régressions par les moindres carrés ordinaires) sur une base journalière sur des périodes glissantes de deux ans entre 1997 et 2012. Dans la même régression, nous estimons aussi l'impact de l'indice boursier de la région émergente (Asie, Amérique latine ou autres) sur l'indice boursier de chacun des pays de la région. Deuxièmement, nous estimons simultanément (dans le cadre d'un modèle trivarié) les corrélations dynamiques entre les marchés boursiers des pays avancés, de la région et celui de chaque pays émergent appartenant à la région.

Nos estimations montrent que l'intégration financière revêt des profils différents sur la période 1997-2012 selon les régions et les pays eux-mêmes. Dans l'ensemble, l'intégration financière a été croissante sur la période pour la plupart des marchés boursiers. Les résultats montrent aussi que le processus d'intégration financière s'accompagne d'une forte régionalisation : les cours boursiers des pays sont surtout affectés par les chocs en provenance des marchés boursiers de leur propre région.

RESUME COURT

La globalisation financière a conduit à une plus forte corrélation des marchés financiers mondiaux et plus particulièrement entre ceux des pays avancés et émergents. Nous nous penchons ici sur la question de l'intégration financière des pays émergents en proposant des approches économétriques complémentaires. Pour cela, nous établissons un parallèle entre les résultats de régressions OLS en fenêtres glissantes – qui permettent d'évaluer dans quelle mesure les chocs sur les marchés régionaux ou avancés sont transmis aux pays émergents – et les résultats d'un modèle BEKK-GARCH trivarié estimant la dynamique de l'intégration de ces marchés émergents. L'intégration régionale ressort comme une caractéristique centrale de la plupart des pays émergents, bien que la transmission des chocs varie substantiellement d'un pays à l'autre ainsi qu'au cours du temps.

Classification JEL : C32, F36, G15.

Mots Clés : intégration variable, marchés émergents, marchés boursiers, BEKK-GARCH multivariés.

INTERNATIONALIZATION VERSUS REGIONALIZATION IN THE EMERGING STOCK MARKETS

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INTRODUCTION

The process of financial globalization started in the late 1980s has spurred international capital flows and also contributed to the development of capital markets in emerging countries. On the one hand, it is expected to bring about substantial benefits to emerging economies, such as an improvement in the allocation of savings and investments, a better intertemporal consumption smoothing and greater financial stability (Kim, 2000; Bekaert, 2003). On the other hand, increased dependence on international financial markets make countries vulnerable to sudden reversals of capital flows with potentially devastating effects; more financially integrated countries are also more likely to be submitted to contagion effects in case of adverse shocks in the global economy. As financial integration also bears these unpleasant consequences, most governments in emerging countries have been very careful not to apply it too promptly, taking a series of gradual measures instead. Consequently, even if started in the late 1980s, the process is not completely achieved in a number of countries. A key issue is then to appraise the evolution of financial integration, in order to assess to what extent emerging countries are now financially interconnected with the rest of the world (Bekaert, 2005; Arouri, 2010a; Arouri, 2010b).

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In this paper, we aim at assessing the degree of financial integration at both the global and the regional level. To do so, we first resort to a rolling window ordinary least square (OLS) regression (Lee, 2011), that accounts for the time-varying pattern of financial contagion emphasized by Bekaert (1995) and Carrieri (2007). Then we use a multivariate model with general autoregressive conditional heteroskedasticity (GARCH) for stock returns, as in deSantis (1997). We focus on a sample of twelve emerging stock markets: six among them are located in Asia (India, Indonesia, China, Singapore, South Korea, Thailand), three in Latin America (Argentina, Brazil, Mexico), three in other regions (Russia, South Africa, Turkey) over a daily sample spanning from 1997 to 2012.

The rest of the paper is organized as follows. Section 2 presents the theoretical basis for asset pricing in emerging stock markets, building on asset pricing theories, and starting from the consumption capital asset pricing model (CCAPM). Section 3 describes our empirical strategy for analyzing financial integration on emerging stock markets: rolling window OLS regression and trivariate BEKK-GARCH as well as compares both econometric methods. Section 4 presents and comments our results. Section 5 concludes.

1. THEORETICAL FRAMEWORK

1.1. The consumption capital asset pricing model (CCAPM): a starting point

The cornerstone of most asset pricing theories is the asset pricing equation, from the investor's maximization program (Cochrane, 2005). In the simplified framework of a two-period-model with one asset, the representative agent calculates the optimal amount of asset to buy by solving the following maximization program:

$$\begin{cases} \max\limits_{\{\xi\}} \; u(c_t) + \delta E_t\left[u(c_{t+1})\right] \\ c_t = y_t - p_t\xi \\ c_{t+1} = y_{t+1} + x_{t+1}\xi \end{cases} \qquad (1)$$

where u is the agent's utility function; c_t, its consumption in time t, y_t, its income; δ, the inter-temporal discount factor, ξ the quantity of asset purchased in time t, p_t, the asset-price, and x_{t+1}, the asset's pay off in $t+1$, i.e. the sum of the future asset price and dividends.

The first order condition determines the asset price:

$$p_t = \mathrm{E_t}\left[\delta \frac{u'(c_{t+1})}{u'(c_t)} x_{t+1}\right] \qquad (2)$$

Dividing equation (2) by p_t and decomposing the expected value, we get the asset's gross return R_{t+1}:

$$1 = \mathrm{Cov_t}[m_{t+1}, R_{t+1}] + \mathrm{E}_t[R_{t+1}] / R_f$$

where

$$m_{t+1} = \delta \frac{u'(c_{t+1})}{u'(c_t)} \quad (3)$$

is the stochastic discount factor (SDF) and $R_f = 1/\mathrm{E_t}[m_{t+1}]$ denotes the risk-free rate. Multiplying each member of Equation (2) by R_f and rearranging the terms, we obtain the standard equation for the asset return:

$$\mathrm{E_t}(R_{t+1}) = R_f + \lambda_t \beta_t \quad (4)$$

$$\lambda_t = \mathrm{Var}_t[m_{t+1}] / \mathrm{E}_t[m_{t+1}] \quad (5)$$

$$\beta_t = -\mathrm{Cov}_t[R_{t+1}, m_{t+1}] / \mathrm{Var}_t[m_{t+1}] \quad (6)$$

where λ_t can be considered as the conditionally expected price of risk and β_t measures the quantity of risk on the asset.

Factor pricing models attempt to draw a link between the stochastic discount factor and the beta representation, by relating the SDF m_{t+1} to empirically tractable, so-called "factors". Those factors are proxies for the SDF which reflects the path of marginal utility from consumption, and hence the path of consumption itself.

1.2. Link to the CAPM

The Capital Asset Pricing Model (CAPM) can be viewed as a particular case of the previous model, with a SDF linked to the return of a so-called "wealth portfolio" that includes all existing assets (Sharpe, 1964; Lintner, 1965; Merton, 1973; Fama, 2004). The wealth portfolio is defined as a claim to all future consumption; that is to say, the flow of payoffs is seen as the flow of consumption in future periods via a wealth effect on the households' permanent income, firms' investment and government's expenses. More precisely, the CAPM can be derived from the former model by using a log-utility function $u(c) = ln(c)$.

If we apply the same simplifying two-period framework as before, the SDF deduced from Equation (3) $m_{t+1} = \delta \frac{c_t}{c_{t+1}}$ is inversely proportional to consumption growth. Applying Equation (2), we see that the price of the wealth portfolio, denoted p^M_t, is proportional to consumption itself:

$$\boldsymbol{p}^{\mathbf{M}}_{\mathbf{t}} = \boldsymbol{E_t}\left[\delta \frac{u'(c_{t+1})}{u'(c_t)} c_{t+1}\right] \qquad = \delta \boldsymbol{c_t}$$

As a result, the return on the wealth portfolio is proportional to consumption growth. Thus, the SDF itself can be viewed as proportional to the inverse of the wealth portfolio's return. When linearizing, we get

$$m_{t+1} = a - b r^{M}_{t+1} \text{ , with } b > 0 \qquad (8)$$

where r^{M}_{t} is the return on the wealth portfolio. In practice, r^{M}_{t} is the return on the market portfolio replicating all assets available on the market.

Obviously, the CAPM model cannot work with only one asset as in the former simplifying framework, since it relates the return of one specific asset to that of the wealth portfolio.

The expected return of a given asset A is defined by re-writing Equations (5), (6) (7) for this specific asset.

$$\begin{cases} \mathrm{E_t}[r^{A}_{t+1}] = r_f + \lambda^{M}_{t} \mathrm{Cov}_t[r^{A}_{t+1}, r^{M}_{t+1}] / \mathrm{Var}_t[r^{M}_{t+1}] & (9) \\ \lambda^{M}_{t} = b \, \mathrm{Var}_t[r^{M}_{t+1}] / [\mathrm{a} - b \mathrm{E}_t[r^{M}_{t+1}]] & (10) \end{cases}$$

Applying Equation (9) to the expected return on the wealth portfolio itself (like a stock market index in a closed economy), we get:

$$\mathrm{E_t}[r^{M}_{t+1}] = r_f + \lambda^{M}_{t} \qquad (11)$$

1.3. Transposition in an international framework

The previous CAPM model described in Equations (8)-(11) directly applies in an international framework in the two polar cases of fully integrated or fully segmented markets. Under the simplifying assumption of no exchange rate changes, the difference of financial integration only stems from the definition of the market portfolio.

First, if financial markets were fully integrated, the market portfolio would be a world market portfolio composed by all assets in the world. Therefore the expected return on an asset in country i depends on its covariance with that of the world portfolio. Now, instead of considering a single stock in country i, we can also use Equation (9) to express the return on country i 's stock index as a function of that of the world portfolio :

$$\mathrm{E_t}[r^{i}_{t+1}] = r_f + \lambda^{W}_{t} \mathrm{Cov}_t[r^{i}_{t+1}, r^{W}_{t+1}] / \mathrm{Var}_t[r^{W}_{t+1}] \qquad (12)$$

where r^i_t stands for the return on country *i*'s domestic market portfolio, r^W_t the return on the world market portfolio and λ^W_t the world price of risk depending on the variance of the world market portfolio return as in Equation (10).

Second, if financial markets were completely segmented across countries, the same model would apply straightforwardly by restricting the market portfolio to the set of assets available in the country. In this case, the SDF, m^i_t would depend only on the return of country *i*'s stock index and this stock index would be determined as in equation (11) :

$$E_t[r^i_{t+1}] = r_f + + \lambda^i_t \quad (13)$$

where λ^i_t stands for the price of risk in country *i*.

Neither of these polar approaches –fully integrated or completely segmented- applies when dealing with emerging economies. In this case, the appropriate assumption to make is that their level of financial integration is partial and time-varying (Bekaert, 1995; Bekaert, 2005). Therefore, the appropriate model is a weighted average of the two cases represented in Equation (12) and (13) - fully integrated and completely segmented - with a time-varying weighting

$$E_t[r^i_{t+1}] = r_f + \Phi_{it}\, \lambda^W_t \mathrm{Cov}_t[r^i_{t+1}, r^W_{t+1}] / \mathrm{Var}_t[r^W_{t+1}] + (1-\Phi_{it})\, \lambda^i_t \quad (14)$$

where the weighting Φ_{it} stands for the degree of financial integration of country *i.*

1.4. Regional and international integration

We now split the world portfolio into a regional and an international component, in order to to determine if a country's stock index responds differently to shocks on stock returns coming from its own region or from the rest of the world. We suppose that the regional component, Asia, Latin America or others, varies across countries as it only involves the neighboring area of the given emerging country, whereas the international component is made of developed countries' stock index for all countries. The weight devoted to regional or developed countries should reflect the capital value of these assets, divided by the total capital value of the whole market.

$$r^W_{it} = w^{Ri}_t r^{Ri}_t + (1 - w^{Ri}_t)\, r^D_t \quad (15)$$

where r^{Ri}_t, (w^{Ri}_t) is the return (weight) of the market portfolio including all the assets of the region *Ri*, *Ri* being the region that country belongs to and r^D_t, the return (weight) of the market portfolio including all developed countries.

2. EMPIRICAL APPROACH

2.1. Data description

The sample is made of twelve emerging countries: six of them are located in Asia (India, Indonesia, the People's Republic of China, Singapore, South Korea, Thailand), three in Latin America (Argentina, Brazil, Mexico), three in other regions (Russia, South Africa, Turkey). The sample spans from 01/01/1997 to 30/06/2012 with daily data. The returns on equity markets are computed as the first log difference of the MSCI free-float adjusted price indices for emerging countries, regions and developed countries extracted from Bloomberg. They are all expressed in USD to account for the currency risk. We delete observations with missing data, in order to avoid replacing them by their previous values, which would yield zero returns and bias the estimations.

2.2. Estimation with rolling OLS

The estimation is aimed at measuring how a shock on regional or developed equity markets will be passed through to emerging countries. Thus, beforehand, all returns are regressed on a constant in order to be demeaned.

$$r^k_t = \mu^k + \varepsilon^k_t$$

for k = country i, region r or the synthetic index on developed countries d; the residuals of the regression ε^k_t are defined as the shocks on market k. Moreover the regional returns r^R_t are regressed on the returns of developed countries in addition to the constant, in order to capture their specific component. The explanatory variables can be taken in t or in t-1, to account for time difference between the sample countries (especially between Asia and Western countries).

$$r^R_t = \mu^R + \zeta_0 r^D_t + + \zeta_1 r^D_{t-1} + \varepsilon^R_t \qquad (16)$$

The econometric test for Equations (14) and (15) can then be written as:

$$\varepsilon^i_t = \beta^D_{it,} \varepsilon^D_t + \beta^R_{it,} \varepsilon^{Ri}_{t} + a_{it} + u_{it} \qquad (17)$$

where β^k_{it}, and a_{it} are coefficients to estimate and u_{it} the residual of the equation.

A fundamental characteristic of asset pricing in emerging markets is the time-varying pattern of financial integration. Therefore regression coefficients β^k_{it}, are time-dependant. Indeed, stability tests (such as Chow tests) performed on the coefficients estimated over the whole period have led us to reject the null hypothesis of no structural break.[1]

[1] These tests are not reported in the paper for the sake of brevity. They are available from the authors upon request.

As the estimation procedure ought to take into account the dynamic nature of the integration process, we resort to a rolling window OLS regression that provides coefficient estimates over a wide range of periods. We set the size of the window at two years (504 days). At each estimation, the window is rolled one day later. This method provides us with time-varying estimates for spillover effects stemming from regional and developed markets. The estimated coefficients $\beta^{D}_{it,}$ and $\beta^{R}_{it,}$ indicate to what extent a local emerging market will react to a shock occurring on a regional market or in developed countries.

We have added lags when estimating Equation (17). This would not have been necessary if financial markets were totally efficient, as a shock on one market would immediately be passed through to the emerging market. However, emerging stock markets have proved to be far from efficient (Arouri, 2010b). The OLS estimations performed on a fixed window show that the coefficients of the lagged values of shocks are often significantly different from zero (Appendix 1). When the coefficients of lagged values of shocks turn out to be significantly different from zero over the whole period (1997-2012), we include the shocks and their lagged values in the equation of interest.[2]

The inclusion of the stocks from a given emerging country in the regional index may lead to an upward bias in the estimation of financial integration between the country and the region, especially for countries with large market capitalization. To check for this possible bias, we have reconstructed for each emerging country a regional stock market index corresponding to the MSCI index, but excluding that very country. Because financial data for emerging stock markets capitalization are not available in the long run, we had to work with recent yearly data (the stock market capitalization for end-2010). It restricted the range of the sample used for testing the bias to the trading years 2010 and 2011, insofar as the unavailability of the data made it impossible to reconstruct a regional stock market index over the whole period[3]. We then performed two estimations of financial integration between the country and its region: one with the regional index including the country, the other with the regional index excluding the country. Finally, we tested whether the coefficient estimates $\beta^{D}_{it,}$ assessing the degree of financial integration were significantly different from each other. To do that, we perform a Student test on the difference of the coefficients estimated with the two indices, using heteroskedasticity and autocorrelation consistent standard errors (Newey, 1987). In all cases, we are unable to reject the null hypothesis that the coefficient estimates are not significantly different from each other. The results for two Asian countries with the largest market capitalization, China and India, are displayed in Appendix 2. This is a strong reason for thinking our estimates of financial integration are not biased, and therefore for working with the MSCI equity indices.

[2] To get a single measure of the spillover effects of regional and global shocks, we then sum the coefficient estimates for a shock and for its lagged value.

3 We used the yearly capitalization of the end-2010 to weight daily series of prices spreading over the beginning of 2010 to the end of 2011, thus not taking into account the evolution of stock market capitalization. In the current state of financial databases, this is however the only possible solution to test for the existence of a bias due to the inclusion of the country index in the regional index.

In this regression, we estimate spillover effects on emerging stock markets of shocks occurring at the regional and global levels. Thus our aim is to point at the transmission of shocks from regional and developed stock markets to emerging stock markets. In the next section, we analyze the co-movements between markets without presuming the sense of causality.

2.3. Multivariate GARCH analysis

Multivariate GARCH models are also able to give a measure for financial integration through estimating time-varying cross-market correlations. In this framework, we consider that the conditional correlation coefficient of country *i*'s stock market with its regional market and the developed stock markets is also a measure for its financial integration.

To assess the magnitude of co-movements of stock prices between a given emerging country *i,* its region and developed markets, we implement a multivariate GARCH model, following the works of (Bollerslev, 1988), (Bollerslev, 1994), (deSantis, 1997), (Wongswan, 2003) and (Silvennoinen, 2009). GARCH models are aimed at estimating conditional variances and covariances, taking into account their auto-regressive structure. Conditional variances and covariances are modeled as functions of their own lags, lagged squared returns and cross-products of returns).

In order to reduce the number of parameters to estimate, we consider a restricted specification, the trivariate BEKK-GARCH (Baba-Engle-Kraft-Kroner) of Engle (1995), as done by Tse (2002), Hunter (2006), and Beirne (2010). To do that, we estimate a diagonal version of the model, that has the attractive property that the conditional covariance matrices are positive definite by construction.

The variance-covariance matrix can be written as

$$H_t = \Omega + A'\varepsilon_{t-1}\varepsilon_{t-1}'A + B'H_{t-1}B \tag{18}$$

Where H_t is the time-dependant (3x3) symmetric matrix of variance-covariance, Ω, A and B are (3x3) diagonal matrices, and ε_{t-1} is the (3x1) column vector of shocks on the returns. We use the standard procedure for estimation (deSantis, 1997), assuming that the shocks on returns ε_t follow a conditional multivariate Gaussian distribution N(0, H_t). We then maximize the likelihood function, which amounts to maximizing the following term

$$L = -\frac{1}{2}\sum_{t=1}^{T}\left[\log|H_t| + \varepsilon_t' H_t^{-1}\varepsilon_t\right] \tag{19}$$

2.4. Interpreting the two estimations

With the GARCH method, we do not assume that the interplay between emerging, regional and developed stock markets is led by one of those markets. The estimated covariances (hence, the coefficients of correlation) comprise both the influence of regional and developed markets on a given emerging market, and the influence of this market on its region and on developed countries. This is one reason why estimations from the multivariate GARCH analysis and the rolling window OLS regression differ. For instance, comparing the influence of the developed countries to that of the region, does not give necessarily the same results with the two methods. We may find a higher regression coefficient for shocks from developed countries in the OLS regression, but a lower correlation coefficient for these shocks than those of the region.

This is the case for example for Mexico: the developed markets (in fact the US one) have a strong impact on the Mexican one, explaining the high regression coefficient; however, if we consider the other way round as in the correlation coefficient, the Mexican market has much weaker correlation with the developed countries than with the Latin American region.

Besides, covariances or coefficients of correlation are crucial to investors, since it determines the risk of their portfolios. Thus correlations between emerging, regional and developed stock markets can be viewed as a tool for understanding and predicting investors' behavior and stock markets movements.

3. EMPIRICAL RESULTS

Consequently, our estimations yield two series of time-varying measures of financial integration for each country. The first ones are the coefficients of the recursive OLS estimations depicted on Figure 1, which represent the sensitivity of country's *i* stock market returns to shocks on the regional and developed stock markets (the $\beta^{D}_{it,}$ and β^{R}_{it} in Equation (19)). The second ones are the conditional correlations estimated by the trivariate GARCH, between country's *i* stock market returns and regional and advanced markets returns, which are shown on Figure 2.

3.1. Asia

Asian stock markets appear to be highly integrated at the regional level. Indeed, the impact on the stock market of a regional shock is higher than that of a shock from developed countries, for all the considered Asian countries in the sample. This result holds with the two methods used, OLS or BEKK-GARCH (Figures 1 and 2). Asian stock markets are also affected by shocks on developed stock markets, though to a lesser extent. The results from the trivariate BEKK-GARCH model also show that shocks on Asian stock markets are increasingly correlated with shocks stemming from regional and developed markets. This result, in line with previous studies (Bekaert, 2005; Guesmi, 2011 and Lee, 2011), supports the idea of a growing process of financial integration on Asian emerging markets.

Despite the upward trend shown by the correlation with developed countries, the correlation with regional shocks is still higher for all Asian markets in the sample. Those results are consistent with those of Guesmi (2011) and with the coefficients of correlation estimated by (Lee, 2011). [4]

The increase of the correlation between domestic, regional and developed stock markets is especially remarkable for countries such as China, India and Indonesia. Many Asian countries, including Korea, Singapore and Thailand, had relatively high levels of correlation with regional stock markets from the beginning of the period, which grew very little over time. This may be due to the crisis that hit most of these countries at the beginning of the period. On the opposite, the correlation with the equity markets of developed countries was weak and rose considerably over the past fifteen years.

Regional integration is especially strong in countries such as China, Korea and Singapore, whose correlation coefficients with the region are, since the mid-2000's, near or higher than 0.8 (against 0.4 with developed countries). For other Asian countries of our sample, the correlation coefficients with the region are slightly lower but still substantial (0.6 at the end of the period).

The Chinese and Korean markets are particularly affected by a regional shock and even overreact to them at the end of the period, as a 1% shock on the regional market returns triggers a 1.2 % increase on the stock returns of both countries according to the OLS estimations, whereas the impact is smaller than one for other countries. A 1% shock on the returns of developed countries spills over to a change by 0.6 / 0.8% on average on the Chinese and Korean markets; for other countries, this impact is lower, close to 0.4 / 0.5 on average in the OLS estimations. The fact that the impact of regional and developed stock returns is more important on the Chinese and Korean markets is confirmed by our results using a trivariate BEKK-GARCH estimation procedure.

India has a relatively unique profile. In 1997-98, it was little affected by “the Asian crisis”, unlike the rest of the sample (as shown by the OLS coefficients of regional shocks displayed on Figure 1). Over time, shocks on regional and developed countries markets start having a larger impact on the Indian stock market, with however a sharp drop in 2004. Such an evolution is in line with the process of increasing integration shown by the multivariate GARCH analysis. Reversely, Indonesia has been strongly affected by the Asian crisis, with a coefficient of sensitivity to regional shock that was around 2. Since 2000, this ratio has sharply declined, before gradually recovering and stabilizing, which is consistent with the results of the trivariate BEKK-GARCH estimation.

[4] However, they contrast with the general conclusion given by Park (2011) that finds equity markets of emerging Asia more integrated globally than regionally. Their result may be due to the fact that their variable for world stock returns includes industrialized countries as well as emerging countries, which may bias the estimate for the impact of worldwide shocks upwards.

Figure 1: Time-varying coefficients measuring spillover effects on an emerging stock market of a shock on regional (blue) and developed (red) markets, and local variations of emerging stock returns (green). Estimation procedure: rolling window OLS regression.

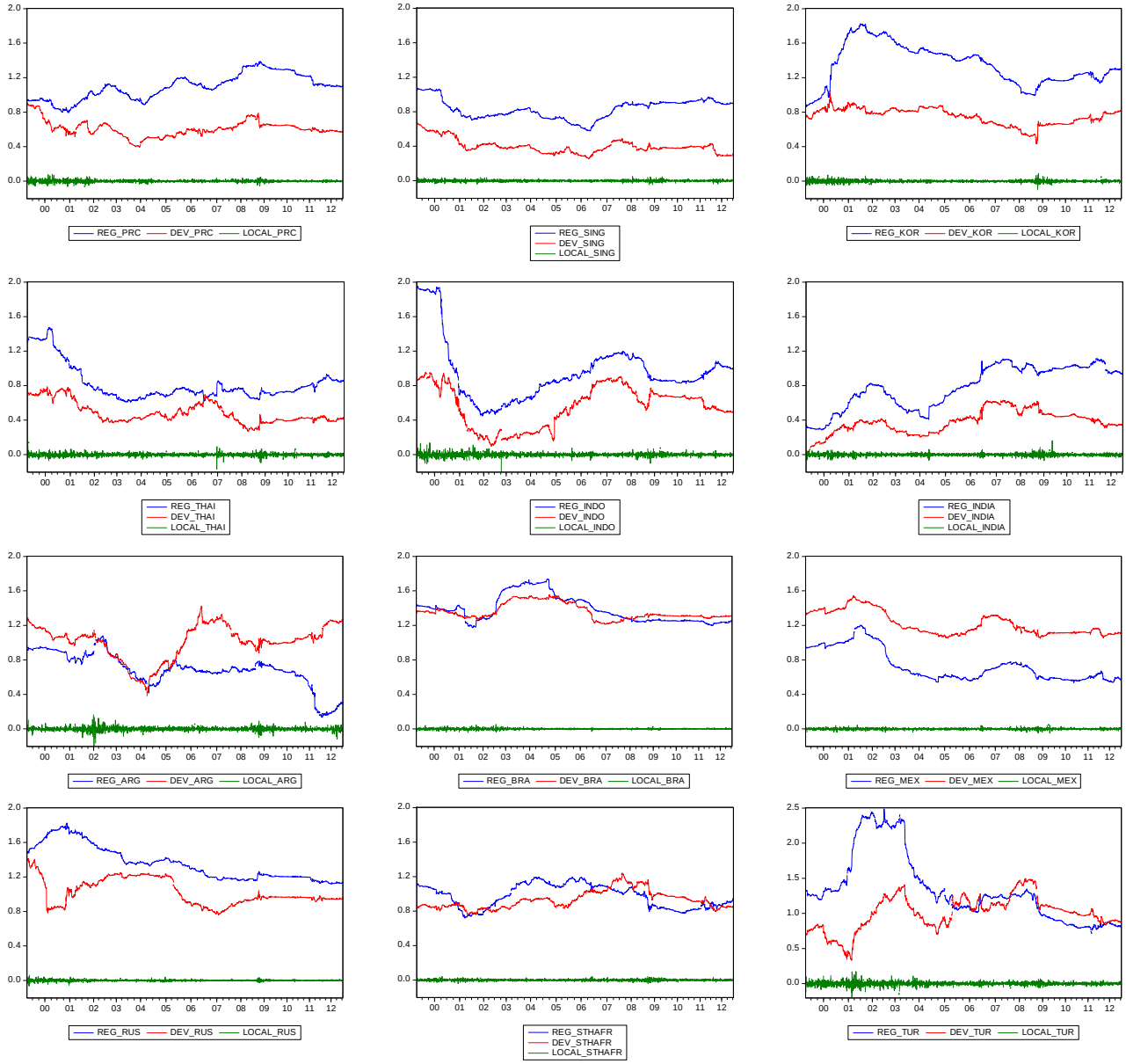
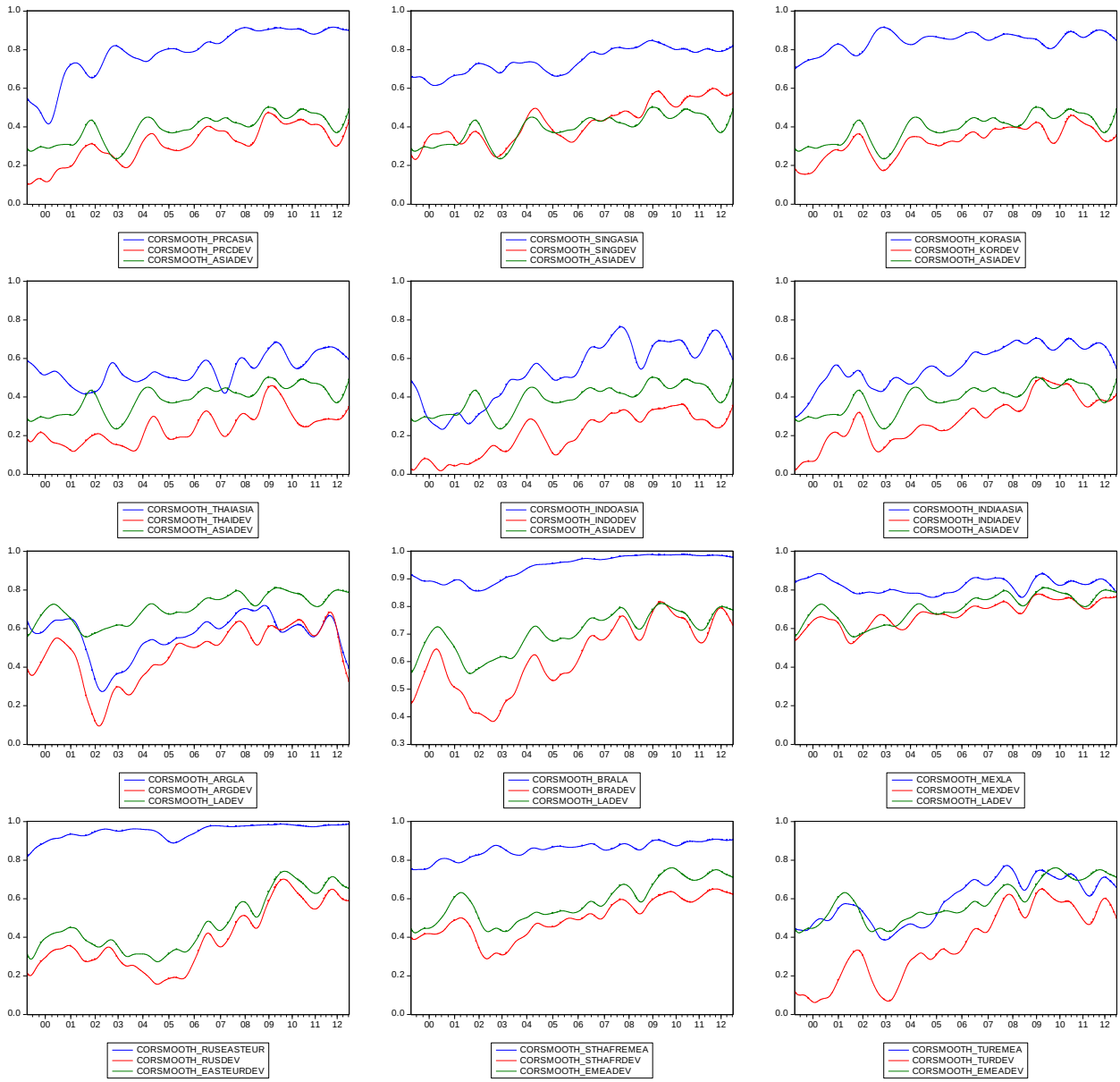


Figure 2: Time-varying correlation coefficients (HP filtered) between the returns on emerging stock markets and on the regional market (blue), on developed markets (red), and between the returns on regional and developed stock markets (green). Estimation procedure: trivariate BEKK-GARCH.



3.2. Latin America

Financial integration appears quite high at a regional as well as a global level in both estimations for Latin America. This result is consistent with Arouri (2009), and Adler (2003) for the specific case of Mexico. Moreover, both correlations with regional and developed stock markets presumably follow an upward trend, which evidences a growing and ongoing process of financial integration, in line with the results found by Arouri (2010a), who conclude to an increase in Latin American markets correlations with developed and regional markets, since 1994. Our estimations also point out that correlations are higher with the regional stock markets than with advanced markets on the bulk of the period, although this characteristic tends to disappear at the end of the period for Argentina and Mexico.

Except these broad common features, the path of financial integration is very different across the three considered countries. As regards to Argentina, its financial opening has been fluctuating over the period, as the 2001 financial crisis isolated the country from international markets. After the crisis, the Argentinean stock market became less sensitive to international shocks - whether stemming from developed or regional markets. Consequently, the regression coefficients shown on Figure 1 as well as the time-varying-correlations on Figure 2 with international markets dropped sharply in the immediate aftermath of the crisis.

Over the bulk of the period, shocks stemming from developed countries generate higher impact than regional ones on the Argentinean and Mexican markets. This is in line with the results found by Dufrenot et al. (2011) using a different methodology.

Results show that both types of shocks yield similar impacts on the Brazilian stock market. Capital controls introduced in late 2008 in Brazil may have slowed down the financial integration process. In addition, it is notable that the impact of these shocks appears relatively stable on the horizon considered.

3.3. Other countries: Russia, South Africa and Turkey

Since the beginning of the period, the Russian and South African stock markets have been strongly correlated with their regional markets, with correlation coefficients greater and close to 0.8 in 1999. These coefficients have increased a little, so that since the 2008 crisis the Russian and the regional markets have been almost perfectly integrated, with a correlation coefficient close to 1.

The path of integration to developed markets is quite different, as the correlations were low at the beginning of the period, 0.4 for South Africa and 0.2 for Russia. These coefficients have been growing continuously over time and are now close to 0.6, which reflects the ongoing financial integration between the South African and the Russian markets, and developed markets. Our results for Russia are in line with those of Guesmi (2011), who find a correlation coefficient between Southeastern European markets and developed markets of 0.5 for the period 1996-2008.

As regards to Turkey, the situation is quite different. At the beginning of the period, the Turkish equity market was little correlated with regional and developed equity markets. Then, the correlations increased a lot, and the Turkish market became more integrated, at the regional level and in a lesser extent with developed countries. Nevertheless, compared to other countries, the correlation of Turkey with regional stock markets remains relatively low (around 0.6). The impact of external shocks on the Turkish market, especially variations of regional stock prices, had increased and reached a peak in 2003. Since then it collapsed towards a still high but stable level.

All over the period, the Russian market is more impacted by shocks on the regional market than by shocks on developed markets. However, this gap tends to narrow over time. Since 2008, the sensitivity coefficients of the Russian market to shocks on regional markets and on developed countries markets have been quite stable and have converged respectively towards 1.1 and 0.9. South Africa shows more complex patterns of financial contagion. Except during the year 2001 probably because of the 9/11, the South African market appeared more affected by a regional shock than by a shock from developed countries, during the first period. However, since 2005 the coefficient measuring sensitivity to shocks on developed markets has started to increase and was by far above the one related to regional shocks in 2008. It has decreased since. At the end of the period, in 2011/2012, the impact of regional shocks seems now bigger than the impact of shocks stemming from developed markets.

4. CONCLUSION

The large number of financial crises that affected emerging and developed markets during the last two decades has given a pivotal importance to financial integration and contagion issues, especially when dealing with financial stability. This paper, using a trivariate BEKK-GARCH approach and rolling window OLS regressions, proposes a measure of financial integration for twelve emerging equity markets, both at the regional and global levels. Our empirical results show the profiles of the integration process are quite different over the period 1997-2012 and depend on the region and even the countries themselves. In Asia, for instance, financial integration has been increasing very rapidly. Indeed, at the beginning of the period, most Asian stock markets were lowly integrated at both regional and global levels This is also true for Russia, South Africa and Turkey. On the other hand, in Latin America at the beginning of the 2000's, the correlations of the countries' stock markets with their regional markets were already high, especially for Brazil and Mexico and remained stable over time. Meanwhile, the correlation of Latin American stock markets with the developed markets steadily increased, reflecting a deeper financial integration with developed countries.

On the whole, we evidence an increasing financial integration for most emerging stock markets. Results show that the financial globalization process goes hand in hand with a strong regionalization, as countries' stock markets are mostly affected by the shocks stemming from their own area.

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APPENDIX

Appendix 1: Estimated β^{D}_{i} and β^{R} coefficients of the OLS regression

$\varepsilon^{i}_{t} = \beta^{D}_{it,}\, \varepsilon^{D}_{t} + \beta^{R}_{it,}\, \varepsilon^{R}_{t} + a_{it} + u_{it}$ with lags for the last two-year period (June-2010-June-2012)

Period: 2010-2012	Variable	Coefficient	Std. Error	t-Statistic	Prob.	Adj. R^2
India	RESID2_ASIAEXJAP	0.804754	0.047301	17.01363	0.0000	0.475874
	RESID2_ASIAEXJAP(-1)	0.087335	0.047047	1.856324	0.0639	
	RESID_DEV	0.179647	0.043587	4.121556	0.0000	
	RESID_DEV(-1)	0.292605	0.043301	6.757432	0.0000	
Indonesia	RESID2_ASIAEXJAP	0.993055	0.049579	20.02956	0.0000	0.534289
	RESID2_ASIAEXJAP(-1)	-0.028737	0.049314	-0.582742	0.5603	
	RESID_DEV	-0.027514	0.045687	-0.602214	0.5472	
	RESID_DEV(-1)	0.560730	0.045387	12.35429	0.0000	
Korea	RESID2_ASIAEXJAP	1.290348	0.037360	34.53798	0.0000	0.787584
	RESID2_ASIAEXJAP(-1)	-0.022193	0.037160	-0.597214	0.5506	
	RESID_DEV	-0.025930	0.034427	-0.753193	0.4516	
	RESID_DEV(-1)	0.830361	0.034201	24.27858	0.0000	
PRC	RESID2_ASIAEXJAP	1.163424	0.025133	46.29093	0.0000	0.858116
	RESID2_ASIAEXJAP(-1)	0.004483	0.024998	0.179324	0.8577	
	RESID_DEV	-0.081255	0.023160	-3.508436	0.0005	
	RESID_DEV(-1)	0.681560	0.023008	29.62290	0.0000	
Singapore	RESID2_ASIAEXJAP	0.725374	0.027608	26.27369	0.0000	0.759042
	RESID2_ASIAEXJAP(-1)	-0.070629	0.027460	-2.572047	0.0103	
	RESID_DEV	0.332663	0.025441	13.07584	0.0000	
	RESID_DEV(-1)	0.363236	0.025274	14.37190	0.0000	
Thailand	RESID2_ASIAEXJAP	0.783138	0.052415	14.94121	0.0000	0.422082
	RESID2_ASIAEXJAP(-1)	-0.086356	0.052134	-1.656425	0.0981	
	RESID_DEV	0.042667	0.048300	0.883369	0.3774	
	RESID_DEV(-1)	0.493651	0.047983	10.28807	0.0000	
Argentina	RESID_LATAM	0.257002	0.075475	3.405137	0.0007	0.427242
	RESID_LATAM(-1)	0.175546	0.075531	2.324146	0.0204	
	RESID_DEV	1.224106	0.055541	22.03951	0.0000	
	RESID_DEV(-1)	-0.133159	0.055495	-2.399452	0.0167	
Brazil	RESID_LATAM	1.254876	0.011585	108.3154	0.0000	0.980686
	RESID_LATAM(-1)	-0.034689	0.011594	-2.991970	0.0029	
	RESID_DEV	1.291604	0.008526	151.4967	0.0000	
	RESID_DEV(-1)	-0.008397	0.008519	-0.985722	0.3246	
Mexico	RESID_LATAM	0.548333	0.030829	17.78626	0.0000	0.796398
	RESID_LATAM(-1)	0.038764	0.030852	1.256439	0.2094	
	RESID_DEV	1.085935	0.022687	47.86617	0.0000	
	RESID_DEV(-1)	-0.003735	0.022668	-0.164767	0.8692	
Russia	RESID_EASTEUR	1.102956	0.011274	97.82934	0.0000	0.970953
	RESID_EASTEUR(-1)	0.024488	0.011222	2.182042	0.0295	
	RESID_DEV	0.954526	0.011930	80.01380	0.0000	
	RESID_DEV(-1)	0.029444	0.012018	2.450006	0.0145	
Turkey	RESID_EMEA	0.809017	0.054595	14.81843	0.0000	0.545135
	RESID_EMEA(-1)	0.044626	0.054175	0.823722	0.4104	
	RESID_DEV	0.844898	0.048361	17.47071	0.0000	
	RESID_DEV(-1)	-0.066906	0.049075	-1.363338	0.1732	
South Africa	RESID_EMEA	1.057374	0.025594	41.31310	0.0000	0.875381
	RESID_EMEA(-1)	-0.109608	0.025397	-4.315744	0.0000	
	RESID_DEV	0.794161	0.022671	35.02911	0.0000	
	RESID_DEV(-1)	0.042568	0.023006	1.850255	0.0647	

Appendix 2: Test for the bias due to the inclusion of the emerging countries' stocks in regional indices)

The following table shows the coefficients of the degree of financial integration of an emerging stock market with its regional market. For each country, the first line corresponds to the OLS estimate of the country regional integration when the country's stocks are included in the regional index, while the second line represents this estimate when they are not. Student's t-statistics correspond to the test of the null hypothesis that the two coefficients estimates are the same. We fail to reject the null hypothesis, which means that the two coefficient estimates are not significantly different.

		Coefficient	Std.dev.	T-stat
India	included	0,34549	0,05617	0,22163
India	excluded	0,32794	0,05581	
Korea	included	0,41172	0,06644	0,68836
Korea	excluded	0,34705	0,06641	
PRC	included	0,69280	0,05812	1,76167
PRC	excluded	0,55180	0,05503	

Appendix 3: MSCI indices

The ticker codes used for the countries, regions and developed countries are the following:

- Argentina MXAR Index
- Brazil MSEUSBR Index
- Mexico MSEUTMXF Index
- Latin America MSEUEGFL Index
- India MSEUSIA Index
- Indonesia MSEUSINF Index
- Korea MSEUSKO Index
- Popular Republic of China MSEUSCF Index
- Singapore MSDUSG Index
- Thailand MSEUSTHF Index
- Asia (Japan excluded) MXASJ Index
- Russia MSEUSRUS Index
- South Africa MSEUSSA Index
- Turkey MSEUSTK Index
- Developed countries MXWD Index

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