International portfolio diversification: An ICAPM approach with currency risk

Dimitriou, Dimitrios and Simos, Theodore

Department of Economics, University of Ioannina, University Campus, 45110 Ioannina, Greece, Department of Economics, University of Ioannina, University Campus, 45110 Ioannina, Greece

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Dimitrios Dimitriou

Department of Economics, University of Ioannina, University Campus, 45110

Ioannina, Greece, e-mail: ddimi@cc.uoi.gr

Theodore Simos

Department of Economics, University of Ioannina, University Campus, 45110

Ioannina, Greece e-mail: tsimos@cc.uoi.gr

Abstract

This article investigates international stock market integration in largest (based on nominal GDP and purchasing power parity GDP) four developed namely USA, EMU, Japan and UK and two Asian emerging namely China and India international stock markets over the period June 1994 to June 2009. To model stock market integration we estimate a dynamic version of international capital asset pricing model (CAPM) in the absence of purchasing power parity. Conditional variance is modeled via a multivariate GARCH specification. To investigate the evolution of integration overtime we estimate the CAPM in sub-periods. In addition, we connect our results to the timing of world financial crises. Our findings show that the stock markets tend to move in parallel after June of 2002, although from 2002 to 2006 there have not been crises events. These results, supports the increasing globalization and interdependence of both emerging and developed markets in the recent decade, reducing the benefits of portfolio diversification.

Key Words: International markets; Market integration; Financial crises; MGARCH-M specification;

JEL classification:: F36, C52, G15

1 Introduction

This paper concentrates on three issues regarding international portfolio diversification via stock market integration among world market and largest[1] four developed (USA, EMU, Japan and UK) and two Asian emerging markets (China and India). First, we investigate the evolution of stock market integration since mid-1990. Subsequently, we study the effect of financial crises on stock market integration. While there are evidence that markets integration intensified over time (Bekaert and Harvey, 1995) it is less clear whether financial crises affect world market integration. Thirdly, we examine possibilities of portfolio diversification for worldwide investors. Financial managers worldwide have become increasingly active in emerging markets. China and India play a significant role as reformed regulations and laws to foster stock market development and attract foreign portfolio flows. The speed and extent of stock market development in emerging countries have been unprecedented and have led to fundamental shift both in the financial structures of less developed countries and in the capital flows from developed nations.

Specifically, India after a balance of payments crisis in 1991 which forced the nation to liberalize its economy; since then it has slowly moved towards a free-market system by emphasizing both foreign trade and direct investment inflows. India has been a member of WTO since 1 January 1995. According to IMF its average annual GDP growth rate of 5.8% over the past two decades, and reaching 6.1% during 2011–12, India is one of the world's fastest-growing economies. Also, Indian market has the distinction of having the second largest number of listed companies after the USA. As per Standard and Poor’s Fact Book 2007, India ranked 8th in terms of market capitalization and 15th in terms of turnover ratio as of December 2007. India posted a turnover ratio of 84% at end of 2007.

Furthermore, after Hong Kong returned to mainland China on first July 1997 and joined the World Trade Organization (WTO) at 2001, the economic growth in China increased sharply. Meanwhile, China’s financial system deregulation and liberalization attracted more foreign capital inflows increasing globalization. According to the IMF, China's annual average GDP growth between 2001 and 2010 was 10.5%, and the Chinese economy is predicted to grow at an average annual rate of 9.5% between 2011 and 2015. In late 2010, China surpassed Japan's GDP for the first time, with China's GDP standing at $5.88 trillion compared to Japan's $5.47 trillion. China thus became the world's second-largest economy after the United States. As a consequence, markets like China and India where their stock markets are undergoing significant transformation with liberalization measures, and the analysis of the nature of integration with world market would not only give an idea of the possible gains to be reaped out of portfolio diversification from Chinese and Indian market, but may also provide some indication of the vulnerability of their stock markets in case of a regional financial crisis and consequent reversal of capital flows from their regions.

Initially, the literature studied developed markets, but over the last two decades much of the focus has shifted to the diversification benefits offered by emerging markets[2]. However, the financial and currency crises and other macroeconomic issues experienced the globe the last fifteen years, the possibilities for international portfolio diversification among developed markets is a subject for examination. Financial managers wanting to optimize their stock selection can now be seen to face another issue; namely, they will need to address the question of whether or not the recent financial crises have resulted in significant changes in the world integration between developed and emerging markets.

Previous studies on international market integration have focused mainly on one source of risk or on the effects of a single or a region of markets on other stock markets. For example, Fratzscher (2002) analyzes the integration process of European equity markets since the 1980s and focus on the role that EMU has played in the process of financial integration. The study develops a GARCH methodology with time-varying coefficients to analyze and compare the role of these three factors. The results indicate that EMU has indeed fundamentally altered the nature of financial integration in Europe. Arouri and Jawadi (2010) investigate the evolution of the US risk premium in periods of crisis using a

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[1] According to CIA World Factbook, at 1st January 2011, EMU, USA, Japan and UK compared to nominal GDP and GDP (PPP) are in first four positions among developed countries. Also, from the above source, China was 2nd after USA and India 4th after USA, China and Japan compared to GDP (PPP). Compared to nominal GDP, China is 2nd after USA and India 11th after seven developed countries China, Brazil and Russia.

[2] For early studies documenting the benefits of international diversification, see Solnik (1974) for developed markets and Errunza (1977) for emerging markets. For more recent evidence, see for example Erb, Harvey and Viskanta (1994), DeSantis and Gerard (1997) and Bekaert and Harvey (2000).

conditional CAPM with time-varying systematic risk and price of risk using a multivariate GARCH-in-Mean model. They found that the US risk premium increased significantly during periods of crisis and that the last 2007-2009 financial crisis has had the largest impact. Also, Kim et al. (2005) examine the influence of the EMU on the dynamic process of stock market integration using a bi-variate EGARCH framework with time-varying conditional correlations. However, several studies, including Roll (1988), Hamao et al. (1990), Lau and McInish (1993), Rahman and Yung (1994), and Meric and Meric (1997), document a significant increase in correlations and volatility transmission between equity markets during, and after, the 1987 international equity market crash. Recently, Kenourgios et al. (2011) support the herding behavior after the 2008 US subprime crisis among five emerging Balkan markets.

All these studies provide empirical evidence on time-varying integration between markets. However, there are two drawbacks. Firstly, they focus only on a region or a country that an economic event takes place. Secondly, they ignore currency risk.

To address these shortcomings in existing literature our study empirically investigates the evolution of four developed and two emerging global markets integration with world stock market. Also, we examine the role of world largest financial crises played on world integration. Finally, our analysis tests an international CAPM in the absence of PPP (Dumas and Solnik, 1995; De Santis and Gerard 1998;) which takes account the currency risk. Theoretical international asset pricing models such as those of Dumas and Solnik (1995), Hietla (1989), and Adler and Dumas (1983) all conclude that currency risk is priced into asset returns when purchasing power parity (PPP) is violated due to either the violation of law of one price (LOP) or different consumption tastes. However, in an empirical context, whether this risk is a priced factor in international financial markets is still inconclusive. For example, utilizing Ross's (1976) APT model, Jorion (1991) find that currency risk is not priced in U.S. data during the period of 1971–1987. However, Prasad and Rajan (1995) conclude that currency risk is priced in the U.S. market using data from industry portfolios over the period 1981–1989 and in both Japan and UK markets during the period of 1986–1989. Their test result shows that currency risk is pervasive and therefore is priced in an international setting. According to standard portfolio theory if the effect of currency risk does not vanish in well-diversified portfolios, exposure to this factor should command a risk premium in the sense that investors are willing to pay a premium to avoid this systematic risk. In this case, hedging policies can affect the cost of capital of a firm and the firm who actively engages in currency hedging is justifiable. On the other hand, if currency risk is diversifiable, investors are not willing to pay a premium for firms with active hedging policies since investors can diversify the currency risk themselves. Similarly, Adler and Dumas (1983) after examination of the impacts of PPP deviations in investors' portfolio choices, suggest that PPP deviations have significant size; they last for lengthy but variable periods and are highly random. So, they suppose that investors residing in different countries have different yardsticks for measuring real returns and their risks.

The purpose of this paper is to explore the issue of possible diversification benefits for international investors on developed markets namely USA, EMU, Japan, UK and two important emerging equity markets, China and India. So, we estimate and test a dynamic market integration model with a parsimonious MGARCH-M parameterization. This methodology has three advantages. First, a joint test of market integration and currency risk factor is conducted based on a dynamic ICAPM. Second, the price of common risk is allowed to be time-varying. This time-varying price of risk is economically appealing in the sense that investors use all available information to form their expectations about future economic performance, and when the information changes over time, they will adjust their expectations and thus their expected risk premia when holding different risky assets. Third, the MGARCH-M process is employed in order to model the conditional covariance matrix of asset returns and common risk factors jointly. The advantage of this multivariate approach is that it utilizes the information in the entire variance–covariance matrix of the errors, which, in turn, leads to more precise estimates of the parameters of the model. In addition, many issues in finance can only be fully addressed within a multivariate framework. Based on the fully parameterized dynamic ICAPM in the absence of PPP, we are able to provide strong evidence regarding the world market integration in under examination markets compared to previous studies. Our results, based on daily data over the June 1996 to June 2009 period containing four sub-periods, indicate that the stock markets of the EMU, China and Japan are not integrated, in the period from June 1994 to June 1998 with the US stock market. Also, for the period June 1998 to June 2002 only India are not integrated with the world market. The results suggest that the relatively high integration of these markets with the world market may be not appropriate for international diversification and international investors should look for other new emerging markets.

The remainder of this paper is organized as follows. Section two motivates the theoretical dynamic ICAPM. Section three presents the econometric methodology. Section four discusses the data and reports the empirical results. Section five concludes.

2 The dynamic ICAPM

Assuming a fully integrated global financial market, for which purchasing power parity holds, the domestic CAPM of Sharpe (1964) and Lintner (1965) can be extended to an international setting. The conditional version of the model can be stated as follows

$$E_{t-1}(r_{i,t}) = \lambda_{w,t-1} Cov_{t-1}(r_{i.t}, r_{w,t}) \tag{1}$$

$$E_{t-1}(r_{w,t}) = \lambda_{w,t-1} Var_{t-1}(r_{w,t}) \tag{2}$$

where $E_{t-1}(r_{i,t})$ is the conditionally expected excess return on the market index of country i; $E_{t-1}(r_{w,t})$ the conditionally expected excess return on a world market index; $\lambda_{w,t-1}$ the time varying price of world market risk; $Cov_{t-1}(r_{i.t}, r_{w,t})$ the conditional covariance between the excess returns of country i's market index and the world market index; $Var_{t-1}(r_{w,t})$ is the conditional variance of the excess return on the world market index. In this model of fully integrated markets, only world covariance risk is priced in global equity markets, and the expected returns are not affected by domestic factors.

In completely segmented markets and under the same assumptions as Eq. (1), the conditionally expected excess return on the country i's market index will only depend on its country-specific risk, and can be written as

$$E_{t-1}(r_{i,t}) = \gamma_i Var_{t-1}(r_{i,t}) \tag{3}$$

where γ_i is the time-invariant price of country-specific risk. However, a country may not be fully integrated with or segmented from the global financial market. Errunza and Losq (1985) extended the international CAPM to account for mild segmentation between markets. In this case, the expected returns are a function of the two risk factors: exposure to world market risk and exposure to non-diversifiable country-specific risk. The conditional version of this model can be written as

$$E_{t-1}(r_{i,t}) = \lambda_{w,t-1} Cov_{t-1}(r_{i.t}, r_{w,t}) + \gamma_i Var_{t-1}(r_{i,t}) \tag{4}$$

Since existing literature (e.g., Ferson and Harvey, 1994; Dumas and Solnik, 1995; De Santis and Gerard, 1998; among others) has documented that currency risk is one of the price factors in global financial markets due to the violation of PPP, in this paper we modify the model in Eq.(4) in order to incorporate the currency risk into the model. The modified conditional ICAPM in the absence of PPP can now be expressed as

$$r_{i,t} = \lambda_{w,t-1} h_{iw,t} + \lambda_{c,t-1} h_{ic,t} + \gamma_i h_{i,t} + \varepsilon_{i,t} \tag{5}$$

$$r_{w,t} = \lambda_{w,t-1} h_{w,t} + \lambda_{c,t-1} h_{cw,t} + \varepsilon_{w,t} \tag{6}$$

$$r_{c,t} = \lambda_{w,t-1} h_{cw,t} + \lambda_{c,t-1} h_{c,t} + \varepsilon_{c,t} \tag{7}$$

where r_w is the excess return on the world market index; r_c the return on a currency index; $h_{i,t}$ the conditional variance of country i's market index; $h_{w,t}$ the conditional variance of the world market index; $h_{c,t}$ the conditional variance of currency returns; $h_{iw,t}$ the conditional covariance between returns on country i's market index and the world market index; $h_{ic,t}$ the conditional covariance between returns on country i's market index and the currency index; $h_{cw,t}$ the conditional covariance between currency return and the return on the world market index; With this modified conditional ICAPM, the test of market integration and currency risk pricing can be conducted jointly. That is after including potential world market and currency risk premia, we want to see if there is any return variation left that could be explained by the conditional volatility of the underlying market.

To allow for time-varying world market and currency risk prices, we model their dynamics according to the theoretical asset pricing model developed by Merton (1980). In his model, the price of world market risk is the coefficients of risk aversion of investors, and thus is expected to be positive. Consequently, along the lines of Bekaert and Harvey (1995), De Santis and Gerard (1997, 1998) and Tai (2007) we use an exponential function to model the dynamic of $\lambda_{w,t-1}$ and a linear specification to model the dynamic of $\lambda_{c,t-1}$ because the theoretical model does not restrict the price of currency risk to be positive. As a result, the dynamics of risk prices can be described as

$$\lambda_{w,t-1} = \exp(\phi_w^{'} z_{t-1}) \tag{8}$$

$$\lambda_{c,t-1} = \phi_c^{'} z_{t-1} \tag{9}$$

where z_{t-1} = {CONSTANT, DUSTP, USDP, WORLD} is a vector of instruments observed at the end of time $t-1$ and ϕ's are time-invariant vectors of weights. One-month Eurodollar interest rate is used as conditionally risk-free rate to compute excess returns on all indices. In particular, the excess stock return is computed as $r_{i,t} = \ln(p_t / p_{t-1}) - 1/365(\ln(1+i_{t-1}^{US\$})$ where p_t is either the market total return index or Datastream world market total return index (dividend included) expressed in US dollars at time t and $i_{t-1}^{US\$}$ is the annualized 1-month Eurodollar interest rate known at time $t-1$. Furthermore, to proxy the currency risk we utilize the log first difference of the trade-weighted U.S. dollar price of the currencies of major industrialized countries (TWFX). We select a set of instrumental variables that have been widely used in the international asset pricing literature (e.g., Harvey, 1991; Bekaert and Hodrick, 1992; Ferson and Harvey, 1993; Bekaert and Harvey, 1995; De Santis and Gerard, 1997, 1998; Tai, 2007; among others). They are the change in the US term premium, measured by the first difference of the yield difference between 10-year Treasury constant maturity rate and 1-month Eurodollar rate (DUSTP), the US default premium, measured by the yield difference between Barclay's BAA - rated and AAA - rated U.S. corporate bonds (USDP), the lagged excess return on world return index (WORLD) and a constant (CONSTANT). Under full market integration, γ_i should not be statistically significant, otherwise there is evidence of partial, at least, market segmentation.

3 Econometric methodology

Estimation of the conditional ICAPM requires the specification and estimation of the conditional variances. A popular parameterization is the BEKK specification, first proposed by Baba et al. (1989). The advantage of this parameterization is that it guarantees the covariance matrices of the system to be positive definite. However, it still requires researchers to estimate a large number of parameters. Alternatively, Ding and Engle (2001) proposed a parsimonious BEKK model by assuming that A and B are diagonal matrices[3]. We adopt the later specification that allows us to reduce the number of estimated parameters. In this case the conditional variance–covariance matrices of the asset returns is given by

$$H_t = \Omega\Omega^{'} + A\varepsilon_{t-1}\varepsilon'_{t-1} A^{'} + B\, H_{t-1} B^{'} \tag{10}$$

where Ω is lower triangular matrix of constants and A and B are $N \times N$ diagonal parameter matrices. We focus on a GARCH (1,1) specification[4] since it has been shown to be a parsimonious representation of conditional variance that can adequately fit many econometric time series (Tim et al.,

[3] In a diagonal system with N assets, the number of unknown parameters in the conditional variance equation is reduced from $2N^2 + (N(N+1))/2$ under full BEKK specification to $2N + (N(N+1))/2$ under the diagonal BEKK specification

[4] We also estimated different specifications of the model. However, the results were qualitatively equivalent. The results are available upon request.

1988). Under the assumption of normality we utilize the full information maximum likelihood (FIML) to estimate Eq. (5), (6) and (7). The FIML estimates can be obtained by maximizing the log-likelihood, which can be written as

$$\ln L(\theta) = -\frac{TN}{2}\ln 2\pi - \frac{1}{2}\sum_{t=1}^{T}\ln|H_t(\theta)| - \frac{1}{2}\sum_{t=1}^{T}\varepsilon_t(\theta)' H_t(\theta)^{-1}\varepsilon_t(\theta) \tag{11}$$

where θ is the vector of unknown parameters, N is the number of series in the system and T is the number of observations. This log likelihood function is maximized by using the Marquardt algorithm.

4 Econometric estimation of ICAPM

The data set employed covers the period from June 1994 to June 2009. It includes daily US-dollar denominated returns[5] on stock indices for six major in terms of capitalization international financial markets, one Datastream index for EMU stock market and a value-weighted world market index proxy for the world market risk. The six stock markets are: USA, EMU, UK, Japan, China and India. All data are extracted from Datastream. The dynamic ICAPM with time-varying world market and currency risk prices are stated in Eqs. (5)–(7), (8) and (9). Estimation results are reported in Table 1. Notice that all instruments are used with one time lag, (see for example Tai, 2007). Our target is to investigate the evolution of integration of the four developed and two emerging markets with the world stock market as well as the influence of financial crises on integration. During the last decades, a series of financial and currency crises occurred, many carrying regional or even global consequences: the 1997 "Asian Flu," the 1998 "Russian Cold," the 1999 Brazilian devaluation, the 2000 Internet bubble burst, the July 2001 default crisis in Argentina and the 2007 world financial crisis that it is not yet ended. So, in order to examine the impacts of financial crises in integration process we split our data set in four sub-periods. The second and forth sub-periods are mostly periods of financial crises. Table 1 reports the results of dynamic ICAPM. The statistics reported in Panel A show that most of the selected instruments are statistically significant explaining the risk prices $\lambda_{w,t-1}$ and $\lambda_{c,t-1}$. Also, there are evidence of dependence of all markets with the world and currency risk measures. Panel B of Table 1 presents estimates of parameters γ_i. EMU, China and Japan are not fully integrated in first period. In the second period only India is not fully integrated. An explanation for India's partial integration is that its market has not been influenced from crises occurred in other areas of the world. In the third and forth period all markets are fully integrated reflecting an additional world market general tendency towards integration during the last decade, reducing the benefits of portfolio diversification. Further, the US subprime crisis does not change the degree of integration among them, supporting the view of increasing integration with world market at recent years. As mentioned above, second and fourth period characterized as crises periods. Following the existence literature, among developed markets the crises does not affect their integration degree, because it is already high. However, fourth period does not affect any of the markets under examination, indicating the increasing degree of openness and liberalization of China and India the last decade.

Table 2 reports diagnostic testing performed on the standardized residuals for the purpose of assessing the fit of the dynamic ICAPM with the MGARCH-M specification. In panel C, Ljung–Box Portmanteau statistics tests the null hypothesis of zero autocorrelation in the standardized residuals. The test statistics LB(571) [6] are reported in Panel C of Table 2. In all cases the null hypothesis is accepted indicating additionally that the volatility process is correctly specified.

However, as suggested by Engle and Ng (1993), the Ljung–Box test may not have much power in detecting misspecifications related to the asymmetric effects. For this purpose we employ the set of diagnostics proposed by Engle and Ng (1993)[7]. These tests are based on the news impact curve implied

[5] As suggested by Bekaert and Harvey (1995), calculating the returns in U.S. dollars eliminates the local inflation.

[6] According to Burns (2002) study, he found evidence that the test starts to deteriorate as the number of lags exceeds 5% of the length of the series; however the number of lags should not exceed 15% of the length of data. Under these results, the percent test is valid. In our case the 571 lags are approximately 14% of the length of our data.

[7] Engle and Ng (1993) asymmetric tests include the sign bias, the negative size bias, and the positive size bias tests. The sign bias test examines the impact of positive and negative innovations on volatility not predicted by the model. The squared standardized residuals are regressed against a constant and a

by a particular ARCH-type model. The premise being that if the volatility process is correctly specified, then the standardized residuals should not be predictable based on observable variables. The results reported at Panel C show that most of the test statistics are statistically insignificant, suggesting no strong evidence of misspecification.

In Panel D, the parameters of the conditional mean process are all statistically significant at 1% level, indicating that the MGARCH process is well specified. Also the condition for covariance stationarity is satisfied in all cases[8].

Figure 1, shows the conditional volatility calculated for the all sample period for each market. The conditional volatility has increased in all under examination markets and indices after June 2006, since the US subprime crisis started. This rise of volatility indicates the increasing interdependence among markets because an event, such as subprime crisis, occurred in USA affected all under examination markets in a high degree.

5 Conclusion

In this work we analyzed market integration of four developed and two emerging stock markets with a world stock market index supporting the view that both largest developed and emerging stock markets have become more integrated over the last years. Moreover it offers empirical evidence suggesting that the recent international financial crisis i.e. US subprime crisis does not influence the overall degree of integration. However, from mid-1990 until 2002 there are some opportunities for diversification among emerging markets and not yet currency unified EMU, after 2002 all markets are completely integrated with world market, eliminating diversification benefits. The findings of the paper highlight the fact that higher integration implies that there are fewer opportunities to diversify portfolios, thus providing incentives to focus more on other new emerging markets such as Indonesia and Taiwan.

The impact of China and India on the international financial system is fundamentally linked to the evolution of their domestic financial systems, including their exchange rate and capital account liberalization policies. As both China and India are likely to undergo further financial development and liberalization, these countries are set to have an ever-increasing impact on the international financial system. In view of their increasing share in global GDP, we have argued that the nature of their integration with the international financial system is likely to be reshaped.

For policy makers, the short run dynamics of financial integration poses some challenges. Financial integration has increased competition and market efficiency and, at the same time, has made individual stock markets increasingly interdependent. Such rising interdependence may thus require prudential supervisors and security market overseers that adopt a global view.

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dummy S_t^- that takes the value of unity if ε_{t-1} is negative, and zero otherwise. The test is based on the t statistic for S_t^-. The negative (positive) size bias test examines how well the model captures the impact of large and small negative (positive) innovations, and it is based on the regression of the squared standardized residuals against a constant and $S_t^-\varepsilon_{t-1}((1-S_t^-)\varepsilon_{t-1}$. The computed t-statistic for $S_t^-\varepsilon_{t-1}((1-S_t^-)\varepsilon_{t-1}$ is used in this test.

[8] For the process in H_t to be covariance stationary, the condition $a_i a_j + b_i b_j < 1 \forall i, j$ has to be satisfied. (see, e.g., Bollerslev, 1986; De Santis and Gerard, 1997, 1998).

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Coefficient estimates of ICAPM: Eqs: (5),(6) and (7)								
	Periods of estimation							
	1st period		2nd period		3rd period		4th period	
Time varying price of risk (Panel A)	6/1994 -	6/1998	6/1998 -	6/2002	6/2002 -	6/2006	6/2006 -	6/2009
Φ_w (World risk)	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Constant	1.40***	0.014	1.306***	0.000	2.39***	0.000	-1.20*	0.093
DUSTP	-272.09	0.104	-77.88	0.364	-553.41***	0.000	2.96	0.967
USDP	28.66**	0.038	-18.90***	0.001	5.04***	0.000	-21.11***	0.000
WORLD	-59.29***	0.000	-65.18***	0.000	-83.15***	0.000	-33.50***	0.000
Φ_c (Currency risk)	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Constant	10.86*	0.074	-21.25*	0.097	-40.61***	0.000	-8.20	0.449
DUSTP	24594.81**	0.048	-154.83	0.937	-753.66	0.374	986.50	0.429
USDP	233.21	0.403	-915.18**	0.039	1436.91***	0.000	-349.42***	0.000
WORLD	15329.95***	0.000	2276.03***	0.001	-1273.69	0.329	2141.02***	0.000
(Panel B)								
γ_ι (Domestic risk)	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
Developed markets								
UK	3.36	0.228	-1.05	0.499	1.10	0.308	0.73	0.221
EMU	4.93**	0.010	-0.79	0.483	-0.37	0.607	-0.30	0.455
Japan	-3.42***	0.000	-1.04	0.289	-1.42	0.162	-1.23	0.166
USA	1.23	0.441	0.86	0.104	0.21	0.728	0.35	0.350
Emerging markets								
India	-1.96	0.269	-3.78***	0.005	0.24	0.776	-0.48	0.536
China	-1.32**	0.022	0.06	0.952	0.14	0.881	0.24	0.604

*denotes 10% statistical significance,**denotes 5% statistical significance, ***denotes 1% statistical significance

Table 1: FIML Estimation of Dynamic ICAPM for developed and emerging markets.

Market	UK	EMU	CHINA	JAPAN	USA	INDIA	D-W.I.	T.W.F.X.
Diagnostic Tests (Total period)								
Engle and Ng Test (Panel C)								
Sign Bias Test	-0.02	-0.32	-0.07*	-0.007	-0.14***	-0.13***	-0.07	0.004
(t-stat.)	(-0.53)	(-0.68)	(-1.69)	(-0.14)	(-3.35)	(-3.08)	(-1.69)	(0.09)
Positive S.B.T	-0.15***	-0.04	0.13***	-0.018**	-0.19***	0.05*	-0.018	0.03
(t-stat.)	(-4.89)	(-1.32)	(4.60)	(-0.54)	(-6.48)	(1.69)	(-0.54)	(1.08)
Negative S.B.T	-0.07**	-0.12***	-0.02	-0.09***	-0.37***	-0.02	-0.009	-0.08**
(t-stat.)	(-2.40)	(-3.75)	(-0.65)	(-2.74)	(-12.24)	(-0.90)	(-0.28)	(-2.58)
Ljung Box test	Inter. markets							
L-B(571) [Q-stat]	45861.73	[0.6296]						
Cond/nal. Variance Process Eq: (10)	*(Panel D)*							
a_i	0.23***	0.25***	0.24***	0.25***	0.27***	0.33***	0.17***	0.24***
(t-stat)	(36.62)	(45.48)	(28.95)	(46.08)	(40.95)	(37.14)	(30.84)	(38.39)
b_i	0.96***	0.96***	0.96***	0.96***	0.96***	0.93***	0.98***	0.96***
(t-stat)	(569.29)	(617.79)	(414.11)	(572.14)	(541.67)	(244.78)	(870.09)	(553.08)

*denotes 10% statistical significance, **denotes 5% statistical significance, ***denotes 1% statistical significance.

Table 2: Diagnostic Tests and Conditional Variance Process for Dynamic ICAPM

Figure 1. Conditional Variance for developed and emerging stock markets