Integration in Futures Markets

Anutchanat Jaroenjitrkam
Thammasat University
Department of Finance
Thammasat Business School
Bangkok, Thailand 10200
E-mail: anutchanat@tbs.tu.ac.th

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ABSTRACT

Integration in futures markets is extended the understanding of this area. The integration index is created following Pukthuanthong and Roll (2009). The outcome display the similarity in the movement but the variance in the level between futures and stock markets. There is sharp declining in futures markets integration in 2012 and 2013 due to the decreasing in futures markets volatility, which is possibly extended in future research.

1. Introduction

Although there are many studies of market integration in equity markets, the study of market integration in futures markets is rare. Both of underlying and derivatives markets share some common characteristics. However, the rules that regulate the markets, and trading method are different, such as, margin requirement, trading hours, securities maturity, and etc.

One evidence of difference in characteristics of these markets is that Andersen (1996) investigates noise trading in equity and futures markets. The findings show that noise trading dominates in the equity market, but informed trading dominates in futures markets (Holmes and Tomsett, 2004). Therefore, the information in futures market should be reflected better than that in the underlying equity markets leading to the hypothesis that the degree of integration in these two markets may be different as the integration in futures markets is expected to be higher than that in stock markets.

The higher degree of financial market integration is associated with the lower cost of capital, which can lead to the efficiency in capital accessing. This study will provide the information in financial market integration with the different data. Most previous studies concentrate to examine the behavior in emerging stock markets. This study explores the

integration with broad sample and focuses on futures markets. The results also present the higher degree of integration in futures markets than that in spot markets, which is consistent with the hypothesis.

The organize of this study is that section 2 reviews previous literatures. Section 3 describes the data used. Section 4 explains the methodology applied. Section 5 shows the empirical results, and section 6 is conclusion and discussion.

2. Literature Reviews

Kearney and Lucey (2004) review the literatures of financial market integration, and categorize the definition of market integration into two types - direct and indirect measures. Direct measure indicates that financial market integration is where the law of one price applied such that in different markets assets with similar risk profile should have the same price. Indirect measure describes financial market integration with liberalization and deregulation policy.

There are studies of market integration in an aspect of the law of one price. Errunza and Losq (1985) test hypothesis of mild segmentation by dividing assets into two groups - eligible and ineligible assets[1], and grouping investors to two types - restricted and unrestricted investors[2]. They study the integration between nine emerging markets and US. The result is not statistically significant to the mild segmentation hypothesis. Errunza, Losq, and Padmanabhan (1992) test the market integration of emerging markets with international asset pricing model (IAPM). They do not find the fully integration nor fully segmentation.

Another approach of financial market integration is financial liberalization. If the markets have higher degree of liberalization, investors are able to invest in various markets, or the

1 Eligible assets are priced as if the market is integrated. On the other hand, ineligible assets are priced as if the market is segmented.

2 Restricted investors hold portfolios of eligible securities and diversified portfolio. Unrestricted investors hold world market portfolios. Unrestricted investors have larger investable securities universe than restricted investors.

barriers of investment are less. Khanthavit and Sungkaew (1993) measure Thailand's barriers to investment between Hong Kong, Japan, Singapore, UK, and US. They apply the single-latent-variable and GMM estimation to estimate the level of barriers between Thai and these markets. The findings are diverse in each market.

Some literatures examine the relation between investment barriers and market integration. Bekaert (1995) measures the market integration with the correlation of excess return in 19 emerging markets with excess return in US market. Then, he measures the correlation between market integration and investment barriers. There are two types of investment barriers - direct and indirect barriers.[3] The outcomes identify that changes in indirect barriers affect the market integration more than changes in direct barriers.

Moreover, dates of events of financial liberalization development is essential in the study of financial market integration. Bekaert, Harvey, and Lumsdaine (2002) investigate the date of world equity markets integration. They employ a reduced-form model to study the structural break in emerging markets. They conclude that actual break dates do not correspond to official dates of capital market reforms (see Laopodis, 2004).[4]

Bekaert and Harvey (2003) examine the market integration and market liberalization with regime switching model. They state that the liberalization increases small level of correlation in world markets, and reduces cost of capital.

Nishiotis (2004) explores the impact of indirect barriers, which the definition is consistent with Bekaert (1995), on market segmentation. He measures the market segmentation with the difference between US closed-end funds and domestic closed-end funds in nine

3 Direct barriers are ones defined legally, such as, ownership structure, taxes, and etc. Indirect barriers can be explained by accounting standards, investor protection, and opportunities provided to foreign investors.
4 Laopodis (2004) uses announcement date, which is not the actual date of liberalization to investigate market integration of Athens stock exchange. He finds that the markets are not cointegrated after liberalization.

emerging countries.[5] The results show that indirect barriers can lead to market segmentation even in the inexistence of the restriction of capital flow. From the previous literatures, we can infer that liberalization plays vital roles on the development of market integration especially indirect barriers.

Time-varying market integration is another issue in market integration. Research questions whether it is constant through time, and whether the level can be reverse are investigated. Bekaert and Harvey (1995) apply a conditional regime-switching model to measure the degree of the market integration. They conclude that the degree of market integration is time varying, but does not present the increasing trend through time.

De Jong and De Roon (2005) use the fraction of noninvestable assets to world assets as a proxy of market segmentation. This allows time-varying market integration. The decreasing in market segmentation leads to the reducing of returns.

Yu, Fung, and Tam (2010) study the financial market integration in Asian stock markets with several methods[6]. The results show the low degree of integration during 2002 - 2006, and the increasing level in 2007 and 2008, which can imply that the degree of integration is higher just before and during crisis period.

The existence of time-varying market integration guides to the development of integration index. Carrieri, Errunza, and Hogan (2007) apply GARCH-in-mean to asset pricing model. They create integration index with R-square from the asset pricing model. They also find that financial liberalization is a significant factor of market integration.

Pukthuanthong and Roll (2009) (thereafter PR) use the principal component analysis to

5 Nine emerging countries are Brazil, Chile, Mexico, Philippines, India, South Korea, Malaysia, Thailand, and Taiwan.

6 The methods include cross market return dispersion, Haldane & Hall (1991) Kalman filter method, dynamic cointegration analysis, common component approach, market cycle synchronization, and dynamic conditional correlation (DCC) model.

find global factors. These factors are independent variables in an asset pricing model of returns of stock market index. R-square from the regression presents the degree of integration similar to Carrieri et al (2009). They find the rising in market integration especially during the bear market.

Carrieri, Chaieb, and Errunza (2013) create integration index with the R-square from IAPM in Errunza and Losq (1985). The integration index does not show the increasing trend all the time. They also display that the improvement in implicit barriers related to institutional environment, corporate governance, and quality of information.[7]

The previous studies in financial market integration focus on stock markets and most of them focus on emerging markets. Hence, this study will concentrate on integration among futures markets and applying the method of PR (2009).

3. Data

The daily data employed in this study covers the period of January 2007 to December 2013. The futures prices are from DataStream continuous series[8]. If there are several indexes in one market, I choose the one that has the longest available period. There are 33 futures markets in the database. The inactive markets are excluded; therefore, only 28 markets are left for this research. Table 1 shows the list of the countries used in this study.

** Table 1 is here. **

Data is converted from its local currency to USD in order to remove the noise from

7 Institutional environment proxies are the rating from the Political Risk Services' International Country Risk Guide political risk index, and the origin of the legal system of the country. Governance environment proxies are investor protection, and ownership structure. Information environment proxies are related to analysts coverage and accounting disclosure.

8 According to the definition of DataStream, the series used in this study is a perpetual series of futures prices. It starts at the nearest contract month, which forms the first price for the continuous series until either the contract reaches its expiration or until the first business day of the notional contract month, which ever is sooner. At this point prices from the next trading contract month are taken. No adjustment for price differentials is made.

exchange rate. The data of January 1 is removed since it is a holiday in almost of every country. However, other holidays are not common in all countries, so the return is computed from the previous daily price for the holiday country.

4. Methodology

4.1 Estimation of global factors

PR(2009) include 82 countries from 1973 to 2004 in their study. Due to broad and depth of the data, they divide the data into three cohorts and use 17 markets in the first cohort to estimate global factors. However, futures markets do not have long history like stock markets. Thus, I do not separate the data to multi-cohort, and I use 11 countries, which have the longest series in DataStream among 28 sample countries, to estimate global factors.

Principal component analysis is employed to estimate the common factors. Connor and Korajczyk (1988)[9] and PR (2009) are also used this method. Principal components are estimated from 11 countries. The largest six eigenvalues can explain more than 90 percent of variance. Figure 1 presents the average cumulative percentage of variance of 11 countries across seven sample years. Only the first component explains 61% and other five factors totally explain about 31%. This evidence is consistent with PR(2009) proving the validity of multiple global factors.

** Figure 1 is here **

Figure 2 shows the cumulative variance each year of the first six principal components. The explanation power is slightly different each year, and declining in 2012 and 2013.

** Figure 2 is here **

9 Connor and Korajczyk (1988) apply an asymptotic principal component analysis to estimate dependent variables in a multivariate regression of the arbitrage pricing theory. They conclude that the APT can explain the expected return better than CAPM.

Estimated eigenvalues are used to calculate the weights of returns of each market. The weight from the previous year will be used with returns in the year later. Therefore, the weights estimated in year 2007 - 2012 are used with the return in year 2008 - 2013, respectively. The eigenvalues of each country are separately estimated, and that country itself is excluded when estimated in order to prevent the high principal component weightings in the particular country. Different time zone is another concern. This study follows the practice of PR(2009) by including one-day lagged return of North American countries because it is the last trading region.

4.2 Measurement of market integration

The return of futures markets are explained by common global factors as shown in equation (1), which is similar to PR(2009). The advantage of this estimation is that it does not restrict to any specific asset pricing model.

$$R(i,t) = \alpha(i) + \sum_{n=1}^{N} \beta(i,n) f(n,t) + \varepsilon(i,t) \quad (1)$$

where R(i,t) is the return of futures market in country i at time t.

f(n,t) is the global factor n at time t

ε(i,t) is the error term

If the return is mostly explained by common global factors, the R-square should be high, and this shows the market integration. This can create measurement of the integration index (Carrieri et al, 2007, and PR, 2009) as:

$$\text{integration index} = 1 - \frac{Var(\varepsilon)}{Var(R)} \quad (2)$$

The advantage of R-square measurement over correlation is that the cross-market correlation of futures market return is not a good proxy of market integration. The correlations can be small, while markets are perfectly integrated because each market may have different sensitivity to the same factors (Carrieri et al, 2007). However, R-square has a drawback that it is biased by heteroskedasticity (Forbes and Rigobon, 2002).

After finding the R-square of each country, then I find average values to measure the integration level in each period. If the integration index equals one, it means that the markets are perfectly correlated.

5. Empirical results

Figure 3 shows the average of adjusted R-square.

** Figure 3 is here **

The level of market integration changes slightly over the studying period. However, it declines in 2012 and 2013. The result is different from PR(2009), which measures the level of integration among stock markets from 1974 to 2007. Their findings show the increasing trend in the degree of the market integration. Moreover, the degree of market integration of developed markets is much higher than that of emerging markets. The changes of integration level of emerging markets are steeper than those of developed markets.

Lehkonen (2014) also applies the method of PR(2009) to study market integration of stock markets from 1987 to 2011. The results indicate that the degree of integration boosts at the early stage of the crisis, but during the crisis the integration level slightly changes. Comparing the intersection period of 2008-2011, the pattern of adjustment in the integration level between Lehkonen (2014) and this study is similar. I also find the high degree of integration in 2008, which is a period of subprime crisis, and it marginally declines in 2009.

The integration index shows the time-varying integration degree, and it does not always increase through time. The interesting finding is the sharp declining of integration level in 2012 and 2013. The volatility of these two years are less than the previous years, and this may be the reason of the declining of integration. The explanation is consistent with the findings of Solnik, Boucrelle and Le Fur (1996) that the correlation across markets increases in periods of high volatility.

6. Conclusion and Discussion

This study creates the integration index of futures markets. The movement of the index of futures markets is similar to that of the index of spot markets, but the degree is different. The index also shows that the integration level changes and not always increases through time. One reason that may explain the declining in the integration level in 2012 and 2013 is the decreasing of the volatility of market returns. However, this issue can possible be developed by investigate the solid evidence that explain this movement, such as, the QE policy, and etc. Moreover, the structural change in futures markets is another possible extension of this research.

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Table 1: List of futures markets and their sample periods.
28 active futures markets are retrieved from DataStream. The continuous series used in this study is a perpetual series of futures prices. It starts at the nearest contract month, which forms the first price for the continuous series until either the contract reaches its expiration or until the first business day of the notional contract month, which ever is sooner. At this point prices from the next trading contract month are taken. No adjustment for price differentials is made. The price of futures contracts are US dollar denominated.

Country	Name	DS Mnemonic	Exchange	Underlying Name	Underlying Mnemonic	DataStream Start Date	Trading Cycle
United States	CME-S&P 500 INDEX CONTINUOUS	ISPCS00	Chicago Mercantile Exchange	S&P 500 COMPOSITE	S&PCOMP	23-Apr-82	Mar, Jun, Sep, Dec
United Kingdom	LIFFE-FTSE 100 INDEX CONTINUOUS	LSXCS00	NYSE Euronext Liffe	FTSE 100	FTSE100	3-May-84	Mar, Jun, Sep, Dec
Brazil	BMF-BOVESPA INDEX CONTINUOUS	BMICS00	BM&F Bovespa	BRAZIL BOVESPA	BRBOVES	14-Feb-86	Feb, Apr, Jun, Aug, Oct, Dec
Hong Kong	HKFE-HANG SENG INDEX CONTINUOUS	HSICS00	Hong Kong Futures Exchange	HANG SENG	HNGKNGI	18-Jan-88	All
Japan	TSE-TOPIX INDEX CONTINUOUS	JSXCS00	Osaka Securities Exchange	TOPIX	TOKYOSE	5-Sep-88	Mar, Jun, Sep, Dec
Netherlands	AEX-AEX INDEX CONTINUOUS	ETICS00	Euronext.liffe Amsterdam	AEX INDEX (AEX)	AMSTEOE	26-Oct-88	All
South Africa	SAFEX-ALL SHARE 40 INDEX CONT.	SALCS00	South African Futures Exchange	FTSE/JSE TOP 40	JSEAL40	2-May-90	Mar, Jun, Sep, Dec
Germany	EUREX-DAX INDEX CONTINUOUS	GDXCS00	EUREX	DAX 30 PERFORMANCE (XETRA)	XETRDAX	23-Nov-90	Mar, Jun, Sep, Dec
Spain	MEFF-IBEX 35 PLUS INDEX CONT.	MBXCS00	MEFF Renta Variable	IBEX 35	IBEX35I	20-Apr-92	All
Norway	OSLO-OBX INDEX CONTINUOUS	OSXCS00	Oslo Stock Exchange	OSLO SE OBX	OSLOOBX	4-Sep-92	All
Belgium	BELFOX-BEL20 INDEX CONTINUOUS	BFXCS00	NYSE Euronext - Euronext Brussels - Derivatives	BEL 20	BGBEL20	29-Oct-93	All

Country	Name	DS Mnemonic	Exchange	Underlying Name	Underlying Mnemonic	DataStream Start Date	Trading Cycle
Hungary	BSE-BUX INDEX CONTINUOUS	BUXCS00	Budapest Stock Exchange	BUDAPEST (BUX)	BUXINDX	3-Apr-95	All
Malaysia	KLSE-KLCI CONTINUOUS	KLCCS00	Kuala Lumpur	FTSE BURSA MALAYSIA KLCI	FBMKLCI	15-Dec-95	All
Portugal	BDP-PSI 20 INDEX CONTINUOUS	PSXCS00	New York Stock Exchange (NYSE) Euronext	PORTUGAL PSI-20	POPSI20	20-Jun-96	Mar, Jun, Sep, Dec
Poland	WSE-WIG 20 CONTINUOUS	WIGCS00	Warsaw	WARSAW GENERAL INDEX 20	POLWG20	16-Jan-98	Mar, Jun, Sep, Dec
Taiwan	TAIFEX-TAIEX WEIGHTD INDEX CONTINUOUS	TTXCS00	Taiwan Futures Exchange	TAIWAN SE WEIGHED TAIEX	TAIWGHT	21-Jul-98	All
Singapore	SGX DT-MSCI SING. INDEX CONT.	SMCCS00	Singapore Exchange - Derivatives Trading Division	MSCI SINGAPORE F	MSSNGFL	7-Sep-98	All
France	MONEP-CAC 40 INDEX CONTINUOUS	FCXCS00	Euronext Paris MATIF	FRANCE CAC 40	FRCAC40	8-Jan-99	All
Mexico	MEXDER-IPC INDEX CONTINUOUS	MIECS00	Mexican Derivatives Exchange	Mexican IPC		1-Jun-99	Mar, Jun, Sep, Dec
Greece	ADEX-FTSE/ASE-20 CONTINUOUS	ASICS00	Athens Derivatives Exchange	FTSE/ATHEX LARGE CAP	FTASE20	30-Aug-99	Mar, Jun, Sep, Dec
Canada	ME-S&P CANADA 60 INDEX CONT.	CDDCS00	Montreal Exchange	S&P/TSX 60 INDEX	TTOSP60	7-Sep-99	Mar, Jun, Sep, Dec
Australia	SFE-SPI 200 INDEX CONT. TRAD	AAPCT00	ASX Trade24	S&P/ASX 200	ASX200I	2-May-00	All
India	NSE-S&P CNX NIFTY CONTINUOUS	INICS00	National India			12-Jun-00	All
Italy	IDEM-FTSE MIB CONTINUOUS	MSMCS00	Italian Derivatives Market	FTSE MIB INDEX	FTSEMIB	22-Mar-04	Mar, Jun, Sep, Dec

Country	Name	DS Mnemonic	Exchange	Underlying Name	Underlying Mnemonic	DataStream Start Date	Trading Cycle
Turkey	TURKDEX-ISE 30 CONTINUOUS	TRTCS00	Turkish Derivatives Exchange	BIST NATIONAL 30	TKNAT30	4-Feb-05	Feb, Apr, Jun, Aug, Oct, Dec
Sweden	OMX-OMXS30 INDEX CONTINUOUS	OMFCS00	OM Nordic Exchange	OMX STOCKHOLM 30 (OMXS30)	SWEDOMX	15-Feb-05	All
Russian Federation	RTS-RTS INDEX CONTINUOUS	RTSCS00	Russian Trading System	RUSSIA RTS INDEX	RSRTSIN	3-Aug-05	Mar, Jun, Sep, Dec
Thailand	TFEX-SET50 INDEX CONTINUOUS	TSTCS00	Thailand Futures Exchange	BANGKOK S.E.T. 50	BNGKS50	28-Apr-06	Mar, Jun, Sep, Dec

Figure 1: Average cumulative percentage of variance explained by sorted eigenvalues.
This figure shows an average cumulative percentage of variance explained by sorted 12 eigenvalues. 11 futures markets and one-day lagged of the return of USA from 2007 to 2013 are included in the estimation. These 11 markets have the longest history in DataStream. The price of futures contracts are US dollar denominated.

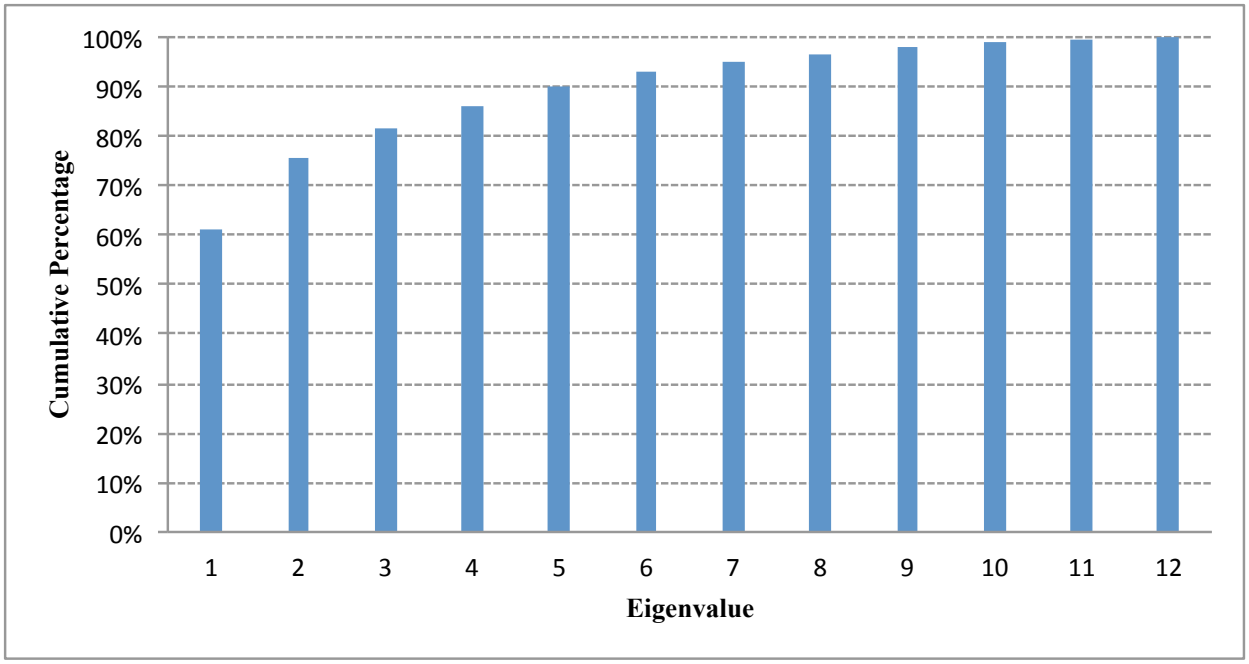


Figure 2: Cumulative variance of the first six eigenvalues.
This figure shows the cumulative variance of sorted eigenvalues from 2007 to 2013. The first six eigenvalues contribute to the average cumulative variance more than 90 percent. 11 futures markets, which have the longest history in DataStream, are employed in the estimation. The price of futures contracts are US dollar denominated.

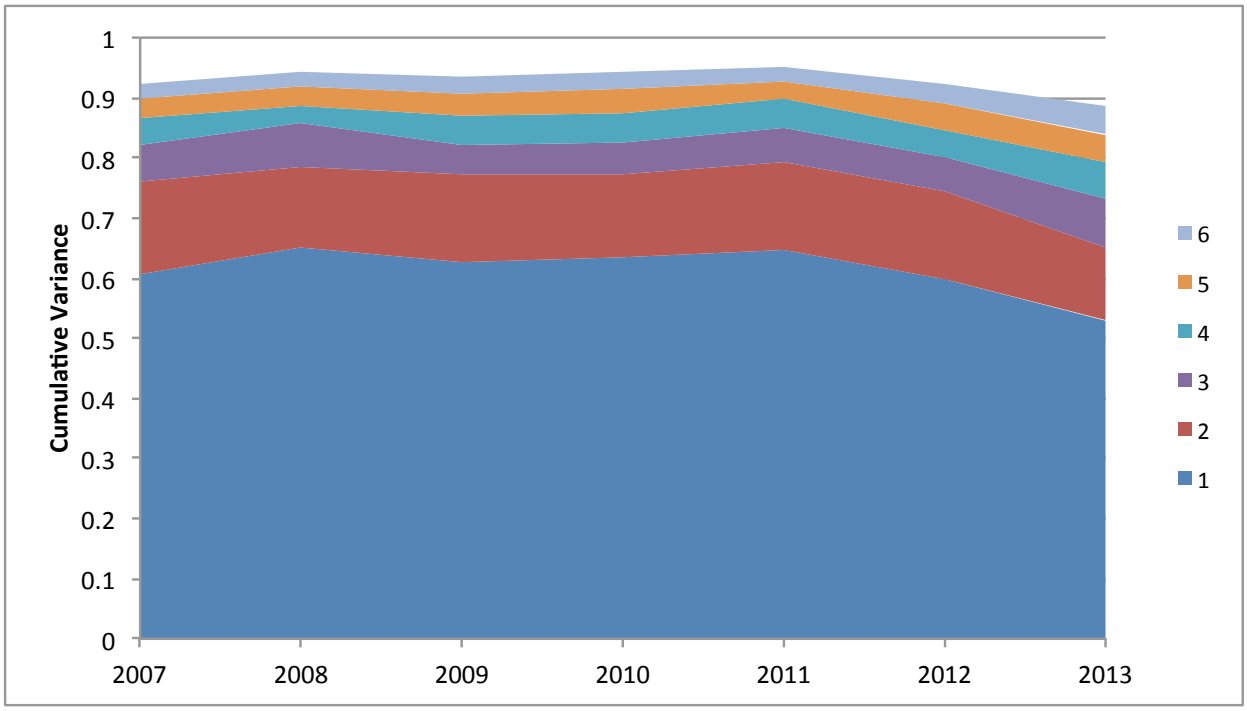
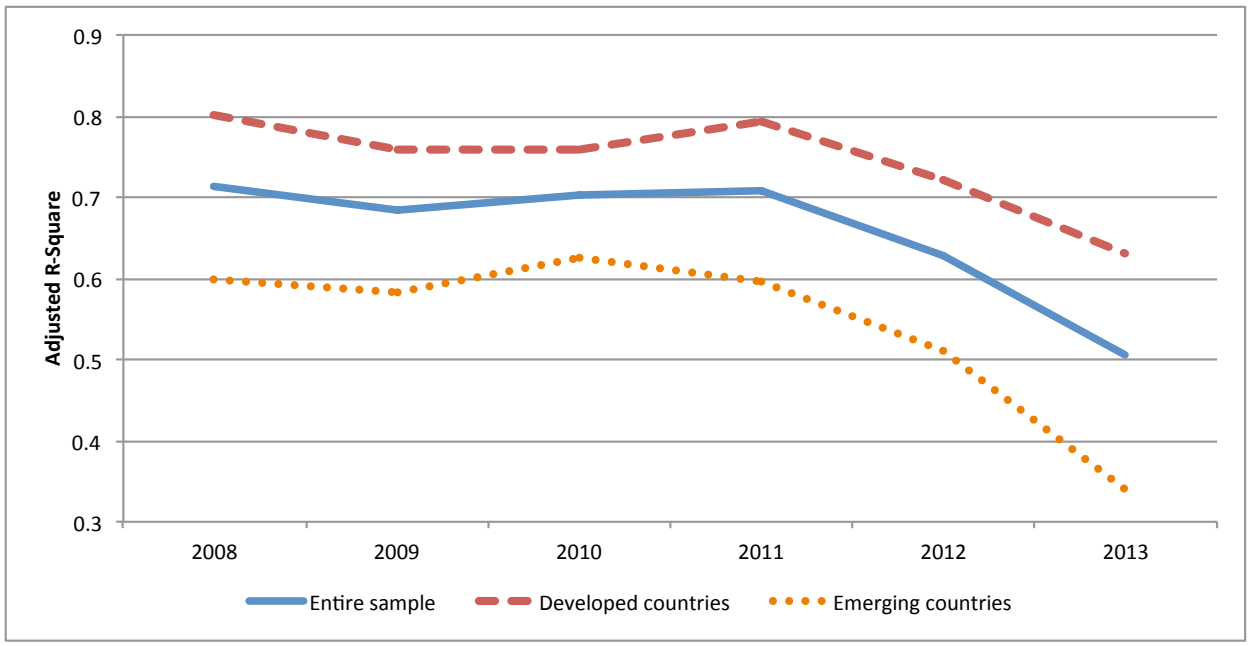


Figure 3 : Global integration of futures markets.
Adjusted R-square from the regression of futures markets returns is a measurement of the level of integration. The regression is analyzed for each country, then, adjusted R-squares are averaged for each period. This figure presents the degree of integration of entire sample of futures markets, developed countries, and emerging countries.[10]



10 The classification of developed and emerging markets follows the classification of MSCI.