CONTRIBUTIONS
TO MANAGEMENT SCIENCE

Mohamed El Hedi Arouri
Fredj Jawadi
Duc Khuong Nguyen

The Dynamics of Emerging Stock Markets

Empirical Assessments and Implications

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Mohamed El Hedi Arouri • Fredj Jawadi •
Duc Khuong Nguyen

The Dynamics of Emerging Stock Markets

Empirical Assessments and Implications

Physica-Verlag

Prof. Mohamed El Hedi Arouri
University of Orleans
Faculty of Law, Economics,
and Management
rue de Blois
45067 Orléans CX 02
France
mohamed.arouri@univ-orleans.fr

Prof. Duc Khuong Nguyen
ISC Paris School of Management
22 Boulevard du Fort de Vaux
75848 Paris CX 17
France
dnguyen@groupeisc.com

Prof. Fredj Jawadi
Amiens School of Management
18 place Saint Michel
80000 Amiens CX
France
fredj.awadi@supco-amiens.fr

ISSN: 1431-1941
ISBN: 978-3-7908-2388-2 e-ISBN: 978-3-7908-2389-9
DOI 10.1007/978-3-7908-2389-9
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2009936784

Cover design: SPi Publishing Services

Printed on acid-free paper

Physica-Verlag is a brand of Springer-Verlag Berlin Heidelberg
Springer-Verlag is a part of Springer Science+Business Media (www.springer.com)

Preface

By the end of 2008, thirty-four developing countries were considered as "emerging markets" by the world's leading index provider Standard and Poor's according to a wide range of economic and financial criteria. Yet, the more we learn about the financial markets in developed countries, the more challenging and mysterious emerging markets look.

Thirty years ago, they, the 32 emerging markets surveyed by the International Finance Corporation in 1982, started to attract attention from investors of developed countries. The simple reason is that exposure to emerging markets allows to take advantage of their enormous growth potential which generates distinctively equity returns superior to those on developed markets. Moreover, as far as diversification issues are concerned, adding emerging market assets into an existing portfolio would lead to improving its risk-adjusted return performance as they have a low correlation with developed markets. The increased investor interest for investing in emerging markets is also linked to the wave of market reform policies aiming to stimulate economic growth, weakened by severe recession and oil crisis of the early 1970. As foreign investors benefit from a greater access to local markets following their openings, private capital flows (net foreign direct investment, portfolio investment, and bank loans and deposits) to emerging markets have steadily increased over time, from only $39.8 billion in 1990 to $1974.9 billion in 2007.

Emerging markets, however, encounter several periods of reversals of foreign capital flows. The 1980s was particularly marked by the debt crisis in Latin America while the 1990s witnessed many episodes of extreme instability including, among others, the Mexican peso devaluation in 1994–1995 and Asian and Russian crises in 1997 and 1998. Some would attribute these consequences to increased mobility of cross-border capitals resulting from financial liberalization.

These observations raise some intriguing questions relating to both market participants (foreign and domestic) and policymakers of emerging markets, and the most important are:

- What are the diversification benefits from investing in emerging markets? And to the extent that emerging markets have become more integrated into the world financial system in recent years, how strong will be these benefits in the long run?
- Is the long-term performance of emerging markets sustainable, given their relative vulnerability to external shocks?
- What are, for policymakers wishing to know the effectiveness of their reform programs, the effects of increased foreign participation in domestic financial markets and real economy?

Answering such questions requires not only a good understanding of emerging markets and the underlying factors of their dynamics, but also an appropriate analysis tools because standard models proposed in financial theory often fail to deal with specific characteristics inherent to these markets.

By blending both theoretical and empirical approaches, this book attempts to bridge the gap between theories and practices of emerging markets, using modern financial econometric techniques. The text is structured in three parts. Part I, composed of two chapters, provides a comprehensive overview of emerging markets in terms of their accessibility, performance characteristics, and dynamics related to ongoing market reforms. Part II, composed of four chapters, explores the dynamics of asset prices and valuations in emerging markets with a particular focus on asset pricing, evolving efficiency and return volatility. Part III, composed of three chapters, develops specific models to apprehend the dynamics of emerging market integration with the world markets as well as contagion effects around the current global financial crisis 2007–2008.

We hope that readers will find material in "*The Dynamics of Emerging Stock Markets*", relevant and useful for understanding the evolving behavior of emerging markets in the contemporary international financial architecture.

M.E.H. Arouri, F. Jawadi, and D.K. Nguyen

Acknowledgements

We would like to acknowledge with considerable appreciation those who have directly or indirectly contributed to the publication of this book.

Our thanks go particularly to all our colleagues who provided us with constructive and helpful comments during international conferences and seminars.

We are also very grateful to our family members for their full support and encouragements throughout the writing of this book.

Authors

Dr. Mohamed El Hedi Arouri is an associate professor of Finance at the University of Orleans and a Researcher at EDHEC Business School (France). He holds a Master's degree in Economics and a PhD in Finance from the University of Paris X Nanterre. His research focuses on the cost of capital, stock market integration, and international portfolio choice. He published articles in refereed journals such as International Journal of Business and Finance Research, Frontiers of Finance and Economics, Annals of Economics and Statistics, and Finance.

Dr. Fredj Jawadi is currently an assistant professor at Amiens School of Management and a Researcher at EconomiX at the University of Paris Ouest Nanterre La Defense (France). He holds a Master in Econometrics and a PhD in financial econometrics from the University of Paris X Nanterre. His research topics cover modelling asset price dynamics, nonlinear econometrics, international finance and financial integration. He has published articles in refereed journals such as Journal of Risk and Insurance, Applied Financial Economics, Finance, and Economics Bulletin.

Dr. Duc Khuong Nguyen is an associate professor of Finance and Head of the Department of Economics, Finance and Law at ISC Paris School of Management (France). He holds an MSc and a PhD in Finance from the University of Grenoble II (France). His principal research areas concern emerging markets finance, market efficiency, volatility modeling, and risk management. He has published articles in refereed journals such as Review of Accounting and Finance, Managerial Finance, American Journal of Finance and Accounting, Economics Bulletin, Applied Economics Letters, and Bankers, Markets and Investors.

The courses taught by the authors in their respective institutions cover a wide range of topics including, among others, international finance, portfolio management, financial econometrics, and financial markets and valuations.

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Chapter 1
Emerging Markets: Overview and Performance Analysis

Abstract Emerging markets have become increasingly important in international portfolio management and world financial system. They now represent a dynamic set of investment opportunities for both individual and institutional investors. Although much has been learned about emerging market finance, these markets still pose challenges for finance studies as standard models are often ill suited to deal with their specific characteristics.

The purpose of this chapter is to provide a comprehensive review of emerging markets through presenting their qualitative and quantitative characteristics. The focus is also put on the ways for foreign investors to gain access to these markets as well as on country and specific risks because their assessment affects, to a large extent, international investment decisions.

1.1 Basics of Emerging Markets

The importance of emerging financial markets in international portfolio diversification was initially evoked by Grubel (1968), Levy and Sarnat (1970) and Errunza (1977). Accordingly, the inclusion of the assets issued by these markets helps to improve the mean-variance performance of an internationally diversified portfolio due particularly to their low correlation with others of the world. High potential of expected returns coupled with high volatility is another financial attribute of emerging markets.

In the course of their rapid development and maturation over the last three decades following the implementation of numerous economic reforms, two intriguing questions arise outstandingly. Which are the specific features of emerging markets? And how far these markets can distinguish themselves from financial markets of developed and developing countries? Answering these questions then allows for a better understanding of emerging market nature and interests, which in turn renders possible the specification of well suitable models to explain the dynamic evolution of risks and rewards in these markets.

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_1,

1.1.1 The Concept of Emerging Markets

The term "emerging markets" appeared in the beginning of the 1980s and was initially used to designate financial markets located in developing countries according to the World Bank's country classification. Indeed, all economies with low and middle Gross National Income (GNI) per capita are classified as developing countries.[1] However, not all financial markets in developing countries are considered as emerging markets since there is actually a category of less developed countries (Ethiopia, Cambodia, Ghana, Laos, Uganda, etc.) whose financial markets are still very embryonic and small. It is thus clear that income criterion might create confusion when defining emerging markets.

In 1981, the International Finance Corporation (IFC) proceeded to an explicit distinction between emerging and developing countries.[2] The criteria used by the IFC to attribute emerging status include not only income criterion, but also stock market's size, level of development and degree of openings. Overall, a market is said to be emerging if it meets the following conditions:

- It is located in a developing country as defined by the World Bank. The country is further characterized by a high potential for economic growth, a relative stability of the macroeconomic and political prospects as well as a sweeping process of economic and financial reforms.
- The stock market experiences significant changes in terms of its relative size (capitalization) compared to GDP, trading activities, and liquidity and sophistication levels.
- The stock market must be relatively liquid and reasonably accessible to foreign investors. In general, one can rely on the relative importance of investable market capitalization over GDP to appreciate the degree of accessibility. Note that the investable market capitalization refers to the portion of total market capitalization after excluding all block holdings and parts of listed companies inaccessible due to foreign ownership limits.
- Other qualitative features including for example capital controls, operational efficiency, quality of market regulation relating to accounting standards and financial reporting principles, corporate governance practices, and minority investor rights are also considered when analyzing specific market.

[1]By the end of 2008, national economies are divided into three groups: low income countries (also referred to as less developed countries) with GNI per capital of $975 or less, low and middle income countries with GNI per capita ranging from $976 to $11,905, and high income countries with GNI per capita of $11,906 or more. Within the low and middle income class, all countries with GNI per capital higher than $3,855 are typically included in an upper middle income category.

[2]The IFC is a member of the World Bank group in charge of promoting sustainable economic growth in developing countries through financing private sector investments, mobilizing capital in the international financial markets, and providing advisory services to businesses and governments.

By the end of 2008, the world's leading provider of credit ratings, risk management services and indices Standard and Poor's has identified and admitted 34 emerging markets in its Emerging Market Database (EMDB).[3] For each emerging market, two families of indices are constructed: S&P/IFCG (Global) which covers a market capitalization target of 70–80% of the whole market capitalization, and S&P/IFCI (Investable) which refers to the investable part (nonrestricted holding blocks available to foreign investors) of the market capitalization of the constituent members of the S&P/IFCG. S&P covers, in addition, 24 lesser developed markets even by emerging market standards, called "frontier emerging markets". Apart S&P, the provider of investment decision support tools MSCI Barra (Morgan Stanley Capital International) also calculates market indices for a number of emerging markets. Even though MSCI Barra uses relatively different criteria to identify emerging markets, the index values do not differ across index providers. Financial economists may however prefer the S&P indices in empirical studies because they include the broadest set of emerging markets. Table 1.1 shows the complete list of emerging and frontier markets surveyed by S&P as well as emerging markets surveyed by MSCI for comparative purpose.

It should be finally noted that judgment criteria used by S&P for country inclusion into the EMDB rather focus on stock markets. That is why in practice a country (or an economy) whose stock market meets the S&P's inclusion criteria is generally referred to as emerging country (or emerging economy). Notice that, in what follows, the generic term "emerging markets" will be also used to designate equity markets in emerging countries.

1.1.2 Dispersions Among Emerging Markets

Emerging markets exhibit much dispersion at the group level, especially in terms of market depth, size and development. First, some markets are much older than the others. Stock markets in Turkey, Brazil and Indonesia were for example established respectively in 1866, 1877 and 1912 whereas Chinese stock markets (Shanghai and Shenzhen) were only created in 1992. Second, the disparity in market capitalization is another outstanding feature. At the end of 2003, the market information reveals that market capitalization of the largest emerging markets such as China and Taiwan reached about $681,204 and $379,023 billion respectively while many other markets including for example Nigeria, Venezuela and Zimbabwe still have a market capitalization less than $10 billion. Finally, the degree of market development also differs significantly across markets of the emerging universe as some matures more rapidly than the others and have been classified as developed markets. For example, Portugal qualified for inclusion into developed market

[3]Interested readers can refer to the S&P's Emerging Markets Index Methodology (November, 2007) for more detailed information about country inclusion criteria.

Table 1.1 Emerging and frontier markets surveyed by S&P and MSCI Barra

	Emerging markets S&P	MSCI Barra	S&P's frontier emerging markets
1	Argentina		Bangladesh
2	Bahrain		Botswana
3	Brazil	Yes	Bulgaria
4	Chile	Yes	Cote d'Ivoire
5	China	Yes	Croatia
6	Colombia	Yes	Ecuador
7	Czech Republic	Yes	Estonia
8	Egypt	Yes	Ghana
9	Hungary	Yes	Jamaica
10	India	Yes	Kazakhstan
11	Indonesia	Yes	Kenya
12	Israel	Yes	Latvia
13	Jordan		Lebanon
14	South Korea	Yes	Lithuania
15	Kuwait		Mauritius
16	Malaysia	Yes	Namibia
17	Mexico	Yes	Panama
18	Morocco	Yes	Romania
19	Nigeria		Slovak Republic
20	Oman		Slovenia
21	Pakistan		Tobago & Trinidad
22	Peru	Yes	Tunisia
23	Philippines	Yes	Ukraine
24	Poland	Yes	Vietnam
25	Qatar		
26	Russia	Yes	
27	Saudi Arabia		
28	South Africa	Yes	
29	Sri Lanka		
30	Taiwan	Yes	
31	Thailand	Yes	
32	Turkey	Yes	
33	United Arab Emirates		
34	Zimbabwe		

Source: S&P Emerging Market Database and MSCI Barra website as of July 19, 2009

group in March 1999 whereas it was admitted in the EMDB in January 1986. Greece also evolved into developed market in 2001 after being included in the S&P's EMBD for a very short period of time.

The heterogeneity of emerging markets can be explained by their differences in development stages. A close look at their evolution reveals four distinct stages: an embryonic phase, a phase of low trading activity, an active development phase and maturity phase (Derrabi 1997).

The *embryonic phase* is typically characterized by the embryo of trading activities, the absence of automatic trading system in stock markets and the irregularity of exchanges (e.g., several trading sessions per day and several trading days per week). Stock markets are not attractive during this phase and display low trading

volume and lack of market transparency and market regulation toward listed firms. Almost all actual emerging markets have got over this phase.

Throughout the *phase of low trading activity*, emerging market governments start opening up their capital markets to foreign capital flows in order to reduce budget deficits and external debts. Many other economic reforms (trade liberalization, privatization, banking system reform, etc.) are also undertaken to improve the functioning, attractiveness and efficiency of stock markets which indeed lead to stimulate the going public (initial public offerings) process of both public and private companies. In addition, market authorities engage actively into regulatory reforms to regulate financial contracts and trading activity.

At the time of the *active development phase*, emerging countries continue to take sound reform policies in effort to enhance the efficiency of stock markets, information disclosure and market microstructure (automatic and continuous quotation). This phase is also characterized by a reasonable degree of market openings and increasing interests of foreign investors on domestic financial securities. Market indicators such as number of listed companies, liquidity, and capitalization increase remarkably due particularly to the arrival of foreign capital flows. It is important to note that most of emerging markets are currently located at this stage.

The *maturity phase* is marked by a significant reduction of legal barriers to cross-border investments and specific risks (political, liquidity and currency risks) as a result of regulatory reforms. Some emerging markets have become comparable to developed markets in terms of both market liquidity and operating systems. They further witness some degree of market integration with international capital markets and attract more foreign investors seeking for international diversification benefits. However, they seem to be still vulnerable to external shocks. Examples of emerging markets in maturity phase include Brazil, India, South Korean, Taiwan, and Thailand.

It arises from the above discussions that each emerging market, given its development stage, will have specific characteristics, which typically leads to different set of investment opportunities as well as different behavior in terms of both risk and return of financial assets.

1.1.3 Capital Markets

Emerging capital markets have evolved significantly over the last three decades and are undergoing constant innovation to improve liquidity and market microstructure. Similar to developed markets, they facilitate the allocation of available funds, the raising of capital and the risk sharing both at national and international levels through their increasing integration process to world capital markets. This section aims at describing the recent evolution of domestic capital markets in emerging countries as well as their prospects. A special emphasis is put on the external market financing from the total issuance of bonds, stocks and syndicated loans as it has an important role in market and economic development in emerging countries.

1.1.3.1 Emerging Markets' Access to External Financing

The recent trends in emerging capital markets in terms of securities issuances are depicted in Fig. 1.1. The emission of bonds and syndicated loans appears to be the principal source of emerging market external financing over the period from 1995 to 2008. The amount of equity issuance still remains low and only exceeds slightly bond issuance in 2007, albeit it experienced steady increase over time.

Two main factors explain the success of bond and syndicated loan markets. First, equity shares are exchanged on domestic stock markets and are usually subjected to a wide range of specific market regulations (listing rules, trading limits, compensation payments, etc.) in the country of issuers. Foreign investors may also face ownership restrictions and restricted access as well. It is, however, not the case for bond and international bonds in particular since the latter escapes generally from all specific constraints of the country where bonds are issued. This feature makes bond issuance easier and more advantageous than equity issuance. Second, the existence of discriminatory tax on foreign investments as well as the lack of a reliable and secure investment environment often pushes foreign investors toward alternative financial instruments which have a "global" nature, such as American Depositary Receipts (ADRs), Global Depositary Receipts (GDRs) and Country Funds.

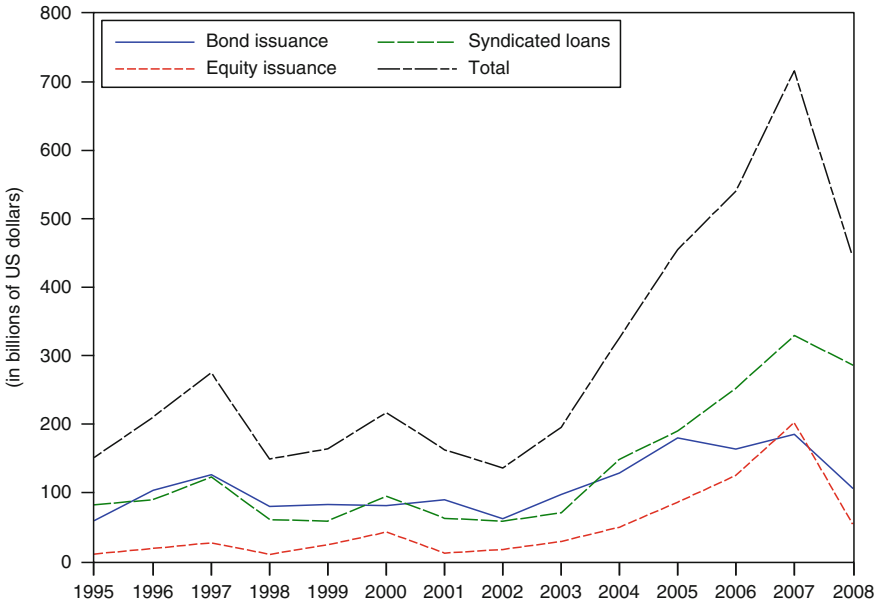

Fig. 1.1 Recent trends in emerging market external financing

Table 1.2 Total value of external financing

Year	Bond issuance	Equity issuance	Syndicated loans	Total	Changes in total issuance value (%)
1995	59.20	10.00	82.00	151.20	–
1996	103.00	17.80	89.00	209.80	38.76%
1997	126.20	26.20	122.50	274.90	31.03%
1998	79.50	9.40	60.00	148.90	−45.83%
1999	82.40	23.20	58.10	163.70	9.94%
2000	80.50	41.80	94.20	216.50	32.25%
2001	89.00	11.20	61.90	162.10	−25.13%
2002	61.60	16.40	57.60	135.60	−16.35%
2003	97.10	28.00	70.00	195.10	43.88%
2004	128.35	49.03	148.36	325.73	66.96%
2005	179.51	85.43	189.70	454.64	39.58%
2006	163.13	124.92	252.14	540.18	18.82%
2007	184.91	202.35	329.15	716.40	32.62%
2008	106.01	54.25	286.27	446.54	−37.67%

Source: International Capital Markets (IMF, 2001) and Global Financial Stability Report (IMF, 2004, April 2009). Unit: in billions of US dollars

The year-to-year changes in emerging market external financing are also reported in Table 1.2. Several intriguing facts can be noted:

- The external environment continued to play a crucial role in the developments and financing of emerging markets over time. The total external financing rose by 195.3% from $151.20 billion in 1995 to $446.54 billion in 2008.
- Foreign investor's appetite for emerging market assets have been considerably reduced during the periods of high systematic risks. Concrete examples include essentially the Asian financial crisis (1997–1998) where the total external financing decreased by nearly 46%, and the Argentina's economic crisis in 2001 coupled with rising economic uncertainties due to the effects of terrorist attacks of September 11, 2001 as well as to the bursting of the internet bubbles.
- The recent breakdown in 2008, i.e., a reduction of 37.67% compared to the 2007 level, is marked by the occurrence of the subprime mortgage market crisis in the US which then spreads quickly to Europe and affects almost all countries. The severity of global recession, the lack of market liquidity and the return of inflation in 2007 are the main risk factors that lead to a sharp decline in external financing of which the most affected segment is equity issuance (73% less than the 2007 level).

1.1.3.2 Bond Markets

Banks and corporations are major players in bond markets of emerging countries. This type of bonds is however not yet accessible to foreign operators in general. Due to the fierce competition among developing countries for capitals since the beginning of the 1990s, emerging markets had to recourse massively to

international bonds in order to get the required capitals for financing their economic development. The majority of international bonds are issued in the forms of foreign bonds and eurobonds.[4] This observation explains effectively the increasing share of bond issuance in the total value of emerging market external financing in Table 1.2.

International bonds are particularly advantageous in that they are accessible to all types of investors and they do not depend on any specific regulations of the issuer's home country. During the 1960s, the main borrowers in international bond markets were local companies in developed countries due to their high credit worthiness. For emerging and developing countries, the access to international bond markets was firstly granted to major emerging markets including Argentina, Brazil, South Korea, Indonesia, Mexico and Thailand. Today, emerging countries that opened up their capital markets to foreigner investors in the 1990s such as Jordan, Sri Lanka, Hungary and Slovakia also get access to these markets. It is finally worth noting that international bonds issued by emerging market issuers have generally a maturity from 2 to 5 years. Some of them can however have a longer maturity which goes up to 17 years.

1.1.3.3 Syndicated Loan Markets

Like eurobonds, syndicated loans or eurocredits are generally underwritten by an international syndicate of banks and denominated in the currencies of developed countries. It is shown in Table 1.2 that emerging markets regained access to syndicated loans in the year of 2000 following dramatic decline caused by the Asian financial crisis. The market for syndicated loan commitments became, for the first time, the most important source of emerging markets' external financing. The Emerging Asia was the principal recipient of these flows of eurocredits with a total issuance value of $56 billion. Of the remaining $38.2 billion, the Turkish market took $9.5 billion owing to its economic stabilization program undertaken in 2000. For many specialists, the strong liquidity observed was explained by the fact that syndicated loans are less costly, especially in terms of loan application and origination fees, than issued bonds.

[4]A foreign bond is a bond issued by a non-resident entity in a domestic market, denominated in the currency of the country where it is issued and only negotiated in a predetermined exchange. Eurobonds refer to bonds denominated in a currency different from the currency of the country or market where they are issued. A Eurodollar bond (i.e., US dollar-denominated) issued by a Thai company in Japan is an example of Eurobonds. In practice, Eurobonds are often denominated in the currency of one of the most advanced countries such as US dollar, Japanese Yen, Euros and UK Pound Sterling, and their issue is led by an international underwriting syndicate of international banks, brokers and dealers. Note that they are more attractive than foreign bonds because the issuers have the flexibility to choose the country in which the bonds are issued as well as to denominate the bonds in their preferred currency. In addition, there is no fix physical market place for Eurobonds, but they can be traded globally and listed in one of the Eurocenters developed throughout the world (New York, London, Paris, Tokyo, etc.).

It is equally important to note that 2008 was the year that ended the remarkably increasing trends in syndicated loan markets, after surging a noteworthy 370.2% between 2003 and 2007. In light of the unfavorable context in both real and financial sectors of developed countries as well as their own increasing macroeconomic instability in the course of the global financial turmoil, private capital flows to emerging markets and consequently the issuance of eurocredits should experience significant falls.

1.1.3.4 Stock Markets

Emerging stock markets have also experienced significant changes over the recent decades in terms of market size, financial depth and development though they generally attracted less attention from global investors compared to bond and syndicated loan markets. The comparison of key markets indicators in 1990 and 2003 outlines, however, the heterogeneous evolution of the number of listed firms (Fig. 1.2), the transaction volume (Fig. 1.3), and the market capitalization (Fig. 1.4) across selected emerging countries.[5] Obviously, some markets have become more mature (e.g., India, South Korea, Taiwan, and Thailand) and very active whereas the others remain still small and illiquid (e.g., Argentina, Colombia, Chile and Venezuela). With an intermediate development level among selected markets,

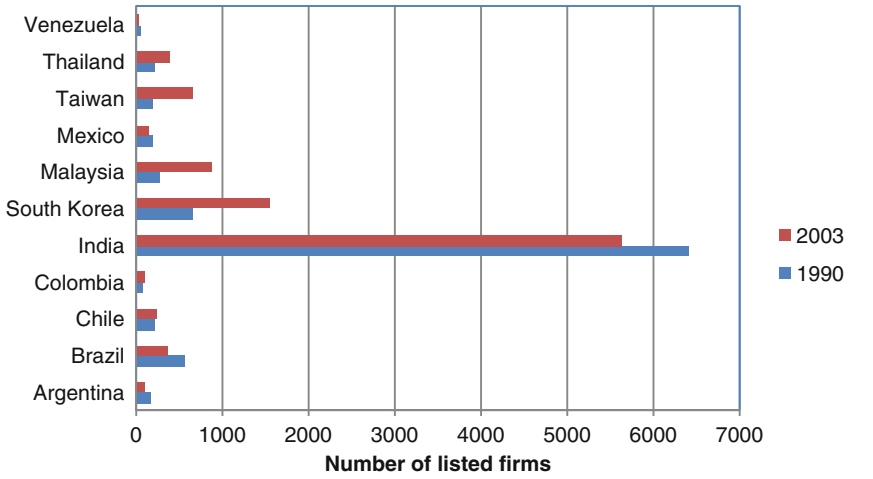

Fig. 1.2 Number of listed firms in selected emerging markets

[5]Data on market indicators are obtained from S&P's Global Stock Market Factbook (2004) and Emerging Market Database. The years of 1990 and 2003 are intentionally chosen for comparative purpose because they cover the period of intensive market openings in almost all emerging countries.

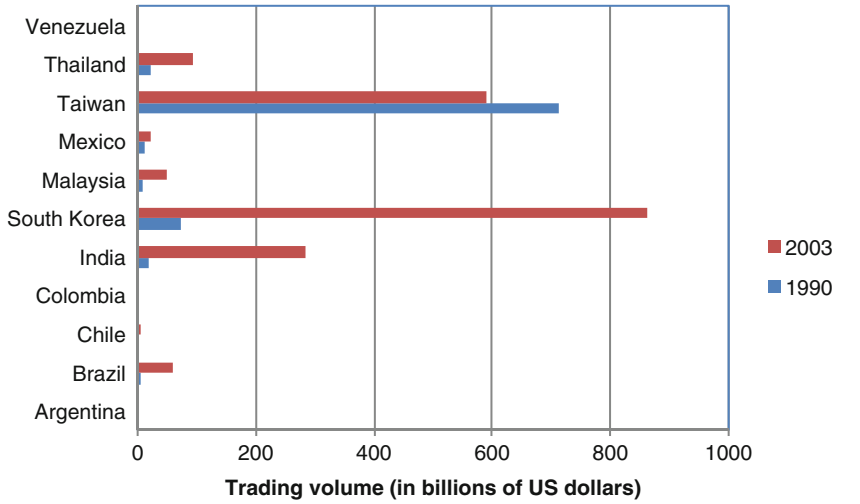

Fig. 1.3 Trading volume in selected emerging markets

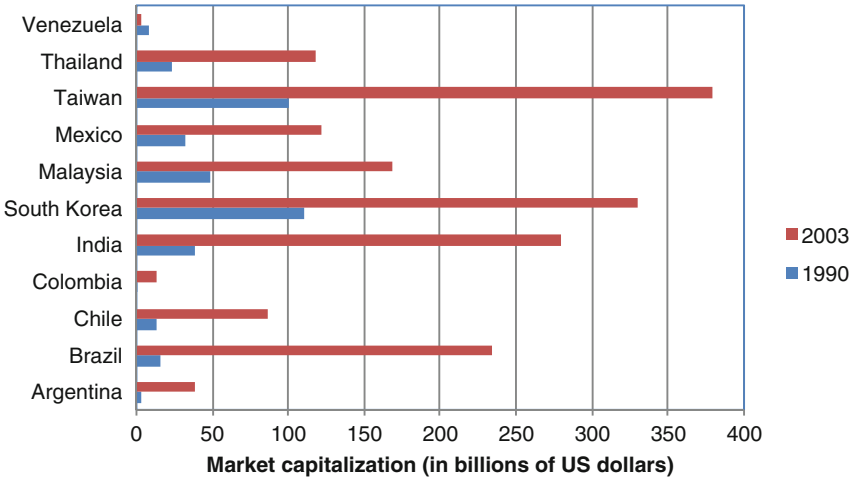

Fig. 1.4 Market size in selected emerging markets

stock markets in Brazil witnessed a striking increase in size from only $16.35 billion in 1990 to $234.56 billion in 2003. Similarly, its liquidity measured by transaction volume in 2003 was 11 times the level in 1990 and attained a yearly level of $60.44 billion. This tendency is also observed for the majority of remaining markets. As it will be discussed further in Chap. 2, this rapid development of emerging markets is primarily due to the adoption of new orientations in economic

policies and structural reforms in banking and financial sectors of which financial liberalization is an important component.[6]

Inside the emerging market universe, market concentration as measured by the market share of the top ten largest firms in terms of market capitalization is still much more stronger than in developed markets. Note that the concentration ratio in developed markets is calculated as the sum of percent market share of the top 5% largest firms.

Another important point to point out is that both bull and bear periods are frequently observed in emerging stock markets. The last serious bear market dated back to the 1997 Asian financial crisis. Their 5 year long bull market (2003–2007) finishes with the recent fall in 2008 due to the global financial panic characterized essentially by extreme risk aversion, liquidity problems, and tight credit conditions. This has resulted in high volatility and financial instability in global emerging markets. Nevertheless, past experiences show that bull markets are typically longer than bear markets, and the average increase during bull markets is relatively more important than the average decline during bear markets. It is generally believed that this pattern tends to be followed in the next decades before the maturity of emerging markets.

1.2 Risk and Return Characteristics of Emerging Stock Markets

Emerging markets are differentiated from developed with respect to several qualitative characteristics such as institutional infrastructure (taxation of dividends and capital gains, capital controls, market regulations and available information flows), market microstructure and market efficiency. The quality of these factors is generally lower for emerging markets than for developed markets. Note that these conditions affect, to the large extent, trading activity, price formulation, and as a result risk-return properties of emerging market assets.

This section turns to shed light on their risk-return characteristics with a particular focus on the equity markets. It permits to justify why emerging markets are considered as an independent and attractive asset class in global portfolio investments. Standard empirical analysis employs MSCI international equity market indices from Datastream International. Sample data are expressed in US dollars to avoid exchange rate effects and include 14 selected emerging stock markets, three emerging regions, G7 market index, and world market index. The study period from December 1992 to June 2009 is chosen to cover the current global financial crisis. Monthly returns are continuously compounded returns.

[6]Throughout this book we use interchangeably the following expressions: financial liberalization, stock market liberalization and market liberalization.

1.2.1 Risk and Returns

A common consensus rising from past studies is that emerging markets offer higher expected returns supported by their high growth prospects, but they are more volatile than developed markets. This proposition is revisited here using more recent data. Table 1.3 reports the obtained results. It is observed that annualized returns in emerging stock markets range from −3.6% for China to 13.9% for Brazil over the study period. In terms of unconditional volatility, the annualized standard deviations fluctuate between 24.8% for Chile and 57.2% for Turkey. All emerging market return series are significantly skewed and leptokurtic (positive excess kurtosis). In 10 out of 14 emerging markets considered, the skewness coefficients are negative, which typically suggests that large negative returns are more frequent than large positive returns when investing in emerging markets. In other words, significant losses are more likely to realize in extreme situations such as financial turmoil or crisis. The presence of positive kurtosis is however quite appreciated by investor community as it indicates a higher probability of getting positive returns (or large price movement). Unsurprisingly, emerging market returns depart significantly from the normal distribution as shown by the JB statistics.

Table 1.3 Stochastic properties of emerging equity market returns

	Average returns	Annualized returns	Std. dev.	Annualized volatility	Skew.	Kurt.	JB
Brazil	0.012	0.139	0.120	0.416	−0.848	5.297	67.256
Chile	0.006	0.072	0.072	0.248	−0.959	6.468	129.579
China	−0.003	−0.036	0.109	0.379	0.042	4.036	8.914
Colombia	0.009	0.109	0.096	0.334	−0.430	3.910	12.924
India	0.007	0.079	0.092	0.318	−0.276	3.625	5.731
Malaysia	0.002	0.020	0.093	0.321	−0.155	6.643	110.309
Mexico	0.005	0.064	0.095	0.330	−1.384	6.794	181.924
Philippines	−0.002	-0.020	0.095	0.329	−0.021	5.107	36.631
Poland	0.009	0.109	0.136	0.470	0.525	8.400	249.648
South Africa	0.007	0.081	0.084	0.292	−0.965	5.382	77.536
South Korea	0.004	0.044	0.116	0.402	0.207	5.725	62.697
Taiwan	0.002	0.019	0.093	0.321	0.399	4.309	19.399
Thailand	−0.003	−0.031	0.123	0.425	-0.371	4.829	32.156
Turkey	0.008	0.096	0.165	0.572	−0.337	3.977	11.628
Regional and global indices							
EM composite	0.004	0.053	0.073	0.254	−1.204	6.627	156.346
EM Asia	0.002	0.024	0.079	0.274	−0.411	3.759	10.334
EM EME	0.007	0.083	0.083	0.288	−1.195	6.765	164.078
EM Latin America	0.008	0.097	0.089	0.308	−1.299	6.989	186.956
G7 index	0.003	0.036	0.044	0.151	−1.073	5.505	89.757
World index	0.003	0.040	0.045	0.154	−1.141	5.792	107.277

Notes: EM composite, EM Asia, EM EME and EM Latin America denotes MSCI emerging market composite index, and emerging market regional indices for Asia, Europe & Middle East and Latin America. JB denotes the empirical statistics of the Jarque and Bera's test for normality. Its critical value at 5% level is 5.99. Skew. and Kurt. refer to the skewness and kurtosis coefficients. The total number of monthly observations is 198

Figure 1.5 illustrates the monthly return distribution of two emerging markets: Brazil (negatively skewed distribution) and Taiwan (positively skewed distribution). The case of Taiwanese stock market is more desirable for investors with respect to skewness feature.

When comparing the realized returns to the amount of unconditional volatility, it is important to remark that high volatility in emerging markets is not necessarily accompanied by high expected returns. For example, Turkey experienced highest volatility (57.2% per year), but an annualized returns of 9.6% which is indeed much less than the Brazilian market does over the same period (13.9%) with a volatility of only 41.6% per year. Other disparities exist in terms of risk-return tradeoff for the remaining markets.

At the group level, it appears that on average emerging market composite index and all regional emerging market indices obtained higher annualized returns than the G7 and World market indices (5.3% vs. 3.6% and 4.0% respectively). The reward-to-risk ratio of emerging market composite index stands at 0.21 compared to 0.26 for G7 and world markets, which typically shows an underperformance of emerging markets. Only two emerging regions outperform developed and world market index (Europe & Middle East, and Latin American). The underperformance of the emerging universe is due to the worst returns provided by Asian emerging markets.

Similar analysis is also conducted over two subperiods of equal observations: from January 1993 to February 2001 and from March 2001 to June 2009. The obtained results in Table 1.4 provide evidence of emerging markets' outperformance in the more recent period as their risk-adjusted performance improves

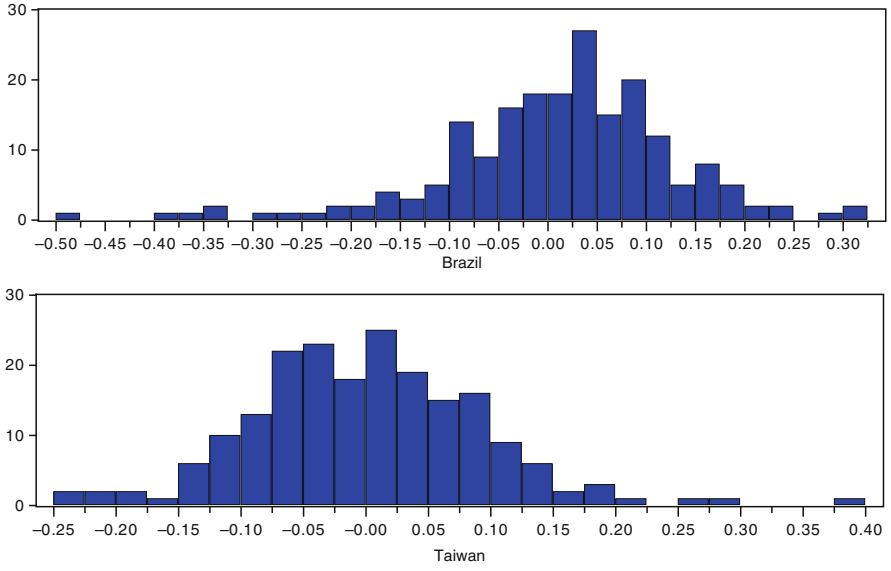

Fig. 1.5 Histogram of return distribution in Brazil and Taiwan

Table 1.4 Comparison of risk-return performance

	EM composite	EM Asia	EM Latin America	EM Europe &middleeast	World index	G7 index
Jan. 1993 to Feb. 2001						
Mean	0.001	−0.003	0.005	0.008	0.008	0.008
Std.	0.072	0.083	0.090	0.079	0.038	0.039
Reward-to-riskratio	0.015	−0.034	0.051	0.095	0.220	0.216
Mar. 2001 to Jun. 2009						
Mean	0.008	0.007	0.011	0.006	−0.002	−0.002
Std.	0.075	0.075	0.088	0.087	0.049	0.048
Reward-to-risk ratio	0.104	0.090	0.130	0.072	−0.034	−0.045

substantially whereas developed equity markets experience negative ratios. This finding is quite interesting and suggestive of the fact that emerging market assets have become recently more mature due to their high return potential and their relatively reduced volatility.

1.2.2 Correlation

Past studies including Harvey (1995a), and Claessens et al. (1995) among others have shown over the 1976–1992 period that emerging markets have low correlations both across markets of the emerging universe and with developed markets. It is worth noting that several emerging markets are even negatively correlated with developed markets.

The pattern of unconditional market linkages has changed dramatically. Tables 1.5 and 1.6 indicate that emerging markets exhibit a positive and moderate correlation between them and with developed markets when monthly data from December 1992 to June 2009 are used. Indeed, the correlation across emerging markets is now far from zero and negative like in historical times. It typically ranges from 0.26 (Colombia/Poland and Philippines/Turkey) to 0.64 (Brazil/Chile and Brazil/Mexico). In addition, the majority of remaining correlation coefficients exceed 0.35 and they are generally higher than 0.45 for markets of the same geographical region.

The correlation of sample emerging markets with MSCI G7 index and MSCI World market index is comprised between 0.34 (Colombia/G7) and 0.65 (South Africa/World). In this scheme of things, actual emerging markets can have a positive and considerable contribution in terms of risk-return tradeoffs of a globally diversified portfolio. Emerging markets with high degree of openness to international capital flows have been found to exhibit relatively high correlation with global equity markets (e.g., Brazil, Mexico, South Africa and South Korea).

The lower part of the correlation matrix in Table 1.6 indicates that emerging markets are now reasonably integrated with global equity markets in the sense that their correlation with G7 and World market indices stands around 0.80, compared to a nearly perfect correlation between G7 and World market indices. All emerging regions are highly correlated with developed world.

Table 1.5 Correlations within emerging market universe

	BRA	CHI	CHI*	COL	IND	MAL	MEX	PHI	POL	SAF	KOR	TAI	THAI	TUR
BRA	1.00													
CHI	**0.64**	1.00												
CHI*	0.47	0.50	1.00											
COL	0.40	0.43	0.28	1.00										
IND	0.47	0.52	0.41	0.38	1.00									
MAL	0.32	0.46	0.47	0.30	0.36	1.00								
MEX	**0.64**	0.57	0.46	0.34	0.42	0.36	1.00							
PHI	0.36	0.51	0.49	0.29	0.33	0.58	0.43	1.00						
POL	0.47	0.40	0.35	**0.26**	0.40	0.37	0.52	0.33	1.00					
SAF	0.54	0.57	0.57	0.34	0.45	0.43	0.56	0.50	0.48	1.00				
KOR	0.37	0.43	0.36	0.31	0.39	0.37	0.40	0.36	0.40	0.51	1.00			
TAI	0.47	0.51	0.55	0.30	0.42	0.51	0.45	0.46	0.33	0.51	0.46	1.00		
THAI	0.42	0.51	0.51	0.29	0.35	0.57	0.45	0.67	0.36	0.61	0.61	0.53	1.00	
TUR	0.45	0.43	0.33	0.35	0.37	0.28	0.43	**0.26**	0.36	0.42	0.30	0.33	0.27	1.00

Notes: BRA, CHI, CHI*, COL, IND, MAL, MEX, PHI, POL, SAF, KOR, TAI, and TUR designate respectively Brazil, Chile, China, Colombia, India, Malaysia, Mexico, Philippines, Poland, South Africa, South Korea, Taiwan and Turkey

Table 1.6 Correlations between emerging and developed markets

	EMcomposite	EM Asia	EM Europe &middleeast	EM Latin America	G7 index	World index
BRA	0.77	0.55	0.64	0.92	0.62	0.63
CHI	0.75	0.64	0.59	0.75	0.57	0.58
CHIN	0.68	0.70	0.47	0.56	0.46	0.48
COL	0.48	0.40	0.41	0.46	**0.34**	0.36
IND	0.64	0.63	0.52	0.53	0.47	0.48
MAL	0.62	0.74	0.43	0.42	0.40	0.42
MEX	0.78	0.57	0.61	0.85	0.64	0.64
PHI	0.61	0.67	0.37	0.47	0.43	0.45
POL	0.61	0.53	0.56	0.54	0.52	0.54
SAF	0.78	0.68	0.62	0.65	0.63	**0.65**
KOR	0.62	0.70	0.41	0.45	0.55	0.56
TAI	0.70	0.74	0.49	0.55	0.52	0.53
THAI	0.68	0.76	0.39	0.52	0.50	0.52
TUR	0.58	0.44	0.77	0.51	0.51	0.51
EM Composite	1.00					
EM Asia	0.90	1.00				
EM Europe & Middle East	0.81	0.63	1.00			
EM Latin America	0.90	0.67	0.73	1.00		
G7 index	**0.77**	0.67	0.69	0.71	1.00	
World index	**0.80**	0.70	0.71	0.73	1.00	1.00

Notes: BRA, CHI, CHI*, COL, IND, MAL, MEX, PHI, POL, SAF, KOR, TAI, and TUR designate respectively Brazil, Chile, China, Colombia, India, Malaysia, Mexico, Philippines, Poland, South Africa, South Korea, Taiwan and Turkey

Since correlations in international markets tend to increase in times of financial turbulences and crisis, the increases in correlations shown in Tables 1.5 and 1.6 are likely subject to great influences from the recent financial crisis of 2007–2009. However, it is important to stress that the more pronounced correlations between

emerging and developed equity markets seem not to be surprising as emerging stock markets are becoming more integrated and the effects of their liberalization policies is becoming more effective in recent years.

1.3 The Process of Market Integration and Risk-return Tradeoff

The analysis of risk-return tradeoff is fundamental to investment decisions. The modern financial theory suggests that expected returns are proportional to the level of risk taken, and as a result investors would prefer an investment project that generates highest rate of return for a given level of risk.

Standard risk-return tradeoff analysis in emerging markets relies particularly on the Capital Asset Pricing Model (CAPM) developed primarily by Sharpe (1964) and Lintner (1965), and the Arbitrage Pricing Theory (APT) developed primarily by Ross (1976). In addition to the determination of relevant risk factors to be included in the asset pricing models in order to accurately describe the dynamics of emerging market returns, empirical studies of the field must also take into account the degree to which emerging markets are integrated with the world equity markets. The rationale is that expected returns would depend only on global risk factors when national markets are entirely integrated with the world market while domestic risk factors are sufficient when national markets are segmented from the world market. In this regard, two main suppositions are frequently examined by past studies focusing on the risk-return relation in emerging markets: complete integration and partial market integration. The complete segmentation hypothesis is intentionally avoided because it appears to be restrictive with respect to an ongoing and active financial liberalization process of emerging markets.

1.3.1 The Case of Complete Integration

In a world of fully integrated markets, assets of the same risk issued in different markets should command identical expected returns. Also, only world risk factors are relevant in explaining the dynamics of expected returns across markets. In the empirical studies relying on the international version of the CAPM (ICAPM), changes in MSCI world market index is often introduced to reflect the worldwide market systematic risk. Empirical results which are controlled for infrequent trading show, however, low significance of the global betas for almost all emerging markets (Harvey 1995b).

The statistical rejection of the single-factor ICAPM leads to think that other factors may be relevant for better capturing the risk-return relation in emerging markets. Two empirical specifications are then proposed:

- The first one refers to an extension of the ICAPM to a two-factor model in which real exchange rate risk is counted for. Examples include either international asset

pricing model of Adler and Dumas (1983) where expected returns in a particular currency is generated by the covariance with the world and the covariances of asset returns and inflation rates in all countries, or a two-factor models of Ferson and Harvey (1994) and Harvey (1995b) where an aggregate index of currency returns is introduced to the single-factor ICAPM.[7] The exchange rate factor is however found to have marginal explanatory power over the 1976–1992 period in describing the dynamics of emerging market returns.

- The second specification is based on a multi-factor model which comprises five systematic risk factors: worldwide market risk, exchange rate risk, changes in commodity prices, inflation rate and world business cycle. With regard to the results, the inclusion of three additional factors does not help to improve the model's explanatory power, compared to single- and two-factor models.

Overall, empirical findings lead to conclude that either asset pricing models are misspecified or full market integration is not a feasible assumption for emerging markets.

1.3.2 The Case of Partial Market Integration

If financial liberalization is effective, emerging markets are at least partially integrated with world equity markets. In this case, both local and world risk factors are pertinent in pricing emerging market securities. However, the gradual and possibly reverting process of such economic policy, as it will be discussed in Chap. 2, has long posed challenge for the development of dynamic models since inferring emerging market integration from the data is a quite difficult task. On the one hand, emerging markets might remain segmented after liberalization if the removal of regulatory restrictions does not attract foreign investors in the presence of significant indirect barriers. On the other hand, the measure of market integration must be, in some circumstances, time-varying insofar as emerging markets may evolve from the segmented state to integrated state through time and inversely.

Previous studies have mainly adopted two following empirical strategies for modeling return dynamics in partially integrated emerging markets:

– The development of asset pricing models that take into account investment barriers such as ownership restrictions (Errunza and Losq 1985; Errunza et al. 1992), withholding tax discrimination (Stulz 1981; Wheatley 1988), and information asymmetries (Brennan and Cao 1996).
– The development of asset pricing models in which two aggregate sources of systematic risks (local and global) are considered. These risks are in general represented by the covariances of asset returns with world and local market

[7]Note that the estimation of Adler and Dumas's (1983) model is only possible for a very small number of countries.

index returns. Within this category, empirical measures of market integration can be either invariant (Claessens and Rhee 1994) or time-varying depending on the dynamics of several information variables (Bekaert and Harvey 1995).

Overall, this research stream concludes in favor of significant impacts of international investment barriers and finds evidence of time-varying market integration using emerging market data.

1.4 Specific Risks

Of the emerging market specific risks, political risk, liquidity risk and exchange rate risk are the most watched by investor community as a number of studies have shown that they are priced. In practice, these risks are not specific to emerging markets, but the risk exposure is much higher in emerging markets than in developed markets. The presence of specific risks prevents heavily the willingness of foreign investors to invest in emerging markets.

1.4.1 Political Risk

Political risk refers in general to the combination of political instability (civil war, terrorism, insurrection, political regime change) and unfavorable economic environment (financial instability and growth uncertainty). Like foreign direct investments, portfolio investments are also exposed to nonmarket factors related to political decisions such as economic (e.g., unexpected changes in fiscal, monetary, trade and investment policies) and social policies (labor, social strike, and developmental purposes). Political changes that increase tax discrimination between resident and nonresident investors as well as restrictions on cross-border capital mobility, foreign ownership and exchange-rate movements are particularly faced by foreign portfolio investment flows. Overall disasters that may result from political risk consist mainly of the unwillingness of emerging market governments to honor their sovereign debts, the nationalization of corporations and the impossibility of repatriating both capital and profits.

Assessing the exposure to political risk is notably hard because the methods used, albeit they are very useful for apprehending the nature and evolution of political risk, can neither provide accurate measurements of loss levels given the occurrence of the risks considered and nor be generalized to another country.[8] Several international risk services have developed synthetic measure for political

[8]Traditional methods for political risk assessment include, among others, the comparative techniques of risk rating and mapping systems, and the analytical techniques of special reports, expert systems and country default probability determination (Clark and Tunaru 2001).

risk using various political and economic variables. For instance, the Institutional Investor constructs a country credit rating index which incorporates political risk, while the International Country Risk Guide (ICRG) establishes an individual political risk index of political risk for major emerging market countries. Even though the risk is small in most of the markets, the associated potential loss is large.

To the extent that political risk can significantly dampen the foreign investor's enthusiasm for international diversification in emerging markets, policymakers should keep an eye on their country's political situations (Cosset and Suret 1995; Diamonte et al. 1996; Clark and Tunaru 2001).

1.4.2 Liquidity Risk

The liquidity is a primary condition which guarantees the good functioning of financial markets since it eases the trading of financial assets. A liquid market is a market in which assets can be traded at lowest costs without considerable price fluctuation. This market is also characterized by a small spread between asking and selling prices. Accordingly, liquidity risk comes generally from the difficulty or the impossibility of reselling financial assets.

Chuhan (1992) shows that low liquidity was one of the most important barriers that prevents institutional investors from investing in emergent markets. At the macroeconomic level, liquidity risk can result from the fact that short-term external debts in a particular emerging country are not fully covered by its foreign exchange reserves. Note that this imbalance was identified as one of the main reasons that caused the 1994–1995 Latin American crisis and the 1997–1998 Asian financial crisis. Also, government's controls on the foreign exchange market imply liquidity risk.

1.4.3 Currency Risk

Currency risk refers to the potential value losses due to sudden and strong volatility of exchange rate as well as changes in purchasing power parities. This risk is particularly present in emerging markets as witnessed by their successive currency crisis (currency devaluations) which were frequently twined with banking crisis over the past three decades. For many economists, emerging markets' currency risk takes its roots in high degree of market openness, specific exchange rate regimes and high macroeconomic uncertainties.

In summary, the above discussions call for a careful analysis of specific risks before making investment decisions. For practical purposes, investors can better apprehend these risks through the use of country risk indices established by, among others, the Economist Intelligence Unit, Euromoney, credit risk rating agencies, the

Institutional Investor, and the International Country Risk Guide. The latter provides a composite country risk index from combining its three individual risk indices (political, economic and financial risks).

1.5 Investing in Emerging Markets: Why and How?

Investing in emerging markets encompasses several activities. To carefully define their investment strategies, foreign investors must answer the following questions:

- What are the benefits of investing in emerging markets?
- What is the degree of accessibility to foreign investors?
- How can they invest (entry modes)?
- What is the future of emerging market investments?

This section aims to bring some answer elements to the above questions based essentially on the qualitative and quantitative analysis of previous sections.

1.5.1 Advantages of Emerging Markets

The motivations for investing in emerging stock markets come from their high growth potential and low correlation with developed markets. Moreover, emerging market asset class represents a dynamic and valuable investment set that matures over time.

1.5.1.1 Risk Diversification Benefits

The modern finance theory suggests that an internationally diversified portfolio offers higher risk-adjusted-return performance than a portfolio composed of only domestic assets. Further, risk diversification can be achieved through investing in uncorrelated or less correlated assets.

Following these theoretical insights, investing in emerging markets is particularly interesting for several reasons. First, emerging markets are characterized by a very low correlation with other markets of the world owing to their numerous restrictions on capital flows from foreign investors. This is entirely supported by the fact that the majority of the correlation coefficients between emerging markets and MSCI World index (as a proxy for global stock market), reported in Sect. 1.2, are less than 35%. Second, the rates of returns in emerging stock markets have been found to be higher than developed markets thanks to the high potential of economic growth that transforms into corporate earnings and dividends. Finally, the higher long-term performance is behind the growing trend toward investing in emerging markets insofar as emerging countries continue to conduct coherent and sound

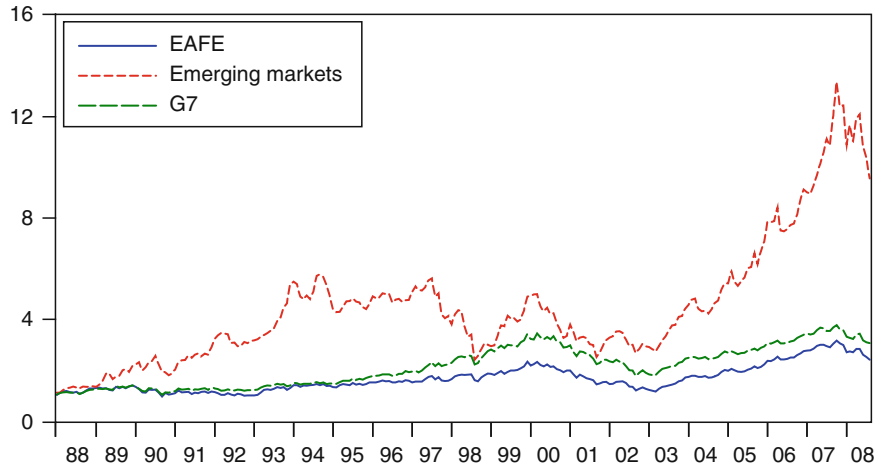

Fig. 1.6 Long-term performance: emerging versus developed markets

economic reforms. This superior performance is depicted in Fig. 1.6 using three US dollar MSCI total price indices over a 20-year period (MSCI Emerging Markets, MSCI EAFE and MSCI G7).

Figure 1.6 shows several attributes of the performance of emerging markets during the recent period of 1988–2008, as follows:

- MSCI emerging market index (MSCI EM) provided substantially higher returns than the international developed markets represented by both MSCI EAFE and MSCI G7.[9] Indeed, over the period from January 1988 to December 2007, one US dollar invested in MSCI EM capitalized about $12.46. The same one US dollar would bring only $2.97 and $3.57 in December 2007 if it was allocated in MSCI EAFE and MSCI G7 respectively.
- MSCI EM remarkably outperformed MSCI EAFE and MSCI G7 in almost all times despite harmful effects of several periods of extreme volatility due to financial and currency crises (e.g., Asian crisis in 1997 and Argentina's debt default in 2001).
- Recently, the long-term performance of MSCI EM is reduced owing to the current global financial crisis of 2008–2009, but the gap of performance is still large since developed markets have collapsed more dramatically.

[9]MSCI EAFE is a market-capitalization-weighted index constructed from the perspective of North American investors. Its constituents include listed stocks from 21 developed countries in Europe, Australasia, and Far East (e.g., Australia, Austria, Finland, Singapore, Sweden, UK, etc.) excluding the US and Canada. The regional weights as of December 31, 2006 are approximately as follows: 45.27% for Europe (excluding the UK), 23.71% for the UK, 25.55% for Japan, and 8.47% for Asia Pacific.

1.5.1.2 A More Maturing Asset Class in Emerging Markets

Of course domestic and foreign investors may take some precautions when investing in emerging markets because their high expected returns are usually accompanied by high risks. They have also gone through serious financial crises during the 1980s and 1990s which might lead to dramatic losses and constraint investors to get out of the markets. The analysis in Sect. 1.2 provided however evidence that emerging market asset class becomes more and more mature during the recent period. In particular, the reduced volatility of emerging markets in the last decade has made more attractive their risk-return characteristics. This translates into more sustainable returns that greatly improve their valuations compared to developed markets. Even though higher correlations between emerging and developed markets (due to growing market integration) may diminish diversification benefits of adding emerging asset class, the lower volatility helps to notably reduce portfolio's marginal risks (i.e., the marginal contribution of an asset's risk to the total risk of the portfolio).[10]

It is equally important to note that structural reforms in emerging markets have provided a more stable and credible investment environment while national economies continue to grow at a faster rate (double-digit growth rate in many countries). The most important improvements include the greater transparency in government and corporate practices, the reduction of foreign currency-denominated debts, the exposure to a lower inflation pressure, and the regulatory changes in favor of a more flexibility for international portfolio investments.

1.5.2 Accessibility to Foreign Investors

Although emerging markets offer evident advantages, they are not completely accessible to foreign investors yet. Numerous investment barriers such as entry-exit conditions and capital mobility restrictions are generally imposed to limit foreign participation. More importantly, these obstacles, either direct or indirect can apply to both domestic and foreign investors.

Direct barriers refer to market regulations that control the activities of investment. They include for example discriminatory taxation treatment for foreign investments (dividends and interests), limits on foreign ownership, and restriction on capital gain and interest repatriation. The foreign access to strategic sectors such as defense industry and telecommunications is generally closed or highly

[10]The increase in cross-market correlations reflects the fact that emerging markets commove largely with developed in recent years. Three main factors explain this phenomenon: the financial interdependences due to high degree of cross-border capital mobility, the economic integration resulting from tighter trade links and increased number of companies with international operations, and the rapid convergence of emerging markets toward the economic and financial structure of mature markets.

controlled. With regard to ownership restrictions, foreign investors are often allowed to hold up to a threshold limit of a domestic company's equity capital or listed stock of the special share classes dedicated to foreign investors. For example, foreign institutions are authorized to hold without limits only B-share class in China and Malaysia. In South Korea, foreign investors could hold, to the maximum, 10% of a listed firm's capital as of January 1992. This restriction has been gradually reduced to 12% in January 1995, then 15% in July 1995, and then 18% in April 1996 and finally 20% in October 1996. In Thailand, the banking law restricts the foreign participation to 25% at most of a Thai bank's capital whereas the Alien Business Act allows a foreign share holding up to 49% of the equity capital of listed companies in other economic sectors at the end of 2003.

Indirect barriers result principally from the overall weakness of market conditions and business environment in emerging markets. In many emerging countries, the lack of good market regulations related to information disclosure and financial reporting, the lack of reliable infrastructure (embryonic private sectors, few financial instruments, specialized portfolio management institutions and unqualified investors) and the absence of international accounting standards and appropriate laws to protect minority shareholders are factors that keep away existing investors and discourage potential investors from investing in emerging markets. Also, the potential vulnerabilities of emerging markets coupled with their exposure to high specific risks including particularly political risk, liquidity risk, and monetary risk affect significantly the willingness of foreign investors to invest in these markets.

Keeping in mind that emerging countries have gradually removed barriers to international investments in effort to make their capital markets more "investable", the appetite of foreign investors for emerging market assets has grown over time. Nowadays, the access to emerging markets is much easier than 20 years ago so that there is no distinction made between domestic and foreign shareholders. Chap. 2 discusses, in great details, dynamic changes in emerging market access in relation with financial liberalization reforms.

1.5.3 Market Entry Methods

As in developed markets, emerging markets also offer a wide range of financial instruments which can be bought directly from both domestic and foreign investors. Traditional securities and derivatives markets have developed rapidly and provided helpful supports to international trading activities. In particular, massive foreign capital inflows are directed to stock market segments in recent years (see Sect. 1.1.3 for more details).

For a market that still imposes significant restrictions on direct investment in shares, foreign investors can buy sovereign bonds or corporate bonds. Mallat and Nguyen (2008) investigate changes in emerging market sovereign spreads (often used as an indicator of sovereign risk) and find that sovereign risk is reduced significantly following the adhesion of emerging countries into macroeconomic

and data transparency standards. In the case of corporate bonds, foreign investors could take advantage of the growth characteristic in emerging markets while eliminating the risk of information asymmetry as these bonds are essentially convertible bonds. The market for derivative instruments are, however, relatively recent for most of emerging markets. In general, they are less sophisticated and less standardized than those in developed markets.

Foreign investors have also the possibility to access emerging markets via instruments such as Eurobonds, Country Funds, and American Depository Receipt and their varieties (Global, International, and European Depository Receipts).[11] These instruments are very useful in case where the emerging market under consideration is technically closed to foreign participation. Their prevailing advantage is that they permit the holders to mimic the performance of emerging markets without having to deal with investment restrictions or any market imperfections.

1.5.4 The Future of Emerging Market Investments

The analysis of emerging market external financing in Sect. 1.3.1 shows that emerging markets have generally gained a particular attention from foreign investor community in the past. The exceptions comprise the years of 1998, 1999, 2001 and 2002 where emerging markets received much less capital inflows due to the severe impacts of the Asian crisis, the Argentinean debt default and the explosion of internet bubbles. The future of emerging market investments depend upon on some new development trends, as follows:

First, with a contribution of nearly 32% of the world economic output in 2007 and a growth rate which is often two times higher than that in developed economies, the group of 34 emerging market countries could expect a greater share to overall world GDP in the years to come despite the actual global economic slowdown (Table 1.7). The 34 emerging markets comprised 32.18% of the world market capitalization, approximately equal to the share of the North American region in the world market capitalization (33.96%). These observations provide the most appealing argument for allocating to emerging markets.

The second point to be noticed is that emerging markets regained investor's confidence and market credibility for emerging markets since 2002. The total issuance amount of equity, bonds and syndicated loans increased considerably

[11]Eurobonds are simply international bonds that are denominated in a currency other than the currency of the country or the market in which they are issued. They are sold throughout the world. Country fund refers to an investment company that issues a number of shares in its home market and uses the proceeds to invest in a portfolio of assets in a foreign country. American Depository Receipt is a negotiable certificate issued by a US bank that represents a certain amount of shares of a foreign company in a foreign stock market. The financial characteristics of these instruments are discussed in Chap. 2.

Table 1.7 Selected economic and indicators of emerging markets in 2007

		Stock market cap.		Debt securities			
	GDP	Value	% of GDP	Public	Private	Total	% of GDP
World	54,840.9	65,105.6	119%	28,629.3	51,585.8	200,162.8	365%
European Union	15,741.1	14,730.9	94%	8,778.3	19,432.3	58,683.5	373%
North America	15,243.6	22,108.8	145%	7,419.2	24,491.9	69,265.0	454%
Emerging market	17,270.8	20,950.2	121%	5,001.3	2,795.6	46,019.1	266%
Asia	7,680.4	13,782.7	179%	2,645.8	1,826.9	25,937.6	338%
Latin America	3,641.0	2,292.2	63%	1,456.5	628.6	8,018.9	220%
Middle East	1,557.8	1,275.9	82%	39.5	84.3	2,958.3	190%
Africa	1,101.7	1,181.7	107%	89.0	78.9	2,452.4	223%
Europe	3,289.9	2,417.6	73%	770.4	176.9	6,655.5	202%

Notes: Data are from Standard and Poor's Emerging Market Database (IMF World Economic Outlook, April 2009). The sample of emerging markets includes 34 markets of five regions. All values are expressed in billions of US dollars. GDP is calculated on the basis of purchasing power parity

from $135.60 billion in 2002 to $446.54 billion in 2008 with a record peak of $726.40 billion in 2007. The recent rise of macroeconomic and financial uncertainties due to the recession of world economy sparked by the US housing and banking crisis might lead to shrinking capital flows to emerging markets, but private investment flows should increase insofar as the recovery of most advanced economies comes.

Next, the economic reality proves that emerging market countries are not neither decoupled from the developed part of the world nor spared from the global crisis. Although they are not directly affected by the global crisis, most of emerging countries in Asia and Latin America have experienced sharp decline in their exports of finished products and commodities. The fast-growing emerging countries in Europe had to turn to the IMF and the European Union for financial assistance in order to overcome rising sovereign risks, social instability, bank liquidity problems and the likelihood of currency devaluations. Consequently, growth projections for almost all emerging countries have been recently reduced. They may, however, have a greater room for manoeuvre than developed countries in the conduct of stimulus plans to foster economic growth due to their higher reserve levels as well as lower debt levels.

Finally, the equity market valuation measures, as indicated in Fig. 1.7, show that both the price/earnings and price-to-book ratios have experienced an upward trend while the dividend-yield ratios have decreased substantially since 2005. Taking together, these trends give evidence of equity price overvaluation over the period of 2005–2007 in emerging stock markets, which was partially corrected by the sharp decline during the current global financial crisis starting in July 2007. Expectedly, equity investment flows to emerging markets should recover when the overvaluation risk entirely disappears by the end of 2009 according to market valuation forecast figures.

To conclude, the arrival of capital inflows depends on a rigorous monitoring of the banking and financial system as well as on sound macroeconomic policies of

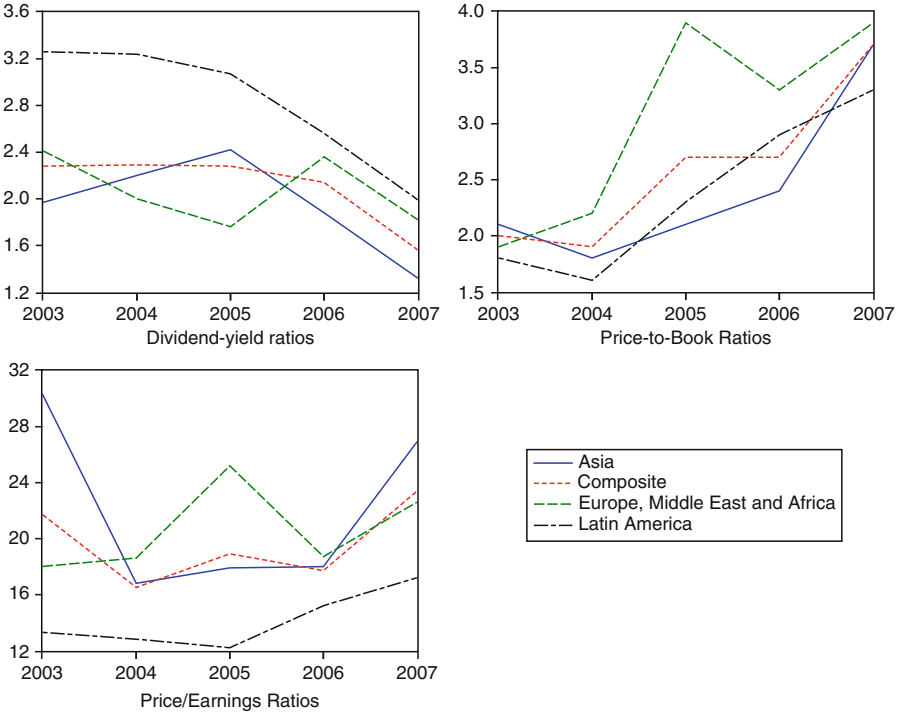

Fig. 1.7 Equity market valuation measures: 2003–2007. Notes: Data are from Standard and Poor's Emerging Market Database (IMF World Economic Outlook, April 2009). The sample of emerging markets includes 34 markets of five regions

emerging market economies. Additionally, the investor's capital investment decision-making relies closely on the actual degree of financial liberalization.

1.6 Summary

This chapter presented the evolutionary characteristics of emerging financial markets with a particular focus on equity markets. It appears that these markets are very heterogeneous and exhibit numerous disparities in terms of market size, liquidity, financial depth, and development levels. With regard to their risk-return characteristics, the most important finding is that emerging markets have now positive and moderate with developed markets, indicating a higher degree of market comovement in the recent period. However this increased correlation does not lead to eliminate international diversification benefits as emerging markets still outperform largely over the long-run thanks to their reduced volatility. Finally, it should be noted that the existence of investment barriers and the importance of country-specific risks may limit foreign participation even though they have considerably diminished over time.

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Chapter 2
Dynamic Process of Financial Reforms

Abstract Financial liberalization has been an important component of a wide-ranging economic reform program undertaken by governments of emerging market economies. It is then essential to apprehend its multidimensional aspects for a better understanding of the dynamic behavior of emerging markets over the recent period. The rationale behind this intuition is that financial liberalization concerns a large variety of restrictions which were imposed there.

This chapter aims at reviewing the driving context that shows the necessity of financial liberalization as well as the induced impacts of this reform on the dynamics of emerging stock markets. Precisely, the following topics are particularly discussed: economic rationale for financial liberalization, liberalization methods, dynamics of liberalization process, and economic and financial impacts of liberalization.

2.1 Oil Shocks and Economic Recession in the 1970s

The demand for crude oil increased considerably in the beginning of the 1970s, particularly in the United States where oil extraction and production have been more and more expensive. To insure their consumption stream, the United States decided to import crude oil at low prices from Middle East countries. Meanwhile the US dollar was devaluated and its convertibility into gold ended on August 15, 1971. The members of the OPEC (*Organization of Petroleum Exporting Countries*) independently agreed firstly to pressure for oil price increases, and then to unilaterally raise oil prices in order to stabilize their real revenues. The price tensions were particularly tightened during the Yom Kippur War where the United States provided weapons and supplies to Israel, and on October 17, 1973 where the OAPEC (the Arab members of the OPEC plus Egypt and Syria) declared that they would cut in oil exports to the United States and other western countries if they supported Israel in the Arab–Israel conflict.

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_2, © Springer-Verlag Berlin Heidelberg 2010

Oil price increases and political tensions immediately led to stock market crash as a result of inflation pressure and collapsing monetary system in a flow-up of the non-convertibility of US dollar into gold. They also had dramatic effect on global economic growth. Oil exporting countries were of course satisfied that they could control the price of a vital commodity and generated real revenues in order to undertake various economic development programs as oil prices continued increasing in several years after embargo removal.

Many countries of the developing world, admittedly being the big losers of the 1973 oil shock, fell into recession. The situation of these economies was very critical due to the lack of financial resources for promoting economic growth as well as to the inefficiency of internal capital markets characterized by a financial repression. Indeed, the existence of many constraints toward the financial system (high level of obligatory reserves in banking industry, restrictive measures on interest rates, in and out barriers to the free mobility of capital flows, restrictions on foreign investors' access to domestic markets, etc.) constitutes the main obstacles to economic development because they discourage international trade and transactions. Consequently, it was imperative for developing countries to open up their internal capital markets and contract more debt from the international community in effort to overcome financial distresses and bring economic recovery.

2.2 Financial Liberalization as a Solution to Economic Development

The economic problems after the 1973 oil shock (e.g., inflationary pressure, distortions in industrial production due to increasing oil prices, insufficient financial resources, lower economic growth, etc.) have forced many countries to undertake a vast program of economic reforms. As a major component, financial liberalization policy, aiming mainly at deregulating domestic capital markets to promote international capital mobility, was initiated by the most advanced countries like Germany in 1973 and the United States in 1974. In the universe of emerging markets, the wave of financial liberalization only started in the late 1970s and became more pronounced in the early part of the 1980s. The principal reason is that foreign bank credits granted to emerging markets, which constitute major external funding sources, decreased considerably following the advent of the 1982–1983 debt crisis in Latin America. The willingness to catch up with the development levels of mature countries was another motivation for emerging countries to liberalize their capital markets.

Conceptually, financial liberalization policy is made up of five key elements:

- The removal of interest rate controls
- The reduction of banking obligatory reserves
- The lowering of governmental interventions in banking operations
- The privatization of state enterprises

- The admission of foreign operators in financial industry, and abolition of investment barriers as well as restrictions on foreign participation in domestic financial markets

They are typically divided into two categories with respect to their impacts on economic indicators and agents: *internal liberalization* and *external liberalization*.

Internal liberalization refers to financial system reforms and involves in particular banking system reforms and privatization policies (i.e., the first four elements listed above). In theory, internal liberalization should allow interest rates to fluctuate freely and central banks to manage loan and credit policies. More importantly, it is expected that the fluctuation of interest rates depend upon the market demand and supply of currencies.

External liberalization concerns policies that ease foreign capital inflows to domestic markets, and thus the participation of foreign investors. On the one hand, policymakers reduce a wide range of controls on capital gain transfers and foreign exchange rates, and on the other hand they allow foreign investors to invest in domestic markets and to provide financial services. Overall, the goal of such policies is to insure that, in a liberalized market, foreign investors are allowed to hold, without bearing restrictions, financial assets issued by emerging market companies, and domestic investors have the right to trade foreign assets. Therefore, any deregulation that facilitates the participation of non-resident investors is viewed as element characterizing external liberalization. Concrete examples include decisions authorizing the introduction of American Depository Receipts (ADRs), Global Depository Receipts (GDRs) and Country Funds. This chapter is primarily concerned with external financial liberalization.

2.3 Liberalization Methods and Indicators

The impact of financial liberalization on investments, stock markets and economic growth in emerging countries has been extensively examined by a large number of scientific works. However, information related to the methods of financial liberalization is still limited and very fragmented. This section describes different ways in which a country can liberalize its capital markets.

2.3.1 Official Versus Effective Liberalizations

Official liberalization events are governmental announcements of changes in the market regulations. They generally consist of suppressing regulatory barriers to international investments. Bekaert and Harvey (2000) provide this kind of information for major emerging markets. In their study, liberalizations are also indentified via the introduction date of the first ADR, the admission of the first country funds and the huge increase in the US capital flows to emerging markets.

Other studies including Kim and Singal (2000) and Henry (2000) also seek to date financial liberalization, but the methodology used by these authors is not

similar to that of Bekaert and Harvey (2000). Indeed, Kim and Singal (2000) propose to use the most significant liberalization event as the effective date of liberalization. Henry (2000) tries to identify financial liberalization dates by using simultaneously three alternative filters including official liberalization dates, the introduction date of the first country funds and the sudden increase in the S&P's investable index (S&P/IFCI)[1]. Concretely, the procedure adopted by Henry (2000) consists of finding the first liberalization date as follows: financial liberalization date corresponds to the announcement date marked by a governmental decree if the latter exists. If the announcement date is unavailable or simply unknown, liberalization date will be the date of the first country funds introduction in relation with the considered emerging market, or the date where a sudden change in the S&P/IFCI index is observed.

The variety of identification methods suggests that a country can liberalize its markets differently, either by governmental decrees or by alternative ways (ADR, and country funds) or both. The choice of liberalization methods depends on a country's preferences for proposing direct or indirect accesses to local markets. Table 2.1 summarizes liberalization dates reported in previous studies. It is worth noting that the absence of consensus on the dates of financial liberalization is a source of true difficulties for the studies seeking to empirically assess the effects of financial liberalization on emerging stock markets. It could also lead to heterogeneous results, and even more to misjudgments about the induced effects of the reforms.

2.3.2 Liberalization Indicators

2.3.2.1 Foreign Capital Flows

Foreign capital flows to emerging markets reflects the macroeconomic effects of financial liberalization and thus constitute the first effective indicator of the said reform. They are mainly composed of foreign direct investments (FDI), international portfolio equity flows, bank loans and deposits. IMF (2001)'s report on developments and prospects of international capital markets shows a decreasing trend of private capital flows to emerging markets after the 1997–1998 Asian financial crisis as well as a significant change in the composition of the flows over the period 1990–1999.

A close look on Table 2.2 typically gives rise to the following facts. Overall net private capital flows tend to grow in the early part of the 1990s and to decrease at the end of this decade. The breakpoint is observed in 1995 which totalized $226.9 billion. The ratio of net private capital flows to GDP also reflects this tendency as well, which is indeed explained by important decline of bank loans and portfolio

[1]The S&P/IFCI measures the portion of emerging market capitalization that can be theoretically held by foreign investors. Its constituents comprise the most liquid stocks listed in the domestic marketplace where foreign ownership is possible. A dramatic increase in the investable index thus reflects a higher degree of emerging market openings.

Table 2.1 Stock market liberalization dates

Markets	Bekaert and Harvey (2000)				Kim and Singal (2000)	Henry (2000)
	(1)	(2)	(3)	(4)	(5)	(6)
Argentina	11-1989	08-1991	10-1991	04-1993	11-1989	11-1989
Brazil	05-1991	01-1992	10-1987	06-1986	05-1991	03-1988
Chile	01-1992	03-1990	09-1989	01-1988	10-1989	05-1987
Colombia	02-1991	12-1992	05-1992	08-1993	02-1991	12-1991
Greece	12-1987	08-1988	09-1988	12-1986	08-1986	n/a
India	11-1992	02-1992	06-1986	04-1993	11-1992	06-1986
Indonesia	09-1989	04-1991	01-1989	06-1993	09-1989	n/a
Israel	11-1993	08-1987	10-1992	n/a	n/a	n/a
Jamaica	09-1991	06-1993	n/a	n/a	n/a	n/a
Jordan	12-1995	12-1997	n/a	n/a	01-1978	n/a
South Korea	01-1992	11-1990	08-1984	03-1993	01-1992	06-1987
Malaysia	12-1988	08-1992	12-1987	04-1992	n/a	05-1987
Mexico	05-1989	01-1989	06-1981	05-1990	05-1989	05-1989
Morocco	06-1988	04-1996	n/a	n/a	n/a	n/a
Nigeria	08-1995	05-1998	n/a	n/a	n/a	n/a
Pakistan	02-1991	09-1994	07-1991	04-1993	02-1991	n/a
Philippines	06-1991	03-1991	05-1987	01-1990	03-1986	05-1986
Portugal	07-1986	06-1990	08-1987	08-1994	07-1986	n/a
Taiwan	01-1991	12-1991	05-1986	08-1992	02-1991	05-1986
Thailand	09-1987	01-1991	07-1985	07-1988	08-1988	01-1988
Turkey	06-1989	07-1990	12-1989	12-1989	08-1989	n/a
Venezuela	01-1990	08-1991	n/a	02-1994	01-1990	01-1990
Zimbabwe	06-1993	n/a	n/a	n/a	07-1993	n/a

Notes: (1): Official liberalization dates; (2): Introduction of the first ADR; (3): Introduction of the first country funds; (4): Dates of the structural changes in the US capital flows; (5): Effective liberalization dates; (6): First liberalization date; n/a: not available

investment flows. The succession of various financial crisis and turbulences which rescued emerging countries during the 1990s has undoubtedly been responsible for this deterioration.

There was a very sharp rise in capital flows into emerging markets in the period 2002–2007 (Table 2.3). Private capital outflows from these markets have also risen sharply as local investment funds have attempted to diversify into foreign assets and as local corporations have expanded their operations overseas. It is however important to note that the expansion was not enough to offset the growing current account surpluses and foreign capital inflows, which typically result in an accumulation of foreign exchange reserves at an unprecedented level.

Figure 2.1 depicts the renewed upswing set in capital inflows to emerging markets from 2000 to 2007, as global measure of external financing sources. Other investment including bank loans and deposits have become the most important type of foreign capital inflows with an increase of 166.77% in 2007 ($967.6 billion) compared to their level in 2006 ($362.7 billion), while in the late 1990s bank loans and deposits were characterized by a sharp decline. The total capital outflows from emerging markets also increased remarkably since 2004 and reached more than $2800 billion. This gives evidence of growing interest of emerging

Table 2.2 Capital inflows to emerging markets: 1990–1999

Types of flows	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Net FDI	19.5	28.8	35.4	54.9	84.0	92.6	113.2	138.6	143.3	149.8
Portfolio investment	6.2	22.5	56.1	84.4	109.6	36.9	77.8	52.9	8.5	23.3
Bank loansanddeposits	14.2	41.7	21.0	28.3	−57.3	97.4	24.9	−44.0	−76.7	−92.5
Total	39.8	92.9	112.6	172.1	136.3	226.9	215.9	147.6	75.1	80.5
In proportion of the GDP (%)										
Net FDI	n/a	n/a	2.3	3.0	2.3	3.5	3.0	2.0	1.1	1.1
Portfolio investment	n/a	n/a	0.7	1.0	1.4	1.4	1.6	1.9	2.1	2.1
Bank loansanddeposits	n/a	n/a	1.1	1.5	1.9	0.6	1.1	0.7	0.1	0.3

Notes: All the amounts are expressed in billions of US dollars. n/a: not available. Data are from *International Capital Markets: Developments, Prospects, and Key Policy Issues* (IMF 2001)

Table 2.3 Capital inflows to and outflows from emerging markets: 2000–2007

Types of flows	2000	2001	2002	2003	2004	2005	2006	2007
Net FDI	212.0	227.9	190.1	203.8	276.4	374.2	464.0	532.5
Portfolio investment	96.8	16.0	−7.8	91.8	138.6	213.2	347.2	474.8
Bank loansanddeposits	2.1	−56.6	3.3	124.1	200.4	170.9	362.7	967.6
Total capital inflows	*310.9*	*187.3*	*185.6*	*419.7*	*615.4*	*758.3*	*1173.9*	*1974.9*
Net FDI	−100.6	−52.1	−49.7	−42.7	−130.2	−145.4	−262.3	−332.3
Portfolio investment	−105.8	−110.1	−90.0	−129.7	−170.5	−263.8	−528.6	−511.2
Bank loansanddeposits	−131.5	43.2	14.6	−140.3	−198.4	−261.1	−415.0	−782.3
Reserve assets	−139.8	−132.7	−191.3	−360.6	−501.9	−585.7	−751.7	−1,257.8
Total capital outflows	*−477.7*	*−251.7*	*−316.4*	*−673.3*	*−1,001*	*−1256*	*−1,957.6*	*−2,883.5*

Notes: The total net capital (in/out) flows are the sum of net FDI, portfolio investment, bank loans and deposits, and reserve assets. Sample markets include the group of emerging market and developing countries defined in the World Economic Outlook, together with Hong Kong SAR, Israel, Korea, Singapore, and Taiwan Province of China (*IMF's Global Financial Stability Report*, April 2009. Amounts are in billions of US dollars

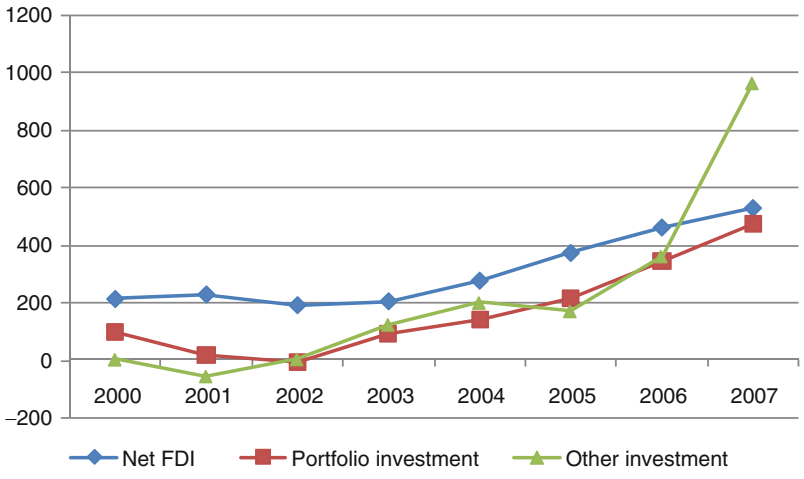

Fig. 2.1 Trends in foreign capital inflows to emerging markets

market investors for foreign financial assets as well as of increasing degree of financial integration between emerging and global markets.

Studying the impact of foreign capital flows on emerging markets is of great interest for both investors and policymakers as different types of capital flows have different impact on stock market development and economic growth. Research works in this field can be divided in several directions.

The first research stream examines whether the dynamics of capital flows can be explained by variations in expected returns (e.g., Edison and Warnock 2003 and references therein). In general, the obtained results show a positive correlation between capital inflows and expected returns, which suggests that foreign investors do only come to emerging markets when their economic and financial outlooks are good, or equivalently when expected returns are high.

The second research stream investigates the impact of capital flows on expected returns (e.g., Froot et al. 2001 and references therein). It is shown that capital flows imply the rise in asset prices due particularly to an increase in demand of foreign investors for emerging market assets. This, in turn, leads to a fall in expected returns. Nevertheless, these studies are not clear-cut about the nature of the impact of capital flows, i.e., some talk about permanent impact whereas others defend the idea of a temporary impact. In fact, if the rise in asset prices is only temporary, it would reflect only price pressures over a short period. Inversely, if price increase is permanent, it would then induce the decline in the cost of capital which leads to economic growth thanks to international risk sharing benefits between domestic and foreign investors. It is evident that permanent rather than temporary effect of capital flows is preferable for emerging markets.

The third research stream discusses the impact of capital flows on the emerging market volatility. Joseph E. Stiglitz, the 2001 Nobel Prize laureate in economics, shows in his recent article which synthesizes the state of the art of financial liberalization policies that capital flows take a large part of responsibility for instability of financial systems in emerging economies over the past decades. More information asymmetry between resident and non-resident investors following financial liberalization causes, according to the author, increased volatility. Some countries already had to impose again capital controls after experiencing successive periods of high volatility (e.g., Malaysia in October 2001). Stiglitz (2000) also stresses on the possibility of stabilizing emerging markets with the huge increase of foreign capital flows as foreign participants would require more transparency, and accurate information disclosure. However, capital flows to emerging markets must not be “hot” capitals which mainly serve speculative trading activities.

2.3.2.2 American Depositary Receipts (ADRs)

ADRs are introduced for the first time by Morgan Guaranty bank in 1927 to help US investors to buy shares listed on overseas markets that might be technically closed to foreign residents (e.g., emerging markets). An ADR is a negotiable certificate

issued by a US depository bank which represents a specified number of shares in a foreign stock that is traded outside the US. ADRs are denominated in US dollars and traded on a US exchange like New York Stock Exchange and American Stock Exchange. US investors interested in investing in foreign firms can do so by purchasing ADRs in the US markets or by purchasing underlying shares in the home market of the foreign firms or doing both. From this viewpoint, US investors are able to realize dividends and capital gains in a foreign country while reducing costs for international transactions (administration, duty fees, etc.) and costs related to trading overseas.

Thus, the emission of emerging marked-based ADRs by depository banks in the US can be viewed as an effective event of financial liberalization as it allows US investors to convert ADRs into emerging market assets according to a predetermined conversion rate. In fact, ADR programs related to emerging markets can precede the official date of market liberalization in many emerging countries.

In order to issue ADRs, a US bank takes custody of the foreign shares in its foreign office. Then an ADR can be issued as claims against these foreign shares. Consider the following example. A Thai company wishes to raise capitals on the US exchanges in the form of ADRs. Before a listing can be submitted to the Securities Exchange Commission, an American broker established in Thailand will purchase shares of the considered company and will entrust them to a representative office of a US bank located in Thailand. When all shares are received, the representative office informs the US bank that the latter can now issue ADRs on the US markets. In principle, an ADR can represent one or more shares of the Thai company. The total US dollar value of ADRs issued is exactly equal to the total value of shares held by the representative office in Thailand after a conversion of Thai baht to US dollar. Based on this mechanism, ADRs convey their holders the right to convert them into underlying shares of the foreign firm or simply to trade out them on the US markets like ordinary regulated shares. ADRs holders also have voting rights and dividend payouts which can interestingly benefit from high potential growth rate in emerging markets. Finally, ADRs can be viewed as a hybrid security in the sense that investors can retire completely from emerging markets when they anticipate worse economic and financial prospects.

ADRs are categorized in different levels depending on the level of information disclosure offered by the foreign company. A company is indeed qualified as Level 1 ADR if it only provides the home country annual report. A Level 2 ADR refers to all companies that meet the disclosure requirements of a US exchange. Companies that comply fully with US accounting principles and disclosure requirements qualify as Level 3 ADRs and they are also authorized to raise equity capital through public offerings. Finally, a company could issue ADRs through a Rule 144a program that limits access to only qualified institutional investors. In this case, US accounting principles or SEC registration and disclosure are not required. Table 2.4 presents the total number of ADR programs related to emerging markets during the period of host liberalizations (Miller 1999).

Over the last two decades, other varieties of ADRs are issued in other stock exchanges of the globe in the form of Global Depository Receipts (GDRs) and

Table 2.4 Number of ADR issuers from emerging markets: 1985–1995

Markets	Types and quality of the ADR listings				Total
	Level 1	Level 2	Level 3	Rules 144a	
Argentina	2	1	1	1	5
Brazil	3	0	0	1	4
Chile	0	2	8	2	12
China	1	0	0	0	1
India	1	0	0	15	16
Indonesia	1	0	0	0	1
South Korea	0	1	1	5	7
Malaysia	2	0	0	0	2
Mexico	3	0	5	2	10
Philippines	1	0	0	1	2
Portugal	1	0	0	0	1
South Africa	2	0	0	0	2
Taiwan	0	0	0	6	6
Thailand	2	0	0	0	2
Turkey	1	0	0	1	2
Venezuela	1	0	0	0	1

International Depository Receipts (IDRs). In general, they are very similar to ADRs, but are offered for sale globally through various branches of an international bank. The issuing currency can be either in US dollars or in euros. These instruments are called European Depository Receipts (EDRs) when they are denominated in euro.

Researches in financial economics are particularly interested in examining the role of ADRs with regard to capital market integration. That is, if capital markets are fully integrated, both ADRs and underlying foreign shares should command the same price of risk. It is generally accepted that ADR issuances permit to integrate national markets with the world markets. Errunza and Miller 's (2000) study shows that ADR programs lead to reduce the cost of capital. This result is consistent with growing market integration.

2.3.2.3 Closed-End Country Funds

A closed-end country fund is a fund that issues shares in its home markets, say for example the US or the UK, and uses the proceeds to invest in the shares of companies in a specific foreign country, say for example South Korea or Argentina. Thus, investing in a closed-end country fund provides exposure to the local market and international diversification. Before the liberalization of stock markets, closed-end country funds provide an investment vehicle to access some emerging financial markets where foreign investors are not lawfully authorized to trade domestic assets. For example, Mexico closed-end country fund is the unique way for US investors to purchase listed shares of Mexican companies until the end of the 1980s.

Closed-end country fund is often managed by an *investment trust* which has a fixed number of shares and holds a certain portfolio in a foreign country. The shares of the fund are traded in the home country's stock market like ordinary stocks as its price would be determined by market demand and supply for the shares. They cannot be redeemed in exchange for the underlying portfolio, but can change hands by buying and selling the representative shares. Accordingly, each fund has two distinct values: the fund value which corresponds to the market capitalization of its shares in the home country; and the net asset value which is equal to the total value of its asset portfolio in the foreign country. In general, fund shares are traded at prices (S) different from the net asset value per share (NAV) due to their inability of redemptions over a certain period. The NAV is announced at regular intervals, weekly or daily. Defining $P = \ln(S) - \ln(NAV)$, the fund is said to trade at premium (discount) when $P > 0$ ($P < 0$). The existence of closed-end country fund premium is often interpreted as limits to arbitrage and investor's irrationality. Table 2.5 provides an incomplete list of closed-end single country funds that are traded in the US as of December, 2005.

Table 2.5 Closed-end single emerging country funds traded in the US

No.	Fund name	IPO date	Change of structure or investment objective	
			Nature of change	Announcement date
1	Argentina	Oct. 1991	Open-end fund	Jun. 2001
2	Brazil	Mar. 1988		
3	Brazilian equity	Apr. 1992		
4	Chile	Oct. 1989		
5	Fidelity advisor Korea	Oct. 1994	Open-end fund	Mar. 2000
6	First Philippines	Nov. 1989		
7	Indonesia	Mar. 1990		
8	India	Feb. 1994		
9	India growth	Aug. 1988		
10	MSDW India	Feb. 1994		
11	Jardine fleming India	Mar. 1994		
12	Jakarta growth	Apr. 1990	Merging with another closed-end fund	Oct. 2000
13	Korea equity	Nov. 1993		
14	Korea	Aug. 1984		
15	Korea investment	Feb. 1992	Open-end fund	Sep. 2001
16	Emerging Mexico	Oct. 1990	Liquidating	Oct. 1998
17	Malaysia	May 1987		
18	Mexico equity and income	Aug. 1990		
19	Mexico	Jun. 1981		
20	ROC Taiwan	May 1989		
21	Thai capital	May 1989		
22	Templeton Russia	Jun. 1995	Converting to new closed-end fund	Feb. 2002
23	Thai	Feb. 1988		
24	Taiwan	Dec. 1986		
25	Taiwan equity	Jul. 1994	Liquidating	Dec. 1999

Notes: closed-end country fund information is retrieved from the Wall Street Journal (various issues)

There is another category of funds, named open-end country funds, which can issue and redeem shares at any time on the basis of the net asset value per share which des vary with respect to the fund performance. In practice, investors of closed-end funds often require higher premium to compensate for the higher risk taken compared to open-end funds.

Similar to ADRs, closed-end country funds offer an attractive research design for examining the degree of world equity market integration. The simplest econometric test of market integration consists of testing the equality between the fund value and its foreign net asset value. For instance, Nishiotis (2002) does not reject the market integration hypothesis using country fund data and suggest that the introduction of closed-end country funds leads to increased financial integration. Errunza et al. (1998) assess that country funds, despite their small size compared to the total market capitalization, help reduce the cost of capital, and as a result constitute a channel for international capital market integration. Based on an event-study of returns around country fund launchings, Tandon (1997) provides empirical evidence in favor of these claims.

2.4 Dynamics of Liberalization Process

This section shows that liberalization process in emerging markets is not only a gradual and complex one over time, but it can be also reverted. Several implications for evaluating the impact of financial liberalization are then presented.

2.4.1 The Gradual Process of Financial Liberalization

It is generally accepted that financial liberalization is not composed of a single event, but a succession of events. The idea is that this market reform is a gradual process where the dates previously identified only refer to the most significant events. To illustrate the progressive liberalization, consider the following cases. Stock exchange in Chile was indeed liberalized in May 1987 following the introduction of the first closed-end country fund, called "The Toronto Trust Mutual Fund", but the participation of foreign investors are still restricted by certain specific laws. For example, the Law 18657 of 1987 requires that foreign funds must be invested over a period of 5 years before they can be repatriated. At the beginning of the 1990s, other restrictions on foreign capital flows were successively imposed.

Argentina is another emerging country which has also shared the same experiences. In fact, this country was actively engaged in a course of intensive financial liberalization process since 1977. Market openings led, however, Argentina to harmful consequences such as the 1982 debt crisis. Prudential measures were then adopted to avoid a country bankruptcy. Toward the end of the 1980s,

Argentina undertook again its liberalization initiatives which started with the adoption of the New Foreign Investment Regime in October 1989.[2] The Argentinean stock market was considered as completely liberalized in October 1991 after the government announced the market deregulation degree. However, Argentina was forced to reintroduce regulatory controls on interest rates and international capital mobility during its monetary crisis of 2001.

Overall, the preceding examples are suggestive of the fact that financial liberalization is not only a gradual process, but it can take times to complete and experience reverting events.

2.4.2 The Intensity of Liberalization

Measuring the intensity of financial liberalization is naturally of great interest for investors to the extent that they can apprehend the degree of market openings in emerging countries. The most important thing to mention is however that the intensity of liberalization is not identical across emerging countries since each of them liberalizes its capital markets differently. Factors that may affect the policy-makers' decisions include essentially those related to the country's economic conjuncture, financial conditions (bearish or bullish markets) and political context. As discussed in Sect. 2.3, some countries prefer to give direct market access by regulatory deregulation, while the others facilitate indirect market access through approving country fund and ADR programs. Consequently, country-specific factors that imply different behaviors in managing financial liberalization will significantly affect liberalization intensity.

Several measures of liberalization intensity have been proposed. For example, the IFC's attempt is to build liberalization intensity indices to capture both liberalization and repression regimes in emerging markets. The IMF also tries to construct this type of index while being based on information about international capital mobility controls.

In finance, as far as the intensity of liberalization is concerned, the measure suggested by Bekaert (1995) is often cited. Indeed, for each emerging market, this measure is constructed by relating the market capitalization of the S&P/IFC Investable index to that of the S&P/IFC Global index (investability ratio, IR_{it}) as follows:

$$IR_{it} = \frac{MC_{it}^{IFCI}}{MC_{it}^{IFCG}}$$

[2]In addition to the introduction of a free exchange rate regime, all legal limits on foreign investment are abolished. Legal limits regarding type or nature of foreign investment are also suppressed. Capital gains and dividends can now be repatriated freely. There is no need for prior approval of transactions.

Here, *MC* denotes the market capitalization at time t of the two indices considered for each emerging market. Note that S&P/IFCG represents the total market capitalization, while IFCI measures the fraction of the local market which is legally accessible to foreign investors. An investability ratio equal to one means that emerging market considered is fully liberalized. Inversely, the market completely closed for foreign participation is characterized by a zero-value ratio. It should be noted that investability ratios only reflect the evolution of market deregulation reforms as it relies on the theoretical level of foreign participation. In addition, the intensity of capital controls can be straightforwardly deduced from the investability ratio by subtracting it from one. The value of the obtained measure varies between zero and one, where zero indicates an open market with lowest degree of capital controls and one a market with highest degree of capital controls.

Figure 2.2 presents the intensity of financial liberalization for selected emerging markets (three Latin American and three Asian markets) over the period from December 1988 to April 2000. The vertical line indicates the official liberalization date of Bekaert and Harvey (2000).

It is observed that the degree of market openness is very specific to each market. In all cases, the abolition of financial restrictions was gradual and only nearly complete in the late 1990s. Some reversion periods appear in the time-paths of the investability indices. Specifically, the official liberalization decision in Brazil was found to coincide with an abrupt change in the intensity of liberalization measure (from 19.98% in May 1991 to nearly 57% in June 1991). This was not the case for other markets.

Kaminsky and Schmukler (2003) propose a more refined measure of capital restrictions based on a detailed chronology of 28 countries' experiences over the 1973–1999 period. The information collected covers three types of liberalization: capital account liberalization (loans and controls on foreign exchange rate and exit conditions of capital flows), liberalization of financial sector (regulations on interest rates and bank deposits in foreign currencies) and stock market liberalization (foreign ownership and repatriation of funds invested as well as dividends and interests). The said measure admits three different regimes: a value of 1 indicates full liberalization, of 2 indicates partial liberalization, and of 3 indicates a complete repression. Empirical results of the study show a decreasing tendency in repression measures for a sample of 14 emerging markets during the 1990s. However, liberalization was not complete yet.

Bekaert and Harvey (1995) develop a time-varying measure of capital market integration using a conditional regime-switching approach. The dynamics of the integration measure is modeled as a time-varying weight which is applied to conditional covariance between an emerging country's market returns and world market returns (world systematic risk), and conditional variance of this country's market returns (local systematic risk). The regime shifts between segmentation and integration are governed by transition probabilities whose dynamics depend on some information variables specific to emerging market considered (lagged equity market capitalization as proportion of GDP and dividend yields). Empirical results effectively confirm the time-varying pattern of world market integration under the effects of financial liberalization process.

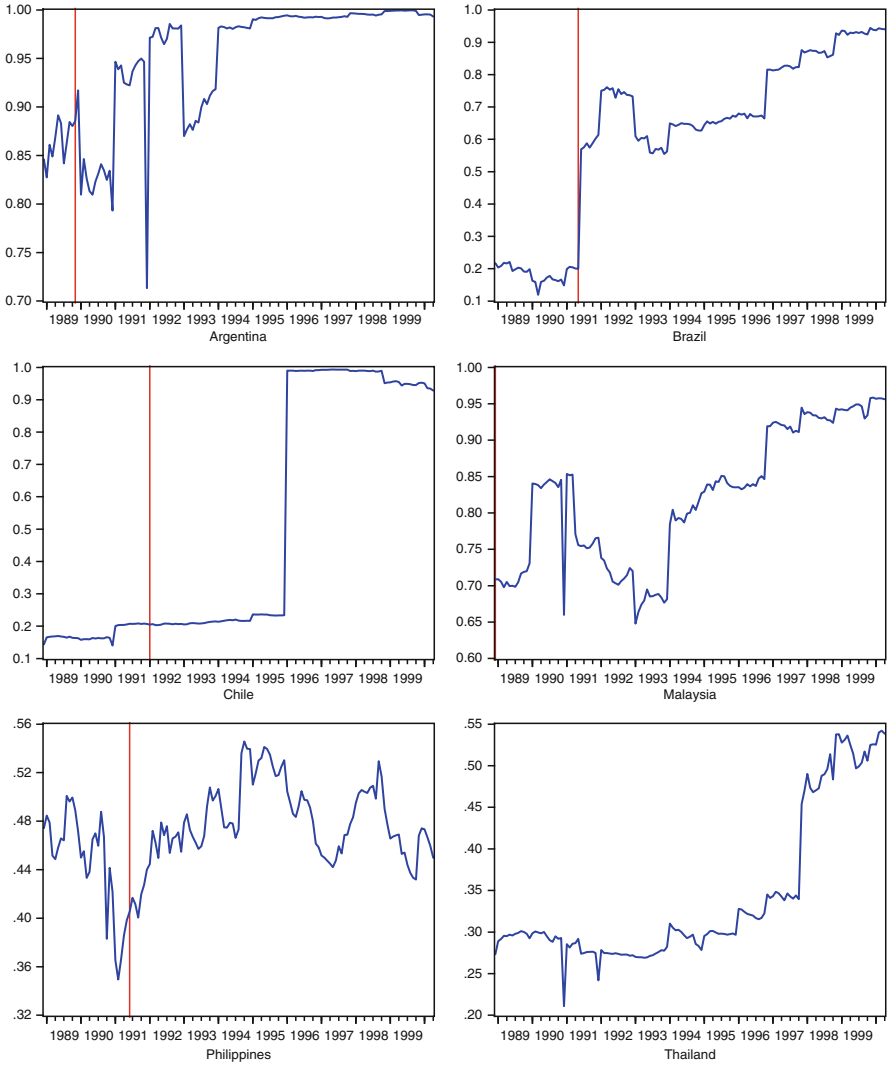

Fig. 2.2 Intensity of financial liberalization in selected markets

Table 2.6 recapitulates the current state of market openings in emerging countries. The information set includes entry and exit restrictions on foreign investment flows as well as withholding tax rates applied to interest and dividend payments. Accordingly, 22 of the 33 emerging countries are freely accessible to non-resident investors. Countries such as Saudi Arabia, Colombia, and Taiwan are the most restrictive in terms of ownership restrictions. In general, withholding tax rates vary between 0% and 34% with a slightly decreasing trend in recent years.

Table 2.6 Degree of market openings in selected emerging countries

Accessibility	Repatriation		Withholding tax*	
	Incomes	Capital	Interests (%)	Dividends (%)
Free entry				
Argentina	Free	Free	0	0
Brazil	Free	Free	15	0
Chile	Free	Free	4	18.5
China (Actions B, H)	Free	Free	10	10
Czech Republic	Free	Free	0	15
Hungary	Free	Free	0	20
Israel	Free	Free	25	25
Mexico	Free	Free	34	0
Morocco	Free	Free	10	10
Nigeria	Free	Free	10	10
Pakistan	Free	Free	10	10
Poland	Free	Free	27	15
Russia	Free	Free	0	15
Slovak	Free	Free	15	15
South Africa	Free	Free	0	0
Turkey	Free	Free	0	11
Venezuela	Free	Free	34	0
Relatively free entry				
India	C.R	C.R	20	0
Indonesia	C.R	C.R	20	20
South Korea	Free	Free	13.2	16.5
Malaysia	Free	Free	0	0
Sri Lanka	Free	Free	15	10
Thailand	Free	Free	15	10
Zimbabwe	Free	Free	10	20
Special types of shares				
Philippines	Free	Free	32	15
Only authorized investors				
Colombia	Free	Free	7	0
China (Actions A)	Free	C.R	10	10
Taiwan	C.R	C.R	20	25
Closed				
Saudi Arabia	C.R	C.R	0	0

Source: *S&P'S Global Stock Markets Factbook 2004*; *: applicable tax rates for American institutional investors; C.R de notes "certain restrictions"

2.4.3 Challenges in Measuring Liberalization Effects

Event-study methodology is often employed to evaluate the impact of financial liberalization. Official liberalization dates serve in general as breakeven point. Although it is easy to implement, this approach does not seem to be relevant since markets may anticipate and react to liberalization events well before announcement dates. Using the intensity measures of liberalization is preferable to the extent that they capture the gradual effects of liberalization. One must however deal either with the unavailability of financial data in emerging markets or with the difficulties of specifying an accurate asset pricing models or both.

Effectively, the dynamic measure proposed by Bekaert (1995) and Edison and Warnock (2003) are unavailable over the pre-liberalization period even they offer some economic interpretations regarding the gradual impacts of the market reform. The time-varying market integration measure of Bekaert and Harvey (1995), albeit complex and fruitful, provides unfortunately a partial story of financial liberalization because it depends only on two information variables. Finally, the measure developed by Kaminsky and Schmukler (2003) does take into account only extreme situations of liberalization.

Various aspects must be considered in order to correctly assess the impact of financial liberalization:

- The market could have immediate responses to disseminated information, i.e., both official and effective liberalization events may exert instantaneous effects on stock prices.
- Market participants might anticipate and react prior to liberalization event due to the existence of rumors or a time-lag between announcement and effective dates of liberalization.
- The market could have delayed reactions to liberalization events. This idea results from the fact that liberalization is gradual process and subsequent events can follow the first liberalization.
- Financial liberalization is part of general economic and financial reforms which simultaneously affect emerging markets. So changes in emerging market behavior would not be due only to liberalization. As a result, it is important to control for the impacts of simultaneous reforms.
- Country-specific factors such as economic and political environment could also have great influences the changes in banking and financial sector. Many countries opened up their capital markets to foreign investors at the times of good economic prospects to avoid selling assets at a discount. These factors also need to be controlled.

Taken together, the above discussions suggest that empirical studies have to consider three types of variables at the same time: qualitative variables (or dummy variables) for capturing the immediate effects of liberalization (announcement date, introduction of ADR and country fund date, etc.); information variables for capturing the gradual effects of liberalization (indicators of market liquidity, market development, market integration, etc.); and control variables for isolating the impacts of other simultaneous reforms (interest rate, exchange rate, inflation rate, political stability indicator, etc.).

2.5 Financial Impacts of Liberalization

The impact of financial liberalization has been investigated by a number of works in both finance and economic development literature. This section reviews major results of past studies and proposes several assessments on the impact of liberalization on

emerging stock markets. Topics discussed include the cost of capital, stock market volatility, cross-market correlation and stock market development over the pre- and post-liberalization periods.

2.5.1 Cost of Capital

In a completely segmented market, a portfolio's expected returns depend on local price of risk and covariance of the asset returns. Prior to financial liberalization, only domestic investors are legally allowed to hold emerging market assets. When domestic market is opened to foreign capital flows, expected returns would be functions of the world price of risk and covariance of international asset returns. Practically, the world price of risk never exceeds the local price of local risk due to its lower volatility. Besides, international assets are less correlated than domestic assets as the economic structure generally differs across countries. In this scheme of things, liberalization should lead to a reduction in investor's expected returns (or cost of capital).

The above theoretical prediction has been largely examined in financial literature (Baley and Jagtiani 1994 and references therein). Past studies can be divided into two major research streams according to their methodology. The first stream examines the changes in expected returns using an explicit asset pricing model whereas the second studies these changes from an event study. They have however a point in common: study period is divided into pre- and post-liberalization subperiods before testing the differences in expected returns. Official dates of liberalization are used as breakpoint.

Formally, the first research stream provides evidence of decrease in the cost of capital after market openings because of the huge increase in demand for domestic assets and international risk sharing effects. When emerging markets switch from a repression state to a liberalized state, expected returns behave as follows:

- Prior to liberalization, high expected returns as required by domestic investors indicate high cost of capital.
- Temporary increase in asset prices during the "host" liberalization period due to high external demand leads thereafter to a fall in expected returns and thus the cost of capital.
- New equilibrium is set after liberalization. Domestic firms are now able to raise public funds at a lower cost of capital while foreign investors benefit from diversifying their portfolio and taking advantage of high growth rate offered by emerging markets.

The second research stream measures the reaction of expected returns around liberalization events. Several studies including in particular Henry (2000); Kim and Singal (2000), and Bekaert and Harvey (2000) report a significant reduction in expected returns in a follow-up of market openings. The result remains unchanged when control variables are introduced.

Figure 2.3 illustrates changes in observed returns over the liberalization period. A tendency of reduction of overall market returns (as an indicator of cost of equity changes) is observed in most of the studied markets.[3]

Whether these changes in observed returns are significant are examined using right-side unilateral statistical test (Z-*test*). Denoting average returns before and after liberalization by μ_0 and μ respectively, the null and alternative hypothesis are as follows:

$$H_0 : \mu = \mu_0$$
$$H_1 : \mu \succ \mu_0$$

The empirical statistics used to choose between H_0 and H_1 is

$$z^* = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Where $\bar{x}$ refers to average return calculated over the 60-month period following financial liberalization. n is the number of observations (n = 60). Under the assumption of the normality of stock returns, z^* follows a standard normal distribution

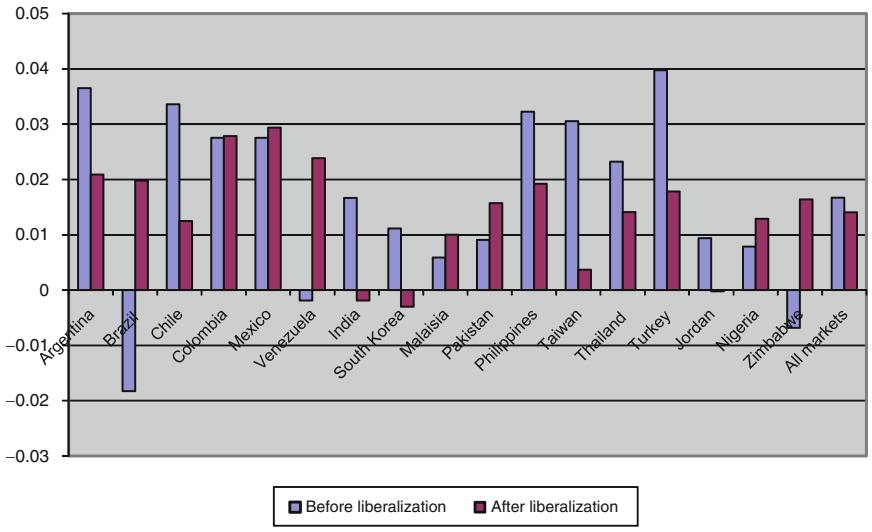

Fig. 2.3 Changes in average returns: 60 months before and after liberalization.
Notes: Continuously compounded returns at monthly frequency on S&P/IFCG indices with reinvested dividends are used. Official liberalization dates of Bekaert and Harvey (2000) are used as breakpoint

[3]Note that this analysis does not resort to neither asset pricing models nor event study as they requires the definition of a benchmark pricing model which accurately describes the dynamics of emerging market returns. None of the existing models satisfies however this necessary condition.

Table 2.7 *Z*-test results

Markets	Before liberalization	After liberalization	Z-test		
			Mean changes(%)	z^*stat.	*p*-value
Argentina	0.04	0.02	−1.56	−0.68	0.75
Brazil	−0.12	0.02	+13.65	2.21	0.01
Chile	0.03	0.01	−2.11	−2.27	0.99
Colombia	0.03	0.03	+0.03	0.02	0.49
Mexico	0.03	0.03	+0.19	0.19	0.43
Venezuela	0.00	0.02	+2.57	1.39	0.08
India	0.02	0.00	−1.85	−1.72	0.96
South Korea	0.01	0.00	−1.42	−1.48	0.93
Malaysia	0.01	0.01	+0.41	0.36	0.36
Pakistan	0.01	0.02	+0.67	0.54	0.29
Philippines	0.03	0.02	−1.30	−1.30	0.90
Taiwan	0.03	0.00	−2.69	−2.06	0.98
Thailand	0.02	0.01	−0.91	−0.72	0.76
Turkey	0.04	0.02	−2.19	−0.61	0.73
Jordan	0.01	0.00	−0.96	−2.36	0.99
Nigeria	0.01	0.01	+0.51	0.56	0.29
Zimbabwe	−0.01	0.02	+2.32	1.49	0.07

Notes: The critical values of the Z-*test* associated with 5% and 10% levels are 1.64 and 1.28 respectively

under H_0. H_0 is rejected if $z^* \geq Z$, where Z is critical value resulting from the table of standard normal distribution such as Prob. $(z^* \geq Z) = 0.05$. Because of symmetry of normal distribution, if $\mu < \mu_0$, the test will result in a *p*-value larger than 0.9. Table 2.7 summarizes the obtained results.

Three categories of results are obtained. First, the null hypothesis of equality of average returns is clearly rejected at conventional levels in three markets (Brazil, Venezuela and Zimbabwe). Pre-opening period's average returns are higher than those of the post-opening period. Second, in six emerging markets (Chile, India, Taiwan, Philippines, South Korea and Jordan), the significance level of the empirical statistics z^* exceeds 0.90. This indicates that average returns were lower in the post-opening period than in the pre-opening period. Finally, the results reject the alternative hypothesis for all remaining markets, leading to conclude on insignificant impacts of market openings on average returns.

2.5.2 Observed Volatility

The impact of liberalization on stock market volatility is not conclusive at both theoretical and empirical levels. Some would argue in favor of a volatility decline thanks to higher degree of market transparency and information quality, while the others predict an increased volatility due particularly to the free mobility of "short-term" capital flows.

Kaminsky and Schmukler (2003) investigate the relation between liberalization and recent financial instability in emerging markets through comparing the characteristics of market cycles during the periods of repression and liberalization. They show that stock market cycles in both developed and emerging countries are not intensified by liberalization. Moreover, market deregulation tends to amplify stock market cycles only right after liberalization announcements, but the level of volatility is not worrying any more 4 years later.

Changes in emerging stock market volatility around market openings are illustrated by Fig. 2.4. Accordingly, one should note that volatility behavior is quite specific to each market. Among the 17 markets studied, 12 markets experienced a decline in volatility over a 60-month period after liberalization while market volatility increased in the five remaining markets.

F-test is then used to check for the statistical significance of volatility changes. Assume that stock returns follow a normal distribution $N(\mu_1,\sigma_1)$ over the 60-month period prior to liberalization and $N(\mu_2,\sigma_2)$ over the 60-month period after liberalization. The comparison test of two subsample variances is written as:

$$H_0 : \sigma_1^2 = \sigma_2^2$$
$$H_1 : \sigma_1^2 \neq \sigma_2^2$$

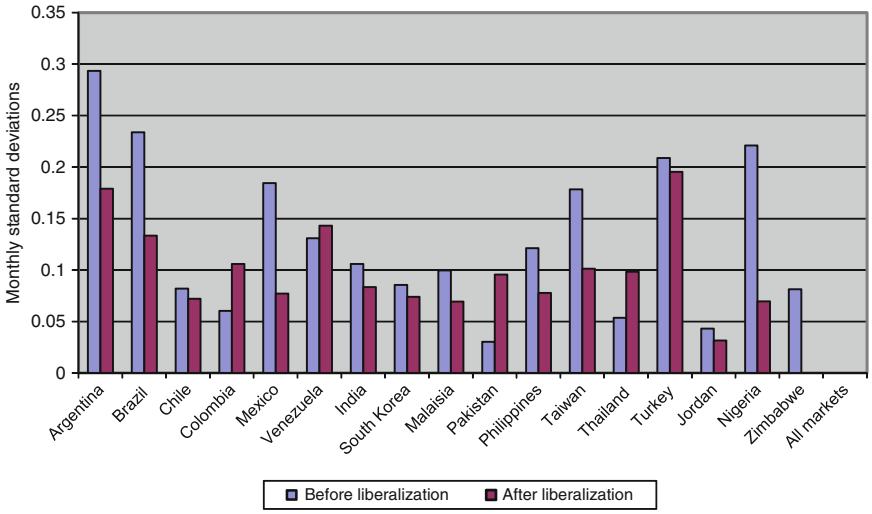

Fig. 2.4 Changes in unconditional volatility: 60 months before and after liberalization. Notes: unconditional volatility is measured by standard deviation of continuously compounded returns at monthly frequency on S&P/IFCG indices. Official liberalization dates of Bekaert and Harvey (2000) are used as breakpoint

The empirical statistics used to make decision between H_0 and H_1 is

$$F^* = \frac{s_1^2}{s_2^2}$$

where s_1^2 and s_2^2 are empirical variances of two subsamples respectively. Under the null hypothesis, F^* follows a Fisher–Snedecor distribution with (n_1-1) and (n_2-1) degrees of freedom where n_1 and n_2 refer to the number of observations of two respective subsamples. H_0 is rejected when $F \leq c_1$ or $F \geq c_2$, where c_1 and c_2 are critical values of the unilateral F-test on the left and on the right at a selected level of significance.

The inspection of the obtained results from F-test (Table 2.8) indicates that the null hypothesis cannot be rejected in 4 of the 17 studied markets (Chile, Venezuela, South Korea and Turkey). Market volatility increased significantly in Colombia, Pakistan, Thailand and Zimbabwe after their openings. As for the remaining markets, F-test indicates significant reduction in the return variances. Using a bivariate GARCH-in-mean model which counts for partial market integration and a time-series cross-section analysis, Nguyen and Bellalah (2008) show that on average, liberalization has insignificant effects on emerging market volatility. The volatility is however lowered when the participation of US investors in domestic markets becomes effective and important, and also when emerging markets increase in size. Note that in their study the results are controlled for the potential impacts of other reforms.

Table 2.8 F-test results

Markets	Before liberalization	After liberalization	F-test		
			Variance changes(%)	F-stat.	p-value
Argentina	0.09	0.03	−5.40	2.69	0.00
Brazil	0.05	0.02	−3.69	3.07	0.00
Chile	0.01	0.01	−0.15	1.29	0.16
Colombia	0.00	0.01	+0.76	0.32	0.00
Mexico	0.03	0.01	−2.81	5.73	0.00
Venezuela	0.02	0.02	+0.33	0.84	0.24
India	0.01	0.01	−0.42	1.61	0.03
South Korea	0.01	0.01	−0.18	1.34	0.13
Malaysia	0.01	0.00	−0.51	2.06	0.00
Pakistan	0.00	0.01	+0.82	0.10	0.00
Philippines	0.01	0.01	−0.87	2.44	0.00
Taiwan	0.03	0.01	−2.16	3.11	0.00
Thailand	0.00	0.01	+0.68	0.30	0.00
Turkey	0.04	0.04	−0.54	1.14	0.31
Jordan	0.00	0.00	−0.09	1.87	0.01
Nigeria	0.05	0.00	−4.40	10.09	0.00
Zimbabwe	0.01	0.01	+0.79	0.46	0.00

Notes: The left-side and right-side unilateral critical values of the F-test associated with 5% level are 0.64 and 1.54 respectively

2.5.3 Unconditional Cross-Market Correlation

With regard to the correlation between emerging and developed markets, it is widely accepted that:

- Emerging markets are slightly correlated with developed markets and also between themselves.
- Emerging markets tend to move much closer together with developed markets in an increasing global financial integration.

Most existing studies seem to agree about the fact that liberalization leads to increased correlation between emerging markets and other markets of the world. Table 2.9 confirms this proposition as well.

To highlight this tendency, changes in correlation between emerging and world market indices over a shorter period (60 months before and after official liberalization dates) are presented in Fig. 2.5.

A comparison test of correlations is performed to show the significance of correlation changes. To do so, correlation coefficients of the two subsamples are first standardized using Fisher transformation:

$$z = 0.5 \ln\left(\frac{1+\rho}{1-\rho}\right)$$

where ρ refers to the correlation coefficient which varies from -1 to $+1$. Accordingly, z varies between 0 and ∞. This transformation permits to generate distributional characteristics for the correlation efficient considered. The empirical statistics used to chose between the null (H_0: $\rho_1 = \rho_2$) and the alternative (H_1: $\rho_1 \neq \rho_2$) is

$$z^* = \frac{z_2 - z_1}{\sigma_{z_2 - z_1}} \text{ where } \sigma_{z_2 - z_1} = \sqrt{\frac{1}{n_2 - 3} + \frac{1}{n_1 - 3}}$$

In these expressions, z_1 and z_2 are respectively transformed correlation coefficients before and after financial liberalization. n_1 and n_2 are respectively the number of observations for two subsamples. Under the null hypothesis, z^* follows a Student distribution with one degree of freedom. The null hypothesis is rejected when $z \leq -t$ or $z \geq t$, where t is the critical value resulting from Student-t statistical table. The results, reported in Table 2.10, indicate that changes in correlation with the World market index are significant in only three emerging markets (Argentina, Brazil and Malaysia). As for the remaining markets, there is no evidence to support significant changes in correlations.

Obviously, the test results are not entirely consistent with previous studies insofar as correlation coefficients with world stock market do not systematically increase for all studied markets in the aftermath of financial liberalization.

Table 2.9 Unconditional correlation matrix: emerging versus G7 and World markets

Correlations before liberalization												
Markets	Arg.	Bra.	Chi.	Mex.	Ven.	Ind.	Kor.	Mal.	Phi.	Tai.	Tha.	Zim.
France	0.28	−0.06	0.17	0.31	−0.05	0.25	−0.04	0.47	0.11	0.19	0.37	−0.15
US	0.00	0.01	0.53	0.64	−0.04	0.01	0.25	0.81	0.42	0.30	0.64	−0.07
Italy	−0.07	0.04	−0.08	0.03	−0.12	−0.07	−0.11	0.27	0.09	0.09	0.28	−0.03
UK	−0.14	−0.00	0.24	0.39	0.08	0.03	0.26	0.77	0.29	0.21	0.52	0.12
Germany	−0.02	0.09	0.26	0.36	−0.35	0.05	−0.05	0.39	0.13	0.05	0.41	−0.12
Canada	−0.00	−0.02	0.44	0.45	0.06	−0.04	0.29	0.75	0.41	0.25	0.62	−0.05
Japan	−0.20	−0.01	0.02	0.16	0.06	−0.06	0.10	0.34	0.16	0.22	0.25	0.41
World	−0.12	0.03	0.33	0.48	−0.00	−0.01	0.22	0.74	0.35	0.30	0.58	0.15
Correlations after liberalization												
Markets	Arg.	Bra.	Chi.	Mex.	Ven.	Ind.	Kor.	Mal.	Phi.	Tai.	Tha.	Zim.
France	0.35	0.17	0.22	0.32	0.07	0.12	0.16	0.28	0.39	0.32	0.29	0.10
US	0.43	0.24	0.39	0.44	0.14	0.03	0.23	0.40	0.40	0.24	0.40	0.20
Italy	0.13	0.32	0.19	0.23	0.14	0.02	0.22	0.13	0.29	0.25	0.23	0.14
UK	0.25	0.26	0.25	0.31	0.09	0.00	0.24	0.29	0.29	0.23	0.26	0.13
Germany	0.10	0.18	0.20	0.27	0.04	0.00	0.11	0.35	0.44	0.38	0.34	0.12
Canada	0.41	0.29	0.41	0.49	0.30	0.07	0.29	0.50	0.53	0.30	0.44	0.30
Japan	0.09	0.26	0.06	0.23	0.00	−0.08	0.43	0.24	0.22	0.25	0.27	0.17
World	0.31	0.37	0.30	0.44	0.10	−0.01	0.36	0.44	0.44	0.36	0.43	0.21

Notes: Arg.: Argentina; Bra.: Brazil, Chi.: Chile, Mex.: Mexico, Ven.: Venezuela, Ind.: India, Kor.: South Korea, Mal.: Malaysia, Phi.: Philippines, Tai.: Taiwan, Tha.: Thailand, Zim: Zimbabwe. For the markets such as Argentina, Brazil, Chile, Mexico, India, South Korea, Thailand, and Zimbabwe, the pre-liberalization period is from January 1980 to December 1989, while the post-liberalization period is from January 1990 to December 1999. For other markets, these periods are respectively from January 1985 to December 1989 and from January 1990 to December 1999

Table 2.10 Test of changes in unconditional correlations around liberalization

Markets	Coefficient of correlation		Statistical test		
	Before liberalization	After liberalization	Changes	z^*stat.	*p*-value
Argentina	−0.124	0.317	+0.441	3.464	0.000
Brazil	0.031	0.374	+0.343	2.769	0.005
Chile	0.336	0.300	−0.036	−0.306	0.759
Colombia	0.100	0.146	+0.046	0.289	0.772
Mexico	0.483	0.441	−0.042	−0.408	0.682
Venezuela	−0.009	0.100	+0.109	0.676	0.498
India	−0.010	−0.010	+0.000	0.000	1.000
South Korea	0.227	0.360	+0.133	1.115	0.264
Malaysia	0.128	0.445	+0.317	2.165	0.030
Pakistan	0.138	0.065	−0.073	−0.393	0.693
Philippines	0.351	0.448	+0.097	0.715	0.474
Taiwan	0.308	0.361	+0.053	0.369	0.711
Thailand	0.261	0.436	+0.175	1.530	0.125
Jordan	0.223	0.159	−0.064	−0.508	0.611
Turkey	0.167	0.174	+0.007	0.036	0.970
Nigeria	−0.071	0.076	+0.147	0.911	0.361
Zimbabwe	0.156	0.212	+0.056	0.443	0.657

Notes: The critical value of the *t*-test associated with 5% level is approximately equal to 1.96

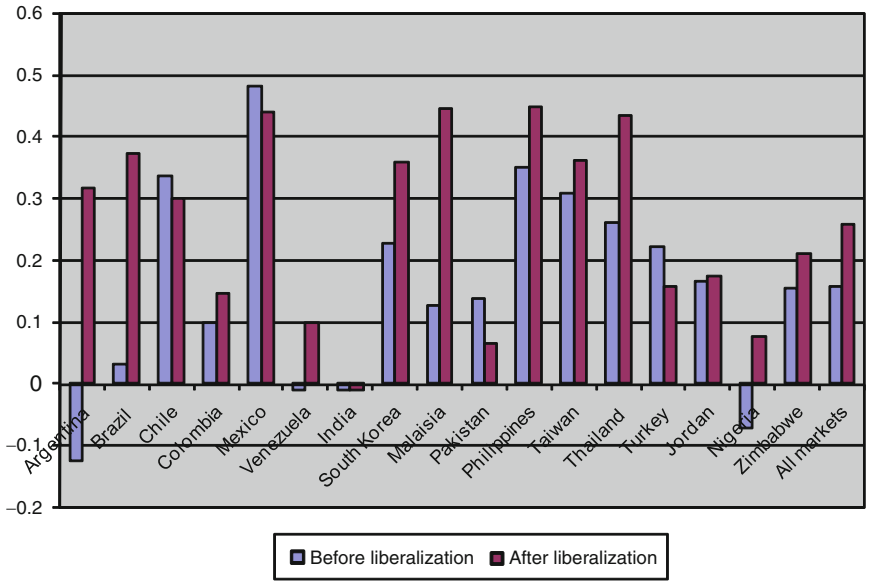

Fig. 2.5 Changes in unconditional correlation with the World market index. Notes: Continuously compounded returns at monthly frequency on S&P/IFCG indices with reinvested dividends are used. Official liberalization dates of Bekaert and Harvey (2000) are used as breakpoint

2.5.4 Stock Market Development

Financial liberalization can contribute to the development and maturation of emerging stock markets as a whole. Foreign participation would naturally force emerging countries to reform their financial system and to develop new institutions in order to support the expansion of financial operations. These reforms help to reduce substantially market frictions such as transaction costs and information asymmetries, and to improve markedly allocational efficiency and market liquidity. The intermediate role of financial markets between lenders and borrowers can be properly insured.

Market indicators are generally used to examine the effects of liberalization on the development of emerging markets. For example, Errunza (2001) proposes to study the evolution of four main indicators: stock market capitalization as a share of GDP, market liquidity as measured by transaction volume as a share of GDP, ratio of transaction volume to market capitalization (turnover ratio), and number of listed firms in the local stock exchange. The results show important improvement of these indicators in the post-liberalization period.

The development of stock markets is also reflected by the degree of market integration and informational efficiency. Past studies including for example Kim and Singal (2000) report that emerging stock markets become more efficient after liberalization, while Bekaert et al. (2002) indicate that liberalization contributes to render emerging markets more liquid and more integrated with world markets. Note that these topics will be carefully discussed in Chaps. 4, 5, 7 and 8 of this book.

2.6 Summary

At the beginning of the 1970s, the majority of developing countries were in a crisis of economic policies. Unfavorable economic conjuncture coupled with the deterioration of main economic and financial indicators, their economic system seems to be inefficient and incapable to stimulate economic growth. Following the recommendations of international institutions such as the World Bank and International Monetary Fund, many of these developing countries in Asia, Europe, Latin America and Africa have decided to undertake a wide-ranging economic reform program aiming to create a sustainable investment environment as well as to develop private sectors through orienting national economies towards a market economic system. Financial liberalization is part of these reforms and often considered as the most important component that implies dramatic changes in emerging countries.

Accordingly, the purpose of this chapter is to show the driving context in which financial liberalization was implemented as well as its financial impacts on emerging stock markets. It is demonstrated that financial liberalization is not only a gradual process, but it does take time to complete and may be reverted over time.

From this viewpoint, the effects of financial liberalization should be gradual and doubtlessly complex due to the existence of simultaneous reforms. They tend to be, in addition, country-specific as liberalization methods generally differ across emerging countries.

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Chapter 3
Asset Pricing Models

Abstract This chapter firstly provides a comprehensive review the modern portfolio theory bases including, in particular, investor's choice, portfolio diversification, and the market model. Then, two most widely used asset pricing models, the CAPM and the APT, are presented. Several empirical tests of these models are also discussed as they are difficult to test and to use in practice. Finally, we expose some problems associated with the application of asset pricing models to emerging market returns. Indeed, emerging markets are at least partially segmented, and emerging asset returns are highly non-normal. Furthermore, emerging markets present other sources of risk: information asymmetries, liquidity, country risk, etc.

3.1 Introduction

An appropriate measure of risk is essential for decision-making in finance. Asset pricing theory is a framework designed to identify the relationships between the return and risk of financial assets. The asset pricing models can be classified into two large families. The first family includes models that do not use the utility function of the investor. The second family includes models based on maximizing the expected utility. The Capital Asset Pricing Model (CAPM) belongs to the second family. Assuming that the expectations of investors are homogeneous, that investors are risk averse and maximize a utility function which depends only on the expected mean and variance of their future wealth, the CAPM shows that the expected return on a given asset is equal to the return on risk-free asset plus a risk premium. The later depends on the market premium and on the sensitivity of the asset to the market risk measured by its beta.

However, the CAPM is a model difficult to test empirically. Many alternative models were proposed, and the most interesting is the Arbitrage Pricing Theory (APT). Assuming that returns are generated by a factor model, the APT provides a more detailed analysis of the asset return structure. But the estimation of the APT also undergoes many empirical difficulties. Moreover, the model does specify

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_3, © Springer-Verlag Berlin Heidelberg 2010

neither the number nor the nature of the factors that determine the structure of asset returns.

This chapter presents the two most often used asset pricing models (CAPM and APT) and discusses some particularities of asset pricing in the context of emerging markets.

3.2 The Capital Asset Pricing Model

The CAPM was introduced by Sharpe (1964), Lintner (1965) and Mossin (1966) in the continuity of the works of Markowitz (1952, 1959) on modern portfolio theory. This model is one of the pillars of financial valuation. By specifying a condition of equilibrium, the CAPM explains the basic relationships between the market variables.

The CAPM determine the expected returns of financial assets based on their sensitivity to market risk or systematic risk (as opposed to individual risk associated with each asset). It relies on the fact that investors, regardless of their risk aversion, choose efficient portfolios in terms of mean-variance. For a given level of risk, investors prefer the portfolio that has the highest expected return and for a given return, investors prefer the portfolio that has the lowest risk. One main implication of the CAPM is that only the systematic risk is priced. The specific risk is not remunerated because it can be fully diversified. Thus the fundamental relationship of the CAPM states that the excess return on an asset or a portfolio is a linear function of that on the market portfolio. The coefficient of linear fit called "beta" primarily represents the covariance between the movements of the asset or the portfolio and the market. The CAPM is based on two fundamental elements: the market portfolio and the concept of beta.

3.2.1 Theoretical Framework of the Model

The CAPM assumes that investors behave in a mean-variance universe, where financial assets are valued according to the expected means and variances of their returns. Here we present some key elements of the portfolio theory of Markowitz (1952, 1959). The market model of Sharpe (1964), which is one of the essential theoretical foundations of CAPM, is also presented.

3.2.1.1 The Portfolio Theory

Markowitz (1952, 1959) assumes that the investor maximizes its financial investments by taking into account not only the return of its portfolio, but also its risk

measured by variance. He determines from a set of assets, for which returns and variances are known, all efficient portfolios, also called the efficient frontier. For a given variance, the latter offers the highest return and vice versa, for a given return, it has the lowest risk. Formally, we have to determine the weight $x_i$of each asset i by solving one of the two equivalent following programs:

- Maximizing the return for a given risk

$$\text{Max } E(R) = \sum_{i=1}^{n} x_i E(R_i) \tag{3.1}$$

Under the constraints: $\sigma(R) = \sigma_0$ and $\sum_{i=1}^{n} x_i = 1$;where R is the return of the portfolio, $\sigma(R)$ its standard deviation, R_i the return of asset i, n the number of assets and σ_0 a given level of risk.

- Minimizing the risk for a given return

$$Var(R) = \sigma^2(R) = \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j Cov(R_i, R_j) \tag{3.2}$$

Under the constraints $E(R) = R_0$ and $\sum_{i=1}^{n} x_i = 1$; where R_0 denotes a given level of return.

With the effect of risk diversification, efficient portfolios dominate individual assets. According to his particular attitude toward risk, the investor chooses the optimal portfolio within the efficient frontier. In the mean-variance framework, this analysis enables to understand the phenomenon of diversification, and also highlights the importance of the contribution of each asset to the overall risk of a portfolio.

3.2.1.2 The Market Model

The market model was developed by Sharpe (1964). The idea of the model is that there is a linear relationship between the return of a particular asset and the market:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{3.3}$$

where R_{it} is the return of the asset i in date t, R_{mt} that of the market.

The market model underlines the idea that the return on a given asset is linked to the market movements and to specific factors. The key parameter of this model is the beta. This parameter indicates how much an asset reacts more or less stronger than the market to different events.

3.2.2 The CAPM

This section reviews the theoretical foundations as well as the derivation of the CAPM.

3.2.2.1 Hypotheses

The original version of the CAPM is based implicitly on the concept of a strictly segmented market. The assumptions of the basic version of the model are:

- H1: Investors choose between portfolios on the basis of the expected returns and risks.
- H2: The decision horizon is the same for all investors.
- H3: Agents maximize the utility of their wealth at the end of the period. They are risk averse.
- H4: Investors can use the lending and borrowing operations at the same interest rate. The latter is determined exogenously to the model.
- H5: Each investor can invest a portion of its wealth in one or any combination of assets that are traded on a single market highly competitive. There are no taxes or transaction costs.
- H6: Homogeneous expectations: investors have the same expectations about the return and the risk of each asset.

3.2.2.2 Derivation of the Model

Consider an investor who allocates his wealth between risky assets and risk-free asset. Let R_{ft} be the return on risk-free asset, R_t the return of an investment in a portfolio of risky assets, and θ the proportion of total wealth invested in risky assets. Let P be the portfolio the investor holds and R_{pt} its return. Thus, we have:

$$R_{pt} = (1 - \theta) R_{ft} + \theta R_t = R_{ft} + \theta (R_t - R_{ft}) \tag{3.4}$$

Suppose that $0 \leq \theta < \infty$ and calculate the expected mean and variance of R_{pt}

$$E(R_{pt}) = R_{ft} + \theta [E(R_t) - R_{ft}] \tag{3.5}$$

$$\sigma^2(R_{pt}) = \theta^2 \sigma^2(R_t) \tag{3.6}$$

The relationship (3.5) shows that investor may, by making an appropriate choice of θ, maximize the expected return, whereas the relationship (3.6) indicates that when the investor increases its investment in the portfolio of risky assets, the risk of the portfolio P increases proportionately.

Deduce θ from relation (3.6) and replace it with its value in the relationship (3.5), we obtain a direct relation between expected return and risk:

$$E(R_{pt}) = R_{ft} + \frac{\sigma(R_{pt})}{\sigma(R_t)}\left[E(R_t) - R_{ft}\right] \tag{3.7}$$

Assume $\lambda = (E(R_{pt}) - R_{ft})/\sigma(R_t)$, the relation (3.7) is written as follows:

$$E(R_{pt}) = R_{ft} + \lambda\ \sigma(R_{pt}) \tag{3.8}$$

Once the relationship between the expected return of the portfolio and its risk is established, it remains to determine which repartition should be made between the risky assets and risk-free asset. The rational investor seeks to maximize the return for a given level of risk or, conversely, minimize the risk for a given level of return. This is equivalent to maximize λ. The investor completes its choice using its utility function.

An important consequence of the assumption H6 is that the efficient frontier is the same for all agents. This leads to the following theorem, known as the separation theorem:

> All investors, regardless of their initial wealth and their preferences for risk, build their optimal portfolios by holding combinations of the risk-free asset and the market portfolio.

The market portfolio is defined as the portfolio that contains all risky assets available on the market. The fraction of each asset is equal to the ratio of the total value of all units of that asset on the total value of all assets on the market. Portfolio theory teaches us that this portfolio is located on the efficient frontier. Moreover, the separation theorem of the two funds tells us that each individual holds a fraction of the same portfolio. So the market portfolio has the same composition as the portfolio of risky assets that each individual holds at the market equilibrium.

The market portfolio is thus the efficient portfolio held by all investors who do not borrow or lend at the risk-free rate. All investors hold the same portfolio of risky assets and differ only by its weight in the total portfolio. The less investor is averse to risk, the more is the weight of the market portfolio in the total portfolio. At the market equilibrium, (3.8) leads to:

$$E(R_{pt}) = R_{ft} + \beta_p[E(R_{mt}) - R_{ft}] \tag{3.9}$$

with R_m *is* the return of the market portfolio and

$$\beta_p = Cov(R_{pt}, R_{mt})/\sigma^2(R_{mt}).$$

Equation (3.9) gives the fundamental relationship of the CAPM. It holds for both individual assets and portfolios. The expected return of asset i is equal to the return on risk-free asset, plus a risk premium. The latter is the product of two elements: the

market risk premium ($E(R_{mt}) - R_{ft}$) and the beta coefficient of the asset. Following the CAPM, efficient portfolios are constructed by a combination of the market portfolio and the risk-free asset, the weight of each fund depends of the investor's risk aversion.

3.2.2.3 Systematic Risk Versus Specific Risk

For any asset i, (3.9) can be rewritten as:

$$E(R_{it}) = R_{ft}(1 - \beta_i) + \beta_i E(R_{mt}) \tag{3.10}$$

Assuming that expectations are rational, the random return of the asset can be given by:

$$R_{it} = R_{ft}(1 - \beta_i) + \beta_i R_{mt} + \varepsilon_{it} \tag{3.11}$$

Equation (3.11) shows that we can divide the return of an asset into two components: a component that depends on the market return ($\beta_i\ R_{mt}$) and a residual return ($\phi_{it} = R_{ft}(1 - \beta_i) + \varepsilon_{it}$). It is then possible to write:

$$R_{it} = \beta_i R_{mt} + \phi_{it} \tag{3.12}$$

If this model is well specified, the covariance between ε_{it} and R_{mt} is zero. Then we can apply the theorem of additivity of variances of independent random variables as

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \omega_i^2 \tag{3.13}$$

where σ_i and σ_m refers to the standard deviation of the asset i and the market portfolio respectively, and $\omega_i^2 = Var(\phi_i) = Var(\varepsilon_{it})$.

The risk of a financial asset is thus constituted of a term related to the market, called systematic risk, and a term depending only on the characteristics of the asset, the specific risk. While market risk is undiversifiable, the second term can be eliminated by portfolio diversification. Equation (3.9) illustrates well the basic principle of the CAPM that only the necessary risk is remunerated by the market. The part of risk that can be eliminated by diversification is not priced.

3.2.3 Extensions of the Original Model

The original CAPM of Sharpe (1964) has known many extensions to date. Next, we briefly discuss the main extensions of the model.

The model described by (3.9) implies that a risk-free asset exists. Black (1972) extends the CAPM if there would be no risk-free asset. The author derives a relation similar to the fundamental relation of the CAPM with a risk-free asset. The excess return of an asset on the return of a portfolio with a zero-beta is equal to the excess return of market portfolio on the zero-beta portfolio multiplied by the beta coefficient of the asset under consideration.

To show this result, Black (1972) uses one of the properties of the minimum variance portfolio: the existence of a linear relationship between the expected return on a given asset and a portfolio of reference (not necessarily the market portfolio) in the efficient frontier. The resolution of (3.1) or (3.2) leads to the following relationship:

$$E(R_{it}) = E(R_{zt}) + \beta_i[(E(R_{mt}) - E(R_{zt})] \tag{3.14}$$

where z denotes a portfolio with zero beta, i.e. not correlated with the market portfolio.

Brennan (1973) examines the impact of taxation on the fundamental CAPM valuation relation. The author establishes a relationship taking into account the fact that the forms of income (capital gains / losses and dividends) are subject to different tax rates:

$$E(R_{it}) - R_{ft} = \beta_i[E(R_{mt}) - R_{ft} - T(\gamma_m - R_{ft})] + T(\gamma_i - R_{fi}) \tag{3.15}$$

where γ_i is the average dividend yield of the asset i and $\lambda_m$average dividend yield of the market. T is a term that reflects the effect of taxation on the equilibrium relationship. It depends on the tax rates of different investors and different forms of income, their wealth placed in risky assets and their degrees of risk aversion. T is positive if the dividends are more taxed than capital gains. According to the new equilibrium relationship (3.15), a firm that distributes more dividends than the average market must offer a higher pre-tax return than the market average in order to compensate the loss due to the payment of taxes.

In the general equilibrium framework, Lucas (1978) has proposed the intertemporal CAPM. This model, based on maximizing the expected intertemporal utility, shows that the returns of financial assets are linked to consumption decisions of investors. Thus, a relationship similar to that of the CAPM of Sharpe (1964) is obtained, but it links the expected excess return of a risky asset to the covariance of its return with the marginal rate of intertemporal substitution. In the basic version of the model with a Constant Relative Risk Aversion (CRRA) utility function, this relationship is:

$$E(R_{it}) = \left(\frac{E(C_t^{\gamma})\ (1 + R_{ft})}{C_{t-1}^{\gamma}}\right) + \frac{Cov(-1/C_t^{\gamma}; R_{it})}{E(1/C_t^{\gamma})} \tag{3.16}$$

where γ is the risk aversion coefficient and C_t the consumption of the representative agent at time t.

3.2.4 Empirical Tests of the CAPM

The CAPM can be tested in several ways. Friend and Blume (1970) conducted two tests of the CAPM. Their study focused on 200 portfolios constructed randomly from stocks listed on the New York Stock Exchange (NYSE) from January 1960 to June 1968. The authors regressed the performance indices of Treynor, Sharpe and Jensen, which are measures of risk adjusted returns, on two measures of risk, the beta coefficient and standard deviation of returns. The use of these performance indices allows, in principle, to eliminate any link with the two risk measures used. Nevertheless, the authors highlighted links negative and highly significant throughout the study period and positive and negative links respectively on the two sub-periods: January 1960 – March 1964 and April 1964 – June 1968.

Friend and Blume (1970) claim that the failure of the model could be due to bias in the estimates of performance indices. They did a second test of the risk-return relationship on stocks listed on the New York Stock Exchange for the 1955–1968 period. They estimated the following model:

$$R_{it} = R_{ft} + (R_{mt} - R_{ft})\beta_i + \varepsilon_{it} \tag{3.17}$$

The authors obtained estimated values of risk-free rate and risk premium significantly different from the values observed. These results are not consistent with the predictions of the CAPM.

Black et al. (1972) study of the shares listed on the New York Stock Exchange for the period from January 1926 to March 1966. They rewrite the CAPM in its basic form by adding a constant:

$$(R_{it} - R_{ft}) = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \tag{3.18}$$

If the CAPM holds, then the constant term is not significant. To address the problem of instability of the beta coefficients, the authors construct 10 portfolios rather than working on individual assets.

Black et al. (1972) find that the constant term is significantly positive for the offensive portfolios ($\beta > 1$), and negative for defensive portfolios ($\beta < 1$). They also obtain higher returns (respectively lower) than the returns provided by CAPM for portfolios with $\beta > 1$ (respectively with $\beta < 1$).

In a different logic, the authors use the cross-sectional technique to test the CAPM. Specifically, they test the following model:

$$\bar{R}_{it} - \bar{R}_{ft} = \gamma_0 + \gamma_1\hat{\beta}_i + \varepsilon_{it} \tag{3.19}$$

where $\bar{R}_A$ denotes the average return of portfolio i over the period, $\hat{\beta}_i$ its systematic risk pre-estimated and $\bar{R}_{ft}$ the average risk-free rate.

Then, Black et al. (1972) test the following null hypothesis: H_0: $\gamma_0 = 0$ and $\gamma_1 = \bar{R}_m - \bar{R}_f$. They obtain a significantly non-zero constant and a market risk premium statistically different from the observed premium. Thus, the results of the study by Black et al. (1972) do not confirm the CAPM in its basic form.

However, the most comprehensive test of the domestic CAPM is certainly that of Fama and MacBeth (1973). This study focused on stocks listed on the New York Stock Exchange for the period from January 1926 to June 1968. The model tested is as follows:

$$E(R_{it}) = E(R_0) + \beta_i[E(R_{mt}) - E(R_{0t})] \tag{3.20}$$

where $E(R_0)$ is the expected return on a risk-free asset within the market portfolio (the zero-beta portfolio).

The relationship (3.20) allows us to test three hypotheses:

- C1: The relationship between expected return and systematic risk of an asset i with respect to an efficient portfolio is linear.
- C2: β_i is a complete measure of the systematic risk of the asset.
- C3: The relationship between risk and return is positive, that is $E(R_{mt}) - E(R_{0t}) > 0$.

To test these assumptions, Fama and MacBeth (1973) propose a general stochastic specification:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\beta_i + \gamma_{2t}\beta_i^2 + \gamma_{3t}\, s_i + \vartheta_{it} \tag{3.21}$$

where $\gamma_{jt}(j = 1,2,3)$ are coefficients varying over time.

s_i is a measure of risk of asset i not taken into account in β_i, the authors used the standard deviation of residuals from the market model estimated by OLS. β_i^2 is introduced in the model to test the linearity of the relationship. The hypothesis C1 is that $E(\gamma_{2t}) = 0$. s_i is introduced to test the hypothesis C2. This assumption is that $E(\gamma_{3t}) = 0$. The hypothesis C3 is that $E(\gamma_{1t}) = E(R_{mt}) - E(R_{0t}) > 0$. Fama and MacBeth (1973) also test the traditional form of the CAPM. By assuming that agents can borrow and lend unlimited amounts at the risk-free rate R_{ft}, then it is expected that $E(\gamma_{0t}) = R_{ft}$.

The authors use the technique of regression in two stages. The first step is to estimate, on a first sub-period of 7 years, the beta coefficients of individual securities. Having classified the securities according to their betas, Fama and MacBeth (1973) construct 20 portfolios. Then they estimate on a sub-period of 5 years, the beta coefficients for individual securities. In a second step after calculating the betas and the monthly returns of portfolios from those of the individual securities that are included, the authors, on a sub-period of 4 years, month by month, perform the regressions of (3.21) for the 20 portfolios constructed (in cross section regressions).

Fama and MacBeth (1973) have obtained the following results:

- The assumption of linearity between C1 profitability of an asset and its systematic risk is on average accepted.
- The hypothesis C2 that β_i is a total measure of systematic risk cannot be rejected.
- The assumption C3 of positivity of the relationship is, in turn, accepted.
- The test of the CAPM in its traditional form ($E(\gamma_{0t}) = R_f$) is not rejected.

In general, the results of Fama and MacBeth (1973) are in favor of the CAPM.

It is important also to mention the criticism of Roll (1977) on the testability of CAPM. Indeed, the CAPM establishes a relationship between the return of any security and the market relying on the efficiency of the market portfolio. But the problem lies in identifying the latter. It must contain all possible risky assets, including real estate, human capital, etc. This portfolio is not directly observable. Roll (1977) concludes that the tests of CAPM can teach us anything about the validity of the risk-return relationship. Precisely, the author establishes that the efficiency of the market portfolio and the relationship of the CAPM are equivalent. However, empirical tests of the model use indices that are approximations of the true market portfolio. The only testable prediction of these tests is the efficiency of these approximations. Roll (1977) also shows that the results are very sensitive to the choice of the approximation (the proxy).

However, the study of Stambaugh (1982), more rigorous econometrically, shows that the tests are not very sensitive to the index chosen to approach the market portfolio. To prove this proposition, Stambaugh (1982) constructed four market indices that do not contain common securities. However, he founds strong correlations between these indices. The use of these indices to test the relationship of the CAPM gives identical results. Stambaugh (1982) thus concludes that the criticism of Roll (1977) is very strong.

3.3 Arbitrage Pricing Theory

The limits of the CAPM are multiple. In particular, the model is based on only one factor. Moreover, the latter is not directly observable. The APT tries to explain the structure of asset returns based on a multifactor model. The APT of Ross (1976) is based on intuition that several factors influence the returns of all financial assets.

3.3.1 Theoretical Framework of the Model

The APT is based on three basic elements: first the assumption that a statistical model, the factorial model, describes the returns of financial assets, then the notion of arbitrage portfolio, and finally the derivation of the relationship evaluation.

3.3.1.1 Model Hypotheses

The APT is based on a number of assumptions that can be divided into two broad groups:

- The first group includes the general assumptions of the CAPM concerning the perfection of the market, the behavior of investors, and the ability to borrow without limit to the risk-free rate.
- The second group covers the basic assumption of the model of Ross (1976) that various economic factors affect the returns of financial assets. These factors can be classified into two categories: the common or systemic factors (i.e., the factors that affect all financial assets), and the specific factors (i.e., the factors are acting only on one or more assets or industry).

The model of Ross (1976) also assumes that the agents are able to anticipate the movement of factors, and incorporate these expectations in the calculation of expected returns. However, unexpected factor changes affect behavior of observed returns.

The ex-post return of an asset is equal to the ex-ante return (the expected return) plus the unexpected return. The latter (the unexpected return) can be decomposed into two parts:

– A part from the unexpected changes in common factors,
– A part from the unexpected changes in specific factors.

In a more formal way, assuming that returns are generated by a linear process with k factors, we can write:

$$R_{it} = E(R_{it}) + \beta_{i1} f_{1t} + \beta_{i2} f_{2t} + \ldots + \beta_{ik} f_{kt} + \varepsilon_{it} \tag{3.22}$$

where:

– $\tilde{R}_{it}$ is the return of the asset i at time t;
– $E(\tilde{R}_{it})$ is the anticipated return of the asset i;
– β_{ij} is the sensitivity of the asset i to factor j for $j = 1,2, \ldots, k$;
– $\tilde{f}_{jt}$ is the unexpected movement of factor j in period t.
– $E(\tilde{f}_j) = 0 \, \forall j = 1, 2, \ldots . k$;

$$E(\tilde{\varepsilon}_i, \tilde{\varepsilon}_j) = 0 \; \forall \quad i, j = 1, 2, \ldots . . N; \quad i \neq j;$$

$$E(\tilde{\varepsilon}_i) = 0 \; \forall \; i = 1, 2, \ldots . . . . . , N;$$

$$E(\tilde{\varepsilon}_i, \tilde{f}_j) = 0 \; \forall \; i = 1, 2, \ldots . N, j = 1, 2, \ldots . , k; \; \textit{and}$$

$$E(\tilde{f}_i, \tilde{f}_j) = 0 \, \forall i \neq j \, \text{and} \, i, j = 1, 2, \ldots . , k.$$

Like the CAPM, the aim of the APT is to assess the expected asset returns.

3.3.1.2 The Arbitrage Portfolio

An arbitrage portfolio is defined as a portfolio without risk containing all the assets, and its construction uses no initial wealth.

To derive the APT, Ross goes from (3.22) and uses the principle of arbitration. The concept of arbitrage is less restrictive than the equilibrium (equality between demand and supply of assets on the market) used in the case of CAPM. Indeed, if there is equilibrium in the market for assets, the principle of arbitrage is respected, while it is not necessary that there will be equilibrium to verify arbitrage opportunities.

The starting point is to build an arbitrage portfolio ϑ constituted of all the assets on the market (the n assets).

Let ϑ' be a row vector of proportions invested in each asset such as $\vartheta' = (\vartheta_1, \vartheta_2, \ldots, \vartheta_N)$. $\underline{R}$ is the vector of realized returns of the n assets. The return of the portfolio ϑ is equal to:

$$\vartheta'.\underline{\tilde{R}} = \vartheta'.E(\underline{\tilde{R}}) + \vartheta'.\underline{\underline{\beta}}.\underline{\tilde{f}} + \vartheta'.\underline{\tilde{\varepsilon}} \tag{3.23}$$

where:

- $E(\underline{\tilde{R}})$ is the vector of expected returns of the n assets;
- $\underline{\underline{\beta}}$ is the matrix of coefficients of sensitivity to common factors;
- $\underline{\tilde{f}}$ is the vector of unexpected movements on the common factors;
- $\underline{\tilde{\varepsilon}}$ is the vector of unexpected movements on the specific factors.

The portfolio ϑ is an arbitrage portfolio, it is supposed to be built so that:

- It uses no initial wealth. $\vartheta'.\underline{1} = 0$;
- The proportion invested in each asset is the same and is equal to $1/n$;
- It is without risk. So that the coefficients of sensitivity of the portfolio to different common factors as well as its specific risk is zero. Formally, $\vartheta'.\underline{\underline{\beta}} = 0'$ and $\vartheta'.\underline{\varepsilon} = 0$. This is assumed possible by the technique of diversification.

Given the above, (3.23) can be simplified to give the following approximation:

$$\vartheta'.\underline{\tilde{R}} \approx \vartheta'.E(\underline{\tilde{R}}) \tag{3.24}$$

In the absence of arbitrage opportunities, the rate of return of this portfolio is necessarily zero (the invested wealth is zero), and accordingly,

$$\vartheta'.\underline{\tilde{R}} = \vartheta'.E(\underline{\tilde{R}}) = 0.$$

3.3.2 Derivation of the Valuation Relationship

The fact that $\vartheta'.E(\underline{\tilde{R}})$, $\vartheta'.\underline{1}$ and $\vartheta'.\underline{\underline{\beta}}$ are all zero, leads to a linear expression of $E(\underline{\tilde{R}})$:

$$E(\underline{\tilde{R}}) = \underline{1}\,\mu_0 + \underline{\underline{\beta}}\,\mu \tag{3.25}$$

where μ_0 is the risk-free rate, and μ is a vector of risk premiums on common factors.

To derive a simple expression of the risk premium, consider a portfolio j with all the coefficients of sensitivity to common factors other than factor j being zero and its coefficient of sensitivity to factor j is equal to 1. The anticipated return of this portfolio is:

$$E(\tilde{R}_j) = \mu_0 + \mu_j \tag{3.26}$$

and therefore,

$$\mu_j = E(\tilde{R}_j) - \mu_0 \tag{3.27}$$

The relationship (3.27) is written for a given asset i:

$$E(\tilde{R}_i) = \mu_0 + \sum_{j=1}^{k} \mu_j \beta_{ij} \tag{3.28}$$

This relationship is the fundamental relationship of the APT. The relationship (3.28) can be rewritten as follows:

$$E(\tilde{R}_i) = \mu_0 + \sum_{j=1}^{k} (E(\tilde{R}_j) - \mu_0) \beta_{ij} \tag{3.29}$$

The relationship (3.29) establishes that the expected return of an asset i is equal to the risk-free rate plus a combination of risk premiums on common factors, weighted by the coefficients of sensitivity of the asset i to the common factor changes.

Note that the existence of the factor structure in (3.21) is a hypothesis, while (3.28) and (3.29) are the implications of the arbitrage model.

3.3.3 APT and CAPM

The CAPM and APT are two paradigms which are not contradictory. Indeed, the APT, unlike the CAPM, is not an equilibrium model and does not attempt to explain directly the expected return of the securities at the market equilibrium. However, it is more operational for portfolio management. The main differences between the two models are:

- The APT is richer than the CAPM because it permits multiple sources of risk, whereas the CAPM has a single source of risk, the risk associated with the market portfolio. The APT would allow a more detailed analysis of the risk of financial securities.
- The APT is not based on any assumption about the asset return distributions (apart from the equation generating returns) and the utility functions of investors. Thus, the APT seems to be more general than the CAPM.

- The APT does not give any specific role to market portfolio and suggests that the latter can be a common factor.
- However, the APT is a model of arbitrage and does not offer a true equilibrium relationship between risk and return. In this regard, it lacks the theoretical foundations of CAPM which describes the behavior of investors.
- In addition, the APT does determine neither the nature nor the number of common factors influencing the returns of financial assets.

3.3.4 Extensions of the APT: Towards the Equilibrium APT

As mentioned, the problem of determining the market portfolio under the CAPM is replaced by that of determining the relevant factor structure in the context of the APT. The arbitrage model should not be considered as a simple generalization of the CAPM. The latter model imposes to a precise asset pricing relationship, while the APT does an approximation.

In this context, Connor (1984) proposed an exact version of the APT in a competitive market in equilibrium. This version assumes that all common factors explain the risk of market portfolio, or that this risk is completely diversified, which is precisely the assumption of CAPM. The valuation relationship becomes a precise relationship (like CAPM). That is, the absence of specific risk of the market portfolio reflects the fact that all the specific risks of each asset can be fully diversified, and therefore such risks are not priced at market equilibrium.

Under these assumptions, the approximate relationship (3.24) becomes an exact relationship. The relationship obtained is strictly similar to (3.28), although there is a significant difference in the formulation of the model, i.e., the specific risks, $\tilde{\varepsilon}_{it}$ in (3.22), are negligible and directly attributed to equilibrium and not arbitrage condition.

The exact version of the APT has a major advantage: a single factor structure is valid which verifies the perfect diversification of the market portfolio.

3.3.5 Empirical Tests of the APT

The study by Roll and Ross (1980) focuses on 42 portfolios from stocks listed on the New York Stock Exchange from July 3, 1962 to December 31, 1972. The authors use daily data and estimate the common risk factors by using the method of factor analysis. They identified five economic factors.

Then they perform the estimation in cross section of the following model:

$$E(\underline{\tilde{R}}) = \underline{\mu}_0 + \underline{\hat{\beta}}\,\underline{\mu} \tag{3.30}$$

The relationship (3.30) is estimated for each time t, $t = 1, 2,..., T$. Then, the authors calculate the average risk premiums. The model is valid if the vector of risk premium is found significantly different from zero, i.e., if there is at least one significant risk premium, and if the constant of the regression is equal to the risk-free rate. The APT is rejected otherwise. The results reported by Roll and Ross (1980) are broadly in favor of the APT.

Chen (1983) focuses on daily data on stocks listed on the New York Stock Exchange for the 1963–1978 period. He divided this period into four sub-periods of 4 years each: 1963–1966, 1967–1970, 1971–1974, and 1975–1978. Within each sub-period of 4 years, Chen (1983) distinguishes odd and even observations. He uses the first to estimate the coefficients of sensitivity and the last to test the APT and find that some key macroeconomic variables significantly affect stock returns. This result is also confirmed by Chen et al. (1986) who focused on monthly data over a period from 1965 to 1984 and show that several economic factors determine the asset returns structures: industrial production, inflation, interest rates, etc.

3.4 Particularities of Asset Pricing in Emerging Markets

Applying asset pricing models (CAPM and APT, among others) to assert securities prices in emerging stock markets offers an interesting challenge to researchers. The rationale behind this proposition is that emerging markets do not obey standard asset pricing paradigms and asset returns in these markets show several singularities.

Indeed, implementing the CAPM or the APT on emerging stock markets seems problematic. This is due to inefficiencies in these markets such as prohibiting foreign capital, insider trading, and high transaction costs as well as data problems such as infrequent trading. Furthermore, most classical asset pricing models are based on the assumption of normality while the hypothesis of normally distributed asset returns is strongly rejected for the majority of emerging stock markets. Next, models like CAPM are limited to the first and second moments (mean and variance) while both skewness and kurtosis are more apparent in historical emerging markets' return data. The evidence tends to suggest greater downside risk in these markets.

It is equally important to note that there are specific risks associated with operations on emerging markets such as political risk and illiquidity risk (see Chap. 1 for more detailed discussions on this topic). Thus, in addition to the risk factors that have been usually identified in developed markets, asset pricing models in emerging markets should account for other risk factors such as country, liquidity and skewness risks.

Other serious problem in applying the asset pricing models to emerging stock markets is the assumption of perfect stock market integration. In an international setting, this assumption means that the same systematic risk commands the same

expected return regardless of geographical location. Thus, for the CAPM and the APT to hold internationally, a sufficient condition is that there are no barriers to portfolio investments and capital flows. Practically, investors can add any financial asset issued elsewhere in the world to their portfolios. The opposite case is the strict market segmentation where local investors are not allowed to own foreign assets and foreign investors are not allowed to trade local assets. In this case, the models discussed above should only hold domestically.

However, in practice, most emerging markets are at least partially segmented and specific asset pricing models must be used. These models include in general a combination of domestic and global risk factors. The weight assigned to each risk factor should change with the degree of stock market integration. The problem of stock market integration and its implications for asset pricing in emerging markets will be studied in greatest details in Chaps. 7 and 8.

3.5 Summary

Asset pricing models offer a framework that identifies the relationships between the return and risk of financial assets. These models can be classified into two large families: equilibrium models and arbitrage models.

In this chapter, we have discussed the two most often used models in financial economics literature: CAPM and APT. Assuming that the expectations of investors are homogeneous, that investors are risk averse and maximize a utility function which depends only on the expected mean and variance of their future wealth, the CAPM shows that the expected return on a given asset is equal to the return on risk-free asset plus a risk premium. In other words, expected returns on a particular asset or portfolio depend on the market premium and on the sensitivity of the asset to the market risk measured by its beta. However, the CAPM is a model difficult to test empirically. Indeed, its main variables (i.e., the market premium and the asset beta) are non-observable and have to be estimated. Many alternative models were proposed, and the most interesting is the APT. Assuming that returns are generated by a factor model, the APT provides a more detailed analysis of the asset returns structure. But, the APT also has to deal with many empirical difficulties. In addition, the model does precise neither the number nor the nature of the factors that determine the return structure.

Finally, we have discussed some problems associated with the application of asset pricing models to emerging market returns. It is important to note that emerging markets are at least partially segmented, and emerging asset returns are highly non-normal. Furthermore, emerging markets present other sources of risk: information asymmetries, liquidity, country risk, etc. The impacts of these problems on asset pricing in emerging markets will be carefully discussed in Chaps. 7 and 8.

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Chapter 4
Threshold Stock Price Adjustments

Abstract This chapter focuses on the study of the stock price adjustment dynamics in emerging countries using recent developments of nonlinear and threshold models. The nonlinearity is employed to reproduce the asymmetry and discontinuity characterizing emerging market price dynamics. This asymmetry is naturally justified by the important changes and developments occurring recently on these markets as discussed in Chaps. 1 and 2.

Empirical results show that emerging stock price adjustment dynamics are neither instantaneous nor continuous and linear, but rather asymmetric and nonlinear. Moreover, the use of an on/off adjustment model enables the reproduction of the price dynamics in emerging stock markets while identifying several different regimes. The analysis of emerging markets' responses to oil price changes also supports the hypothesis of nonlinear and threshold price adjustments.

4.1 Introduction

As discussed in Chaps. 1 and 2, emerging stock markets have experienced important developments over the recent years due to the increase of cross-border investments, capital exports and foreign investor participations in the aftermath of vast economic and financial reforms including stock market liberalization Thus, emerging stock markets receive much more important afflux of information and liquidity (Kim and Singal 2000) and become more integrated with the word market (Bekaert and Harvey 1995; Carrieri et al. 2007). This pattern induces rapid changes in their financial infrastructure and has affected directly or indirectly the stock price adjustment dynamics. Indeed, investors getting easier access to new information would prefer to immediately react to and exploit the information acquired as rapid as possible to maximize their trading profits.

From this view, market fluctuations would depend on the heterogeneous investor actions. Nevertheless, such heterogeneous behavior may imply several stock price movements that are not really justified by the fundamental fluctuations of emerging

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_4,

markets. Then, this may induce asymmetric and discontinuous stock price adjustment. Also, the more investors' expectations are important and heterogeneous, the more stock price adjustment is asymmetric, abnormal and nonlinear. The reason is that it will be difficult to obtain a market price reflecting local fundamentals while taking into account all investors' expectations. This type of price dynamics may be ignored by usual linear modeling and require the use of nonlinear models to reproduce the stock price adjustments.

In sum, this chapter aims to provide a comprehensive analysis of the dynamics of emerging stock price adjustment. After presenting the economic justifications for possibly asymmetric price movements in emerging stock markets, the focus is particularly put on the class of nonlinear modeling techniques and their applications in reproducing the said stock price behavior.

4.2 Economic Justifications of Nonlinearity in Stock Price Dynamics

Nonlinear models have been widely used in recent years to model the dynamics of stock prices in developed and emerging countries. The application of these techniques was differently justified across studies in financial theory and practices. Besides the specific characteristics of emerging stock markets, two types of justifications were essentially put forward: the market microstructure and the behavioral finance. They are presented firstly. Then, the most important specificities of emerging markets are discussed in a second step to show why nonlinear models are more suitable to apprehend stock price dynamics in emerging markets.

4.2.1 Market Microstructure Approach

Concerning the market microstructure, informational asymmetry and transaction costs are considered as the most important sources of nonlinearity. Following Dumas (1992), transaction costs may induce discontinuity in arbitrage and price adjustment since investors would react only when they expect a future returns higher than the induced costs. Therefore, transaction costs would define an inaction band within which arbitrage and adjustment are inactive and another regime for which adjustment is only active when stock price deviations exceed some threshold defined by these transaction costs. As a result, the presence of transaction costs implies persistence, smoothness and inertia effects in price dynamics. In addition, as suggested by Anderson (1997), the heterogeneity of transaction costs owing to the fact that they depend on transaction volumes and vary from one investor to another as well as from one market to another can affect the stock price mean reversion. Thus, the more transaction costs are distinct for investors, the more the

threshold values distancing stock price regimes are heterogeneous. In this case, price adjustment is rather smooth than abrupt. This is strongly expected for emerging markets where investors are quite heterogeneous and markets are "infrastructurally" and historically distinct.

The information asymmetry is also a plausible explanation for further nonlinearity characterizing stock price adjustment dynamics in emerging countries. Indeed, market operators may not have the same information set, i.e., there are informed investors who instantaneously possess a relatively complete information set whereas ill-informed investors only obtain the information while observing the trading actions performed by informed investors. A rational reaction of the ill-investors aiming to reduce this information risk would consist of following the response of the informed investors. The asymmetric information is expectedly more important in emerging markets than in developed markets due to the lack of appropriate market regulations in financial reporting as well as the low quality and quantity of information disclosure.

Overall, the coexistence of these types of investors may generate a market price that does not reflect its fundamental value, and as a result the price dynamics could be extremely complex and highly asymmetric.

4.2.2 Behavioral Finance Approach

Boswijk et al. (2007) state that the underestimation of nonlinearity, asymmetry, and structural breaks due to behavioral finance biases may lead to misunderstanding of stock price dynamics. Accordingly, the heterogeneity of investor expectations and the phenomenon of mimetic behavior in finance are the most fundamental issues in justifying nonlinearity in stock price mean reversion.

As regards the heterogeneity of investors, the price anticipation and trading behavior of at least three kinds of investor – chartists, fundamentalists and nose traders – must enter into consideration. Indeed, chartists are investors who suppose that stock prices often evolve following the same linear trend and argue that if the share was overvaluated, it shall continue to be similar to previous quotations in the future. For their part, fundamentalists develop a different approach according to which stock prices are strongly correlated with fundamentals (e.g., dividends, benefits, interest rates, etc.) rather than with their previous realizations. From this view, stock price should continuously evolve around its fundamental value defined as the sum of its discounted future cash follows. Finally, noise traders are investors who do believe neither on the first nor on the second approach. They are not numerous in general, but their actions may have considerable effects on stock markets.

De Grauwe and Grimaldi (2005), and Boswijk et al. (2007) assess that the coexistence of these different agents and their interaction may generate different arbitrage operations, and as a result different stock price dynamics. The authors suggest two distinct regimes to describe price dynamics under this situation.

A "follower regime" is identified when the market is governed by chartists, while a "fundamentalist regime" appears when price deviations are higher and fundamentalists tend to correct the gap between the price and its intrinsic value. The adjustment is being more complicated when at each time chartist (respectively fundamentalist) decides to convert into fundamentalist (respectively. chartist)

Mimetic behavior also constitutes a reliable explanation for stock price fluctuations as some investors tend to follow the others rather than to trust information they gather from price fundamentals. The higher is the information asymmetry, the stronger is mimetic behavior. Note that following other investors who are supposed to be more informed may be rational if it permits to generate higher returns and to reduce the risk of being not well-informed. Mimetic behavior is however often judged as a source of important stock market deviations and fluctuations. Therefore, in presence of mimetic behavior, stock prices may reflect market opinion, but not necessarily changes in fundamental factors. This situation leads to the formation of at least two types of price dynamics (also referred to as stock price regimes). The first regime is characterized by a market state in which investors trust much more on the market opinion than on fundamentals whereas in the second regime investor beliefs converge toward fundamentals. In this scheme of things, stock prices fluctuate according to a bimodal dynamics which clearly rejects the linear modeling framework frequently used to apprehend price movements.

4.2.3 Nonlinearity and Emerging Stock Markets

In emerging markets, the nonlinearity and asymmetry of stock market prices can be further justified, in addition to traditional approaches (i.e., market microstructure and behavioral finance), by sudden and complex changes related to various economic and financial reforms. To illustrate these empirical facts, this chapter focuses on two representative emerging countries of the most active emerging regions, Latin America (Mexico) and Asia (the Philippines). The empirical application of threshold stock price dynamics in Sect. 4.4 relies on aggregate market data of these countries.

Chapter 1 shows that Mexico is one of the most developed countries of the Emerging Latin America. At the regional level, the market capitalization of Latin American emerging markets has increased substantially over the recent years. In 1990, it represented 14.6% of all the emerging markets' capitalization and about 1% of the world market capitalization, compared to 30% and 3.7% respectively in 2000. This rapid development stems both from internal and external factors including in particular the debt reduction plan and banking system reforms in Argentina, Brazil, Mexico and Venezuela in effort to overcome the economic recession coupled with American monetary politics and the introduction of American Depository Receipts.

Several other domestic factors also account for the high level of financial integration of the Mexican stock market into the world market: improved economic

and social stability, institutional economic reforms, and liberalization policies that implied a commercial and financial deregulation of the economic activity as well as privatization. Therefore, the Mexican stock market has an outstanding position in the Latin American region in terms of both market size and development degree. Its market capitalization increased by 23% in 2005 compared to the level of the preceding year, and 44% of the local financial securities were held by foreign investors. Moreover, Mexico's exports reached a record of $250 billion in 2006 and 85% of these exports were destined to the United States. This economic performance is mainly due to its adhesion to the North-American Free Trade Agreement (NAFTA).

However, Mexico experienced several episodes of strong financial turbulences and crisis during the 1990s. In December 1994, Mexico lost $5 billion in only 5 days and the Mexican market capitalization fell by 43% in 1994. Nevertheless, Mexico managed to overcome this disequilibrium thanks to its commercial integration to the North American region. Indeed, after the crisis, Mexico carried out vast program of economic adjustments to restore the investor confidence by opening up its economy to international trade and by encouraging the free circulation of capital. Consequently, Mexico has known a fast growth recovery after the 1995 recession. On average, the country's GDP increased by 6% between 1996 and 1997, and Mexican exports as a share of GDP went from 13% in 1993 to 26% in 1999 due to its high degree of regional integration within the NAFTA. Moreover, Mexico's ties with the USA explain the huge increase of foreign direct investments which reached more than $11 billion in 2000 against only $4.4 billion in 1993. It should be finally noted that many multinational enterprises such as Danone, EADS, Accord, Suez, and Schneider Electric have extended their activities to the United States through investments in branch firms in Mexico.

Overall, it is obvious to expect that these different changes in the Mexican market induce different regimes that govern the dynamic process of stock price movements.

The Philippines share many features in common with Asian emerging markets. The first point to mention is that these markets have also launched a series of reforms throughout the 1980s and the beginning of the 1990s including notably the modernization and liberalization of their financial markets. They experienced, as a result, significant growth which created attractive international capital budgeting and investments. Further, several researches find that these markets become actually increasingly integrated with the world stock markets (Bekaert and Harvey 1995; Gerard et al. 2003; Carrieri et al. 2007). Note however that the intensity and efficiency of these reforms differ from one country to another.

In addition, the Philippines are one of the most welcoming countries of the Asian region for the western investment flows. The country's trade openness ratio reached, indeed, an average of 119% over the last decade. This is essentially due to the advancement of the ASEAN (Association of South-East Asian Nations) created in 1965 by five countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand). Comparatively, stock markets in the Philippines are less developed than those in Mexico as the part of local markets held by foreign investors is smaller.

In presence of structural reforms whose aim is to promote financial integration with international stock markets, it is expected that stock markets in the Philippines exhibit nonlinear and regime-switching behavior during the postliberalization period rather than during the period prior to market openings.

4.3 Threshold Econometric Modeling

This section briefly introduces the threshold nonlinear models that seem to be appropriate for reproducing the changes in emerging stock markets and the possible mean-reversion process in stock prices.

4.3.1 Brief Presentation of Threshold Models

The cointegration theory, which has been introduced by Granger (1981) and developed by Granger (1986); Engle and Granger (1987); Johansen (1988), stipulates that some variables undergo some short-term disruptions, but while possessing the long-term same properties, they can tie between them stable relations which converge toward equilibrium of long term. Formally, let X_t and Y_t be two variables that are not stationary in the level but stationary while differentiating them d times. In the long term, if it is possible to find a linear combination z_t between these two variables which is stationary, then X_t and Y_t are cointegrated.

$$z_t = X_t - a_0 - a_1 Y_t \tag{4.1}$$

The series z_t in (4.1) is defined as the error term or the residual of the cointegration relationship. It measures the residual innovations in the relationship between X_t and Y_t. X_t and Y_t refer respectively to the emerging and world stock market price indices. Thus, the stationarity of z_t indicates the existence of a stable economic relationship between these two variables and suggests further evidence of bilateral linkages. This also implies that it is possible to forecast the future dynamics of X_t while knowing that of Y_t.

Under the hypotheses of frictionless market and especially the absence of transaction costs, the stock price adjustment is linear, symmetric, and continuous with an invariant equilibrium and adjustment speed. The well-know adjustment model is given by a standard Error Correction Model (ECM) defined as follows:

$$\Delta Y_t = \alpha_0 + \lambda z_{t-1} + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{p} \beta_j X_{t-j} + \varepsilon_t \tag{4.2}$$

where λ denotes the linear adjustment term and p refers to the lag order of the ECM. However, this modeling may not be appropriate to reproduce the asymmetry and the persistence inherent to stock price adjustment. In addition, emerging stock markets, as discussed above, are not frictionless.

In order to adequately reproduce all the characteristics of the stock price dynamic sin emerging countries, it would be recommended to extend the linear model described in (4.2) to the nonlinear framework. In particular, a possible way consists of integrating different regime dynamics and allowing stock prices to adjust nonlinearly with a certain changing adjustment speed. The advantage of such extension is to reproduce a time-varying price adjustment process provoked by structural changes, evolving market regulations and liberalization reforms in emerging countries.

The extension proposed in this chapter is based on the threshold ECM introduced firstly by Granger and Terasvirta (1993) and further developed by Van Dijk et al. (2002). A particular class of these models yields the Exponential Switching ECM, noted ESTECM and defined through the following representation:

$$\Delta Y_t = \alpha_0 + \lambda_1 z_{t-1} + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{p} \beta_j X_{t-j} + \lambda_2 z_{t-1} \times F(\gamma, c, z_{t-d}) + \varepsilon_t \quad (4.3)$$

where $F(\gamma, c, z_{t-d}) = 1 - \exp\left[-\gamma(z_{t-d} - c)^2\right]$, $\gamma > 0$ and c are respectively the transition speed and the threshold parameter, $\varepsilon_t \rightarrow \mathrm{N}(0, \sigma^2)$ and z_t is the error correction term of linear cointegration relationship obtained from (4.1).

The main advantage of this econometric modeling is that it exactly checks the theoretical model of Anderson (1997) which is used to describe the price adjustment in presence of heterogeneous transaction costs. Indeed, this specification describes two regimes corresponding to the extreme values of F and an intermediate (or central) continuum state. The central regime is defined when the stock price adjustment dynamics is close to long-run equilibrium (i.e., transaction costs are low) and it is described by the following linear specification:

$$\Delta Y_t = \alpha_0 + \lambda_1 z_{t-1} + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{p} \beta_j X_{t-j} + \varepsilon_t \quad (4.4)$$

The extreme regimes are described by another linear representation as:

$$\Delta Y_t = \alpha_0 + (\lambda_1 + \lambda_2) z_{t-1} + \sum_{i=1}^{p} \alpha_i Y_{t-i} + \sum_{j=1}^{p} \beta_j X_{t-j} + \varepsilon_t \quad (4.5)$$

Note that for this ESTECM, λ_1 and λ_2 are the most important parameters as their values and signs specify the stock price adjustment dynamics, and determine their convergence speed towards the equilibrium. Indeed, even though λ_1 is positive, λ_2 and $(\lambda_1 + \lambda_2)$ have to be negative and significant in order to validate a nonlinear

mean-reverting process of stock price toward its equilibrium. This implies that for small deviations, the emerging stock market index would diverge from the equilibrium and would be characterized by a unit root or an explosive behavior, while for important deviations, adjustment process would be nonlinearly mean-reverting with an adjustment speeds that increases proportionally to the deviation magnitude from the equilibrium given by the long-term relationship in (4.1).

It is important to notice that mixing tests must be carried out before estimating the proposed empirical model in order to know whether there is nonlinear relationship between the variables of interest.

4.3.2 Mixing Tests

Following Dufrénot G and Mignon (2002), the co-mixing processes may be defined differently. Let $\{X_t\}_{t=1}^{\infty}$ and $\{Y_t\}_{t=1}^{\infty}$ be two non-mixing processes and f a nonlinear function, these processes are said to be mixing if

- There exists a sequence $\{f(X_t, Y_t, \gamma)\}_{t=1}^{\infty}$ that is mixing for $\gamma = \gamma^*$ and non-mixing for $\gamma \neq \gamma^*$.
- Or there exists a sequence $\{f(X_t, Y_t, \gamma)\}_{t=1}^{\infty}$ that is non-mixing with a dependence structure weaker than the dependence characterizing the processes $\{X_t\}_{t=1}^{\infty}$ and $\{Y_t\}_{t=1}^{\infty}$.

Several mixing tests have been introduced in the econometric literature. Among these tests, the most useful and powerful ones are the KPSS nonparametric test and the R/S parametric test of Lo (1991). The former tests the null hypothesis of "mixing" against the alternative of "non-mixing", whereas the latter tests the null hypothesis of null or short-range dependence (mixing) against the alternative of "non-mixing" or long-range dependence.

As far as the KPSS is concerned, we empirically retained the values recommended by Schwert (1989) for the truncation parameter:

$$l_4 = \text{int}\left[4\left(\frac{T}{100}\right)^{\frac{1}{4}}\right]$$

and

$$l_{12} = \text{int}\left[12\left(\frac{T}{100}\right)^{\frac{1}{4}}\right]$$

where T is the number of observations and int[.] denotes the interior part. Concerning the choice of q for the R/S test, we used the value of Andrews (1991) as defined by the following formula: $q_t = [K_T]$, where $K_T = \left(\frac{3T}{2}\right)^{\frac{1}{3}}\left(\frac{2\hat{\rho}}{1-\hat{\rho}^2}\right)^{\frac{2}{3}}$, $[K_T] = \text{int}(K_T)$ and $\hat{\rho}$ is the first-order autocorrelation coefficient.

In practice, the empirical methodology of these models is carried out in several steps. First, the application of the usual unit root tests (Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests) is useful to check the integration order of the stock price series. Second, the mixing hypothesis is checked applying KPSS and R/S tests on the residual term ($\hat{z}_t$) in order to test the nonlinear co-integration hypothesis. Third, accepting the mixing hypothesis suggests that stock prices are nonlinearly mean-reverting and justifies the estimation of the ESTECM through the Nonlinear Least Squares (NLS) method.

4.4 Empirical Results and Discussions

This section first summarizes the data used to illustrate the application of threshold stock price adjustment models in the case of emerging markets. Then, empirical results and implications are presented.

4.4.1 Data and Preliminary Tests

The data used consist of the monthly MSCI stock market indices of two emerging countries (the Philippines and Mexico) and the MSCI world stock market index over the period from December 1988 to January 2008. They are expressed in US dollars and obtained from Datastream International. First of all, the results of both ADF and PP tests, not reported here in order to save spaces, show that all indices are integrated of order one, $I(1)$.[1] Then, the bilateral return correlation between emerging and world markets, calculated and presented in Table 4.1, points out that there is an increase of bilateral correlations of the Mexican and Philippine stock markets with the world market after the Mexican crisis. This may be indicative of a higher degree of financial integration of Mexico and the Philippines with the world market.

Second, the relationship between emerging and world market price indices is investigated using co-integration tests. Concretely, the long-term relationship described by (4.1) is estimated for both emerging market indices. The usual linear co-integration tests (ADF) is then applied to examine the stationarity of the model residuals. The inspection of the results indicates, as expected, the rejection of linear co-integration hypothesis for both emerging market indices. This suggests, in addition, further evidence of market segmentation for Mexico and the Philippines. However, these results have to be interpreted carefully because the rejection of linear co-integration hypothesis is sometimes due to the misspecification of linear co-integration tests notably when the data generating process is rather nonlinear.

[1]Results are available under request addressed to the authors.

Table 4.1 Bilateral correlations

Series	RPHI	RMEX	RMSCI
Before Mexican Crisis: January 1988 to November 1994			
RPHI	1.000		
RMEX	0.096	1.000	
RMSCI	0.327	0.264	1.000
After Mexican Crisis: December 1994 to January 2008			
RPHI	1.000		
RMEX	0.398	1.000	
RMSCI	0.437	0.598	1.000
All the period: January 1988 to January 2008			
RPHI	1.000		
RMEX	0.310	1.000	
RMSCI	0.394	0.474	1.000

Note: RMSCI, RPHI and RMEX are respectively the continuously compounded returns of the World, Philippine and Mexican stock markets

In order to remedy these limits, "mixing" tests that are more robust than linear co-integration tests are used to check for the co-integration hypothesis in a non-linear framework.

4.4.2 Mixing Test Results

Two "mixing" tests are indeed carried out: the KPSS and the *R*/*S* tests which both check the null hypothesis of "mixing" against its "non-mixing" alternative. The obtained results are reported in Table 4.2.

It is demonstrated from Table 4.2 that the mixing hypothesis is accepted for Mexico according to KPSS and R/S tests, which implies a co-integration relationship between Mexican and world stock market indices. The null hypothesis is retained only at 10% level for the Philippines according to R/S test. The KPSS test does not reject the null hypothesis, but only for the second value of the truncation parameter (l_{12}). Accordingly, the mixing hypothesis and the nonlinear co-integration are also accepted for the Philippines. These findings support entirely the use of an ESTECM to reproduce the stock price adjustment for Mexico and the Philippines with respect to world stock markets.

4.4.3 Estimation of ESTECMs

The ESTECM is estimated using the NLS method following Van Dijk et al.'s (2002) procedure:

- First, the number of lags (p) of the ESTECM is specified by the information criteria, the autocorrelation functions and the Ljung-Box tests. These tests lead to retain zero lag ($p = 0$) for Mexico and one lag ($p = 1$) for the Philippines.

Table 4.2 Mixing tests

KPSS		R/S
Mexico		
l_4	l_{12}	Andrews
0.45	0.12	1.1
Philippines		
l_4	l_{12}	Andrews
0.72[a]	0.29	1.6[a]

[a]Denotes the rejection of the null hypothesis at the 5% significance level

Table 4.3 ESTECM estimation results for Mexico

Coefficients	ESTECM (0,1)
α_0	0.004 (1.04)
ρ_1	0.099[a] (2.36)
ρ_2	−0.131[a] (−3.05)
β_0	1.105[a] (8.52)
γ	26.060[a] (2.04)
$\gamma \times \sigma_{z_{t-d}}$	7.640
c	0.626[a] (16.979)
ADF^{GLS}	−9.830
R/S	1.400
$\sigma_{NECM}/\sigma_{LECM}$	0.730

Notes: The values in parenthesis are the t-statistic of nonlinear estimators. [a]denotes the significance at 5%

Table 4.4 ESTECM estimation results for the Philippines

Coefficients	ESTECM (1,1)
α_0	−0.002 (−0.37)
ρ_1	−0.181 (−1.02)
ρ_2	0.162 (0.91)
β_0	0.218[a] (3.55)
δ_1	0.923[a] (6.82)
γ	625.070 (0.49)
$\gamma \times \sigma_{z_{t-d}}$	219.530
c	−0.332[a] (−16.36)
ADF^{GLS}	−15.850
R/S	2.500[a]
$\sigma_{NECM}/\sigma_{LECM}$	0.990

Notes: The values in parenthesis are the t-statistic of nonlinear estimators. [a] denotes the significance at 5%

- Then, the linearity hypothesis is tested against nonlinearity using Multiplier Lagrange tests. The results reject the null hypothesis of linearity for both emerging market indices.
- Finally, different initial values are tested with the ESTECM parameters, and the optimal results retained are reported in Table 4.3 for Mexico and in Table 4.4 for the Philippines.

These findings witness significant linkages between two selected emerging markets with the MSCI world market index. One should note that the ESTECM did not seem to be appropriate to the Philippines, suggesting that another type of nonlinearity might be still present in the stock market data (i.e., the residuals of the estimated model are not mixing). In other words, the ESTECM does not permit to apprehend the whole nonlinearity in the data, leading to the rejection of this nonlinear representation for the Philippines.

This model provides however interesting results for Mexico. Indeed, γ and c are statistically significant which confirms the choice of the exponential function for Mexico. The findings also point out significant evidence of slow transition between the regimes according to the explanations of nonlinearity discussed in Sect. 4.2. More interestingly, the nonlinear adjustment terms (ρ_1 and ρ_2) offer an important result in terms of nonlinear and threshold adjustment in the sense thatρ_1 and ρ_2 are positive and negative respectively, and they are both statistically significant at 5% level. This indicates that in the first regime, the Mexican stock prices may deviate from its equilibrium established with the world market and its deviations might be uncorrected and possibly characterized by a random walk process. However, when its deviations are being higher and exceed a certain threshold, the activation of mean-reverting process helps converging stock prices in Mexico toward its equilibrium with world market.

Further, the negativity of the sum ($\rho_1 + \rho_2$) implies a significant nonlinear error-correction adjustment dynamics for the Mexican market index and shows a nonlinear integration process of Mexico into the world stock market. Indeed, in the first regime (i.e., before the Mexican crisis), when the Mexican deviations are small, the Mexican index cannot follow the MSCI world index and Mexico is rather segmented. By contrast, a nonlinear integration process is active and its convergence speed increases with the stock price deviation size in the second regime when its stock price deviations are large.[2] The application of several misspecification tests shows that the residuals of ESTECM are mixing and stationary and thus validates this specification for Mexico.

The estimated transition function for Mexico is plotted with respect to the transition variable in Fig. 4.1. Two important features can be noted. First, the ESTECM captures the asymmetry characterizing the Mexican financial integration dynamics. Second, the graph clearly shows the high degree of persistence in Mexican stock price movements, particularly after 1994.

In what follows, the focus is on the relationship between selected emerging stock markets and oil markets in order to further investigate their price adjustment dynamics. The rationale behind this idea is that recent emprical studies in energy economics have shown signficant nonlinear correlation and linkages between stock and oil markets. These studies suggest that threshold models may provide best fits of the said relationship. In this chapter, an ESTECM is also used to apprehend the

[2]The threshold parameter approximates the value of the Mexican stock price deviations in May 1993.

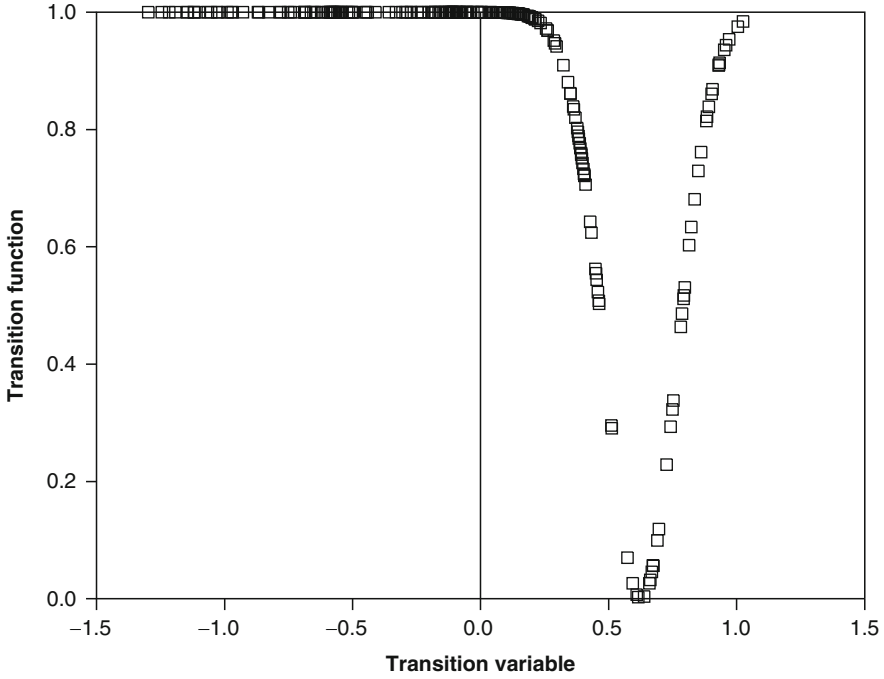

Fig. 4.1 Exponential transition function for Mexico

dynamic price adjustment of two emerging markets in response to oil price changes, a major source of economic fluctuations.

4.4.4 Essays in Nonlinear Modeling of Oil and Stock Market Linkages

We used the similar monthly prices over the period from December 1987 to March 2008 to investigate the link between oil prices and stock markets in Mexico and the Philippines. The oil price series was obtained from the Dow Jones & Company database. Defining the equilibrium by the relation (4.1), Y_t and X_t denote respectively the stock and oil market price indices. The linear co-integration hypothesis is not rejected for both stock markets either at 5% level or 10% level, implying that oil and stock markets are at least linearly linked. However, the presence of negative skewness, asymmetry, and normality in both market indices suggests some nonlinearity in stock and oil price dynamics. Table 4.5 reports the correlation matrix between variables, and shows a negative correlation between oil and stock returns. This finding implies that an increase in oil prices yields a decrease in stock returns and inversely.

Table 4.5 Correlation matrix

	RPH	ROP	RMX
RPH	1.00	−0.11	0.30
ROP		1.00	−0.03
RMX			1.00

Notes: RPH, RMX and ROP designate the Philippine, Mexican and oil returns

As stated previously, the nonlinear adjustment between oil and stock market indices is investigated using the ESTECM modeling. The results of linearity tests strongly reject the linearity for $d = 1$ for Mexico and the Philippines, and show some evidence of an asymmetric co-integration relationship between oil and stock prices. They suggest that the linkages between these two variables may be time-varying and price adjustment dynamics is typically activated when oil and stock prices significantly rise or fall.[3] In this case, the use of the ESTECM permits to specify the nonlinear mean reversion in stock prices with respect to oil price movements.

In particular, an ESTECM (0,1) and an ESTECM (1,1) are estimated for Mexico and the Philippines respectively through using the NLS method. The empirical results are reported in Table 4.6. Overall, empirical results suggest a number of interesting facts. First, oil prices significantly and negatively affect Mexican stock market, thus confirming the negative unconditional correlation and indicating evidence of significant linkages between the oil and stock markets. Second, the negativity and significance of the second adjustment term imply strong evidence of nonlinear mean reversion between oil and stock markets. Indeed, oil and stock markets may deviate in the first regime and stock market deviations may persist, remain uncorrected and away from equilibrium, but when deviations become higher and exceed a certain threshold, a nonlinear mean reversion process is activated. More precisely, the negativity of the sum $(\lambda_1 + \lambda_2)$ indicates the effectiveness of a nonlinear mean-reversion in the stock prices and also suggests the asymmetric responses of stock prices to oil market shocks.

Third, the estimation of transition functions plotted in Figs. 4.2 and 4.3 indicates the validity of the exponential function in reproducing the relationship and the price adjustment between oil and stock markets. Different regimes are identified for price adjustment dynamics. The first one is to a central regime in which price deviations follow a near unit root process and the convergence toward oil-stock price equilibrium relationship is not activated. In this regime, also called a "pure chartist regime", stock prices are essentially governed by their previous tendencies. The second regime corresponds to the upper regimes for which stock prices are mean-reverting toward oil prices. In this "oil market follower regime", the adjustment is activated more strongly and integration between oil and stock markets is statistically significant.

For both emerging markets, the transition function reaches unity, implying that the oil-stock price reciprocal adjustment is often activated and that both markets are closely linked. Similar to the price adjustment dynamics followed by emerging and

[3]See Jawadi et al. (2009) for more details about linearity tests.

Table 4.6 ESTECM estimation results

Coefficients	Mexico	Philippines
Model	ESTECM (0,1)	ESTECM (1,1)
α_0	0.01^{**}	-0.01
	(1.9)	(-0.7)
λ_1	-0.21^{*}	0.13^{**}
	(-2.3)	(1.7)
α_1	–	0.22^{*}
		(3.4)
β_1	-0.17^{*}	–
	(-2.2)	
λ_2	-0.18^{**}	-0.16^{a}
	(-1.91)	(-2.2)
γ	5.3^{*}	6.3^{*}
	(6.0)	(10.1)
c	-0.27^{*}	0.46^{*}
	(-1.99)	(5.8)
ADF[a]	-9.8	-10.2
ARCH[b]	0.02	0.68
RNL[c]	0.13	0.48
$\lambda_1 + \lambda_2$	-0.39	-0.03

Note: (*) and (**) designate the statistical significance at 5% and 10% levels respectively. (a), (b), and (c) respectively designate the empirical statistics of the ADF, ARCH and remaining nonlinearity tests. Values between brackets are the t-ratios

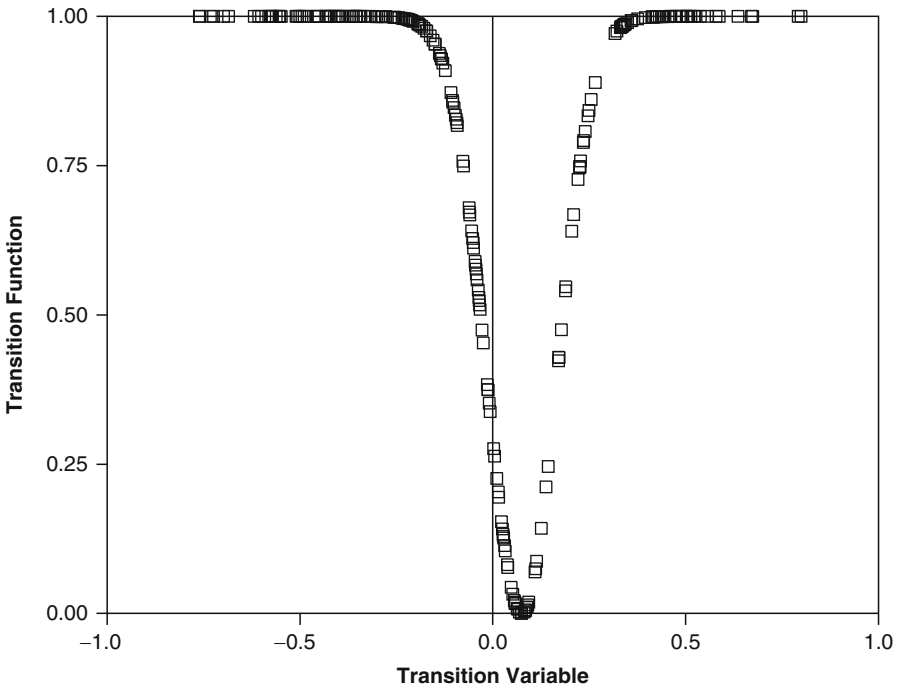

Fig. 4.2 Estimated transition function for Mexico

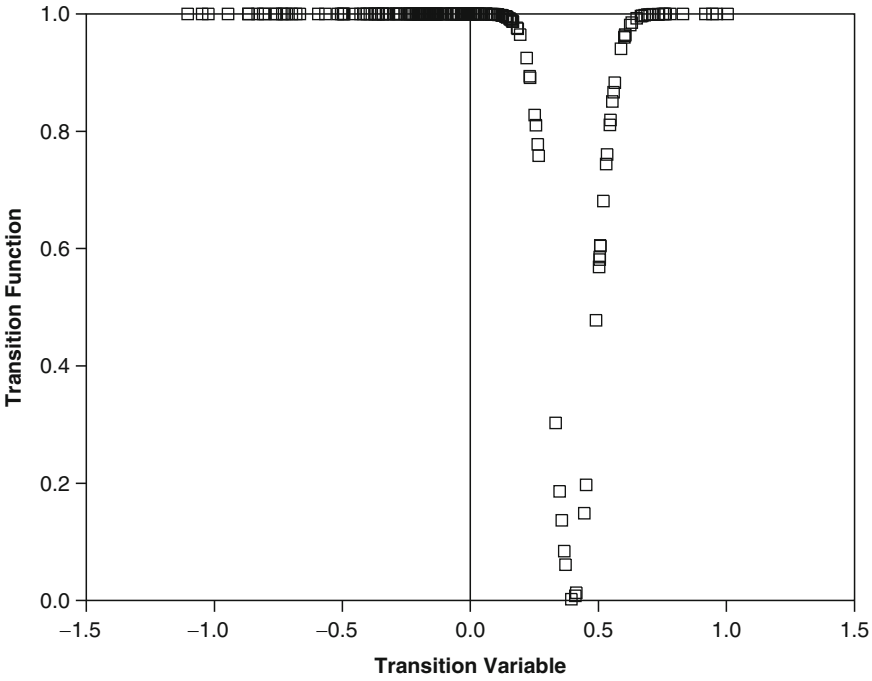

Fig. 4.3 Estimated transition function for the Philippines

world stock markets, the mean-reversion speed of oil and stock prices also depends on the magnitude of price deviations from the equilibrium. That is, the higher are the price deviations, the higher is the likelihood that strong mean reversion is activated.

To sum up, this investigation also confirmed the hypothesis of threshold price adjustment dynamics for two emerging countries under consideration. In particular, the ESTECM model seems to be a useful tool for characterizing the oil-stock price relationship. These results have important implications insofar as the use of such an on/off co-integration relationship between oil and stock markets could help investors to manage their stock and oil-related stock portfolios depending on the actual regimes of oil-stock market relationship.

4.5 Summary

This chapter investigated the threshold stock price adjustment for emerging countries in a nonlinear framework. After explaining the potential of nonlinearity in the asset price dynamics of emerging markets, an empirical investigation was carried out using the recent developments of threshold and nonlinear co-integration models.

It is shown that these econometric tools enable to reproduce the different regimes of stock price adjustment as well as the linkages between emerging and

world markets in a time-varying and nonlinear manner. The findings are particularly consistent with the presence of nonlinear mean-reversion process in stock market prices in Mexico with respect to the world stock market. This suggests doubtlessly further evidence of nonlinear financial integration between these markets, especially after the year of 1994, which is activated per regime once price deviations from equilibrium exceed an endogenous threshold.

The investigation of oil-stock market relationship also supports the hypothesis of nonlinear, asymmetric and mean-reverting price adjustments of both markets toward their long-term equilibrium.

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Chapter 5
Evolving Stock Market Efficiency

Abstract Understanding the efficiency of emerging stock markets have become important over the last decades as they are now reasonably integrated with developed and world markets. If emerging markets are efficient, both foreign and domestic investors could, when making their investment decisions, consider an asset price to reflect its true fundamental value at all times.

The empirical studies on emerging market efficiency are however very challenging. First, the heterogeneity of these markets in terms of market size and development levels often leads to country-specific results. Second, only a few studies focus on tests of efficient market hypothesis in emerging markets because the majority of them appear to be less efficient than the semi-strong and the strong forms due to numerous market imperfections such as transaction costs, poor quality of information disclosures, thin trading, and inadequate financial and accounting regulations. Finally, their degree of efficiency may evolve though time, which typically reflects different stages of development and gradual process of liberalization.

The purpose of this chapter is to provide a comprehensive review of the efficient market theory and to explore how the market processes information in emerging countries. Specifically, we present a dynamic parameter model that is suitable for characterizing the possibly time-varying pattern of weak form efficiency in emerging stock markets under the gradual effects of market reforms.

5.1 Theory of Stock Market Efficiency

Economics is essentially concerned by three types of efficiency: operational efficiency, information efficiency, and allocational efficiency (also referred to as Pareto efficiency). Operational efficiency is a market condition whereby market participant can execute transactions and receive services at the fair price and actual costs required to provide them either they enter the market directly or they use financial intermediaries. To know the degree of operational efficiency, investors and fund managers ask the question of whether transactions are completed at a timely basis,

M. EI H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_5,

accurately and without excessive costs. For its part, informational efficiency describes a market situation where market price of a security reflects all relevant information to pricing the said security. Finally, allocational efficiency stipulates that capital markets are able to direct available funds to the most productive utilizations or highest risk-adjusted return projects. This characteristic requires a priori the validity of both allocational and informational efficiency.

The focus of this chapter is on the informational market efficiency because it constitutes an underlying assumption for many other financial theories and plays a crucial role in mobilizing savings and investment resources for economic developmental purposes.

5.1.1 The Concept

Informational or market efficiency is one of the most fundamental issues in finance as it permits to explain why asset prices change in financial markets and how these changes take place. This concept is based on the arguments put forward by Samuelson (1965) that expected price of an asset fluctuate randomly, a proposition anticipated by Bachelier (1900) who recognizes that "*past, present and even discounted future events are reflected in market price, but often show no apparent relation to price changes.*"[1] Fama (1970) presents a formal review of theory and evidence for market efficiency and subsequently revised it further on the basis of development in research (Fama 1991). Globally, market efficiency refers to the proposition that current stock prices incorporate fully, if not instantaneously, relevant information that is known about the stock at time t, and as a result no investors can make abnormal profits from using these pieces of information.

More precisely, the price at which a security is exchanged in an efficient market corresponds to its true fundamental value, and there are neither undervalued nor overvalued assets available to trade. When making investment decisions, investors could then consider the observed price to be the market's best estimate for the risk-return tradeoff of the considered asset. To the extent that future prospects of the listed firms would be also impounded in the asset prices, available funds can be allocated towards firms where they will be the most effective for investors. This market situation is indisputably desirable for market development and economic growth as a whole.

In practice, financial markets are not always efficient. A good and sophisticated analysis sometimes permits to predict price movements or to identify assets that are currently undervalued and expected to increase in value in the future. That is why many investors and investment managers believe that they can select assets that will outperform the market.

[1]See Dimson and Mussavian (1988) for a brief history of market efficiency. The authors also discuss the contributions and inter-linkages between the most influential research articles of the field.

There exists however a natural mechanism for financial markets to converge toward efficient state through price competition among market operators and exploitation of any arbitrage opportunities. For example, if the market is unable to reflect instantaneously, or at least quickly, all relevant information at a given point in time, the ability to detect mispriced stocks is valuable because some economic agents (especially those who possess privileged information such as a new contract or changes in forecasted income) can take positions to capitalize upon the arrival of any new information. The profitable investment strategy thus consists of buying undervalued stocks for less than their fair value and selling others for more than they would be worth. As more and more professional investors and financial analysts will perform these arbitrage operations (also called risk-free profit deal) to take advantage of the price differential, price competition between investors will force stock prices to their efficient values. Consequently, profit opportunity is eliminated in equilibrium, and for almost all investors the trading profit based on the new information would not outweigh the transaction costs. At this stage, the new information is said to be completely incorporated in stock prices, and the market is efficient. The convergence mechanism as described previously reflects the process through which the market learns about new information. The speed of convergence is as rapid as the market is liquid and large, and information is freely accessible and costless.

5.1.2 Consequences of the Market Efficiency

The hypothesis of instantaneous and complete incorporation of new information in stock prices, which indeed define the existence of efficient capital markets, has many implications on the behavior of stock prices and market participants as well as on the abnormal profit opportunities. The most obvious ones can be summarized as follows.

The observed price of a financial security in efficient markets is determined in a random manner, and then any price variations are due to the arrival of new information. In fact, when the informational efficiency of the market cannot be rejected, past information regarding the security is already reflected in the prices. So, only the new information, totally random and independent from the past sequences of prices, causes the security price to change. For example, after the company A announced an increase of 10% in its net income over the last quarter, the market price of its shares grew by 20% to establish at €50, and this new price remains unchanged until the arrival of new information. As a result, one would say that the new price incorporating the new information is set on the basis of past prices and random incremental changes, uncorrelated with past price variations. That is why financial researchers and practitioners often employ the expression of random walk to describe price movements in efficient markets.

The new equilibrium (or efficient) price is instantaneously established just after the new information is published without being subject to successive trials and errors. This assertion is somewhat strong because market participants may react to

the new information according to their beliefs and expectations. It is however supported by the fact that the price adjustment is so immediate and instantaneous in perfectly efficient markets that nobody has sufficient time to exploit the new and presumably "valuable" information. Thus, any continual price formation constitutes an *antifact* to the market efficiency.

The current market price accurately reflects the fundamental or intrinsic value of the share. In finance, the fundamental value of the share is commonly measured by the present value of expected future cash flows (or dividends) provided by the issuing company, where the discounted rate refers to investors' required rate of return for the risk level taken. The existence of efficient markets implies that market forces including especially price competition among participants will drive the market price of the security to its fundamental value. The efficient state has an important implication for security markets in that investors can infer the market's expectation of the compound growth rate (g) from the current dividends (d_{t-1}) using the observed price of the financial security (P_t). Assuming a discount rate k, the inference is made from the dividend discount model:

$$P_t = \frac{d_{t-1}}{k-g}$$

It is worth noting that the equality between fundamental value and market price is not respected when the market is not efficient, i.e., the estimated fundamental value can be higher or lower than what the share is currently trading at. In this case, abnormal gains can be obtained by exploiting the price differentials on undervalued and overvalued securities.

In efficient markets, no abnormal profit can be generated by using either past, public or private information. In practice, this consequence says that the security market insures a fair game between investors and the difference between actual and expected returns tends to be insignificant and unpredictable assuming rational expectations of the investors.

If, for example, returns are assumed to be generated as follows

$$\tilde{r}_{i,t+1} = E(\tilde{r}_{i,t+1}|\Omega_t) + \varepsilon_{i,t+1}$$

The following conditions must hold in an efficient market

- The error term is an unbiased zero-mean process: $E(\varepsilon_{i,t+1}|\Omega_t) = 0$.
- The error term is independent of expected returns: $E\big(\varepsilon_{i,t+1}, E(\tilde{r}_{i,t+1}|\Omega_t)\big) = 0$.
- The prediction error is temporally independent: $E(\varepsilon_{i,t+1}, \varepsilon_{i,t+k}|\Omega_t) = 0$ with $k \neq 1$.

It is important to note that in the above formula, $\tilde{r}_{i,t+1}$ refers to the realized returns on security i at time $(t+1)$, Ω_t is the information set in time t which *a priori* contains all past, public and private information about the security prospects, and

finally $E(\tilde{r}_{i,t+1}|\Omega_t)$ reflects the expected returns on security i which can be evaluated by using the Capital Asset Pricing Model (CAPM):

$$E(\tilde{r}_{i,t+1}|\Omega_t) = R_f + \beta_1\left[E(R_M) - R_f\right)]$$

where R_f and $E(R_M)$ refers to the returns on a risk-free asset and a market portfolio. β_i is interpreted as the systematic or undiversifiable risk of the security i.

In summary, some may claim that there is room for outperforming the market (i.e., one can obtain a profit higher than what is given by the CAPM) even though the market is efficient because the security prices do only incorporate the new information progressively. But, this possibility is quite random and unpredictable according to the efficient market hypothesis.

5.1.3 Three Forms of Informational Efficiency

According to the aforementioned discussions, the efficient market hypothesis (EMH) predicts that markets are efficient if stock prices fully reflect all available information.[2] Since stock prices can be influenced by different types of information, financial economics often distinguish among three versions of market efficiency depending on the underlying information set that is available to market participants: weak form, semi-strong form and strong form.[3]

Markets are said to be weak form efficient if the current stock prices fully reflect information contained in the *past realizations of the price*. As a result, price changes are unpredictable, and one cannot earn abnormal returns on the basis of historical information on prices and trading volumes. It is also important to remark that the weak form of the EMH relies on the simple idea that the sequence of past prices is the most public and easily available piece of information. Then, the validity of the weak form efficiency would mean the impossibility to take advantage of something that everybody else knows.

The semi-strong form of the EMH claims that the current stock prices fully incorporate *all publicly available information*. Here public information includes all available market and firm-specific data such as expectations regarding market performance and macroeconomic factors, the firm's financial statements, earning and dividend announcements, merger and acquisition plans, the financial situations of the firm's direct competitors, etc. Obviously, this information set contains naturally the past prices and volumes, and it is not of a strictly financial nature.

[2]From now on the chapter deals with the informational efficiency of stock markets, but the general knowledge is also valid for other segments of financial markets.

[3]This categorization is initially due to Fama (1970) and further explained in Fama (1991). The interested readers can refer to these works and references therein for a comprehensive review of the theoretical and empirical developments of the efficiency concepts.

This implies that a market being semi-strong form efficient is necessarily efficient according to the weak form. One should realize that the rationale behind the semi-strong form efficiency is always the impossibility to forecast future returns from what everybody knows, i.e., information is public and diffused to investors at the same time. Nevertheless, this version is somewhat stronger than the weak form efficiency in that sophisticated skills (i.e., the ability to understand and analyze the implications of economic and financial information from multiple sources) are needed if one would like to "beat" the market. The reason is that public information may be relatively more difficult to gather and sometimes costly to process. Moreover, in order to collect all valuable information to effectively analyze the evolution of stock prices, investors must gain information from not only economic newspapers and company-produced publications, but also from professional reports, databases and academic research journals for example.

If the market is strong form efficient, then the current stock prices fully reflect all existing information including both public and private information. Remark that the latter is also called "inside information" as it is often concerned by organizational agency problems. The validity of the strong form of market efficiency induces that no abnormal profit can be systematically generated even if trades are executed on the basis of the information not publicly known. Consequently, privileged information to which management team and research department members of the firm might have access does not permit them to earn nonzero gain after transaction costs are taken into account. From a theoretical point of view, it is worth noting that the strong form of market efficiency assumes that the market is able to anticipate its future developments in an unbiased manner due to the full incorporation of relevant information into stock prices.

5.1.4 Empirical Evidence

Since its introduction into the financial economics literature, the concept of market efficiency has been examined and tested in a large number of studies. The empirical evidence, extensively concentrated for stock markets in major developed countries, show that the efficient behavior of stock prices cannot be rejected in general.

Many studies have attempted to test the weak form of market efficiency by examining the time-dependence between the current returns on a security and their past realizations. If the security price follows a random walk, one would expect to find a zero-correlation coefficient between current and past returns. The market is efficient in this case. A positive correlation, however, indicates that a rate of return higher than the average tend to be followed by a rate of return higher than the average, while a negative correlation is indicative of the fact that a rate of return higher than the average is followed by a rate of return lower than the average (mean-reverting process). For example, Fama (1965) finds evidence of the serial correlation for a sample of 30 Dow Jones Industrial stocks, but the author suggests that it is too small to cover transaction costs of trading. More recently, the test of

weak form efficiency is extended to include the predictive power of financial and macroeconomic variables regarding the distribution of security returns (e.g., Campbell and Shiller 1988 for Pricing-Earnings Ratio; Fama and French 1988 for dividend distribution rate; Harvey 1991 for term structure of interest rates). Most of the studies on developed markets report empirical results which are consistent with the weak form of market efficiency.

Tests of the semi-strong form of market efficiency rely on the fact that asset prices react to and incorporate all public information. Researchers often examine two propositions: (1) Mutual fund managers, as skilled investors, can consistently beat the market; (2) Information contained in firm-specific events is instantaneously reflected in the security prices. For example, Jensen (1969) reports, based on a risk-adjusted performance analysis, that on average, mutual funds do not outperform the market index. The most influential papers that use event studies to test for the semi-strong form efficiency include, among others, Fama et al. (1969) for stock splits, Ball and Brown (1968) for earnings announcements, Ibbotson (1975) for initial public offerings, and Jensen and Ruback (1983). Empirical results of this research stream is however controversial due to a number of market anomalies which act against the market efficiency hypothesis.

Empirical tests of the strong-form efficiency may be the most difficult to implement since they rest on existence of the asymmetric information between insiders and outsiders, and the profitability of insider trading. Only few attempts have been made in the finance literature to investigate the ability of insiders to take advantages of their private information (e.g., Jaffe 1974; Rozeff and Zaman 1988; Jeng et al. 1999). Empirical results are generally inconsistent with the strong-form of the EMH.

5.1.5 Anomalies to Market Efficiency

The theory of efficient markets has been long challenged by the detection of numerous anomalies, especially in stock markets, that reject directly or indirectly the EMH. First, it is now common that there exist seasonal effects such as January effect (Rozeff and Kinney 1976), and weekend or Monday effect (French 1980). The January effect stipulates that the stock returns appear to be higher for the month of January than for other months of the year, while the weekend effect is related to the fact that stock returns tend to be negative on Monday, but positive for other days of the week. Accordingly, stock markets are somewhat predictable when taking into account the "seasons."

Basu (1977) detects another anomaly, called "Pricing-Earnings Ratio" effect according to which PER ratios permit to predict the market performance. In particular, low-PER firm portfolios realize higher returns than high-PER firm portfolios do. Subsequently, Banz (1981) suggests that this PER effect is closely related to firm size. That is, small firms tend to outperform large firms even when risk-adjusted performance measures are used to control for the riskier characteristics of small firms.

Other studies focusing on the impact of the psychological aspects of investors on stock prices report that price variations are predictable. For example, DeBondt and Thaler (1985) argue that investors tend to pay more attention to recent information, and less to attention to prior information, which typically lead the stock prices to overreact to the new information. Using a contrarian strategy that consists of selling a portfolio of winner stocks (high past returns) and buying a portfolio of loser stocks (low past returns), DeBondt and Thaler (1985) observe that contrarian profits are almost 25% above the market average. More importantly, stock prices appear to adjust slowly to earnings announcements (underreaction). Prices move upward in reaction to good news (positive earnings surprises), and downward in reaction to bad news (negative earnings surprises). There is also evidence of overreaction of financial markets to series of good or bad news (DeBondt and Thaler 1987; Zarowin 1989; Bernard and Thomas 1989).

A variety of more recent anomalies are also reported. They notably include the underpricing of IPOs (Ibbotson 1975; Aussenegg 2000) as well as superior profits of momentum and value strategies (Jegadeesh and Titman 1993; Lakonishok et al. 1994). Note that momentum effect is a phenomenon that occurs when stocks with high returns in the past continue to outperform low-return stocks over a horizon of 3–12 months. The existing momentum profits can be explained by either the underreaction of investors to new information or by investors' herding behavior. With regard to value strategies, they involve buying stocks that have low prices relative to their book values (or low price-to-book ratio), dividends or historical prices. The most important point to mention is that these value stocks are not riskier than "glamor" stocks (high price-to-book ratio), but they offer higher rate of return.

Altogether, these proofs against market efficiency underline the fact that prices may not react instantaneously to information.

5.2 Informational Efficiency in Emerging Stock Markets

Only a few studies have focused on testing the informational efficiency of emerging markets compared to a large amount of works on the US and other developed markets. It is widely accepted that the majority of emerging markets are less efficient than developed markets due particularly to certain market imperfections such as transaction costs, poor quality of information disclosures, thin trading, and inadequate financial and accounting regulations. For this reason, recent studies on emerging markets have mainly stressed the weak form efficiency whereas the literature on developed markets is concerned by all three forms of efficiency.

This section first highlights the challenges to market efficiency in emerging markets. Next, it describes briefly usual tests of market efficiency and reports the empirical evidence of past studies. Finally, the induced impact of financial liberalization on market efficiency as well as its implications for evaluating the degree according to which emerging markets process new information are discussed.

5.2.1 Challenges to Market Efficiency

The primary condition for market efficiency to hold is the quality and availability of marketwide and company-specific information.[4] Once this condition is fulfilled, tests of market efficiency can be implemented to evaluate how such information is processed (or used) by the markets. Past experiences typically suggest that in emerging markets, the quality of both information and processing is less than reasonably good as in developed world. A number of factors contribute effectively to prevent emerging markets from the efficient state.

Infrequent and discontinuous trading refers to the first significant barrier to emerging market efficiency. In fact, for some small emerging markets like Ski Lanka and Zimbabwe and especially during their embryonic development phase, share trading is often operated on a discontinuous basis, i.e., one trading session per day and 2, 3, 4 trading days per week. Some markets are only open to trades for a short time span over a day. For example, the Colombo stock exchange of Sri Lanka is open from 9:00 am to 2:00 pm for equity exchange, and from 9:00 am to 12:30 pm for secondary trading of corporate and government debt securities). In Morocco, the Casablanca stock exchanges still impose six fixing trading sessions for less liquid shares from 9:00 am to 3:30 pm. Obviously, these features renders difficult the full adjustment of stock prices to new information and as a result amplifies the deviations of market price from its fundamental value.

Low market liquidity is another problem commonly encountered. Except for the most advanced emerging markets (India, South Korea, Taiwan, and Thailand), trading activity is still weak in many of them as indicated by their turnover ratios (or the ratio of trading volume to total market capitalization). Institutional investors, especially those who come from foreign countries, are neither willing to invest in these relatively less liquid and low capitalized markets, nor willing to hold portfolios of their assets because buy or sell orders cannot be executed immediately due to the lack of liquidity. Significant transaction costs also discourage the investors' willingness to trade (Bekaert et al. 2007). The problem of market liquidity is particularly serious in cases where investors try to make an instant profit from selling their shares while the market takes time to execute trade orders. Due to the increase in market size over the recent periods, liquidity risk in emerging markets

[4]Some would use the term for which the local government is able to borrow from both foreign and national residents at a fixed interest rate – and thus the horizon for which investors are willing to commit – as a measure for the time span for which timely and reliable information is available. Then, the longer is the maturity date for a local-currency-denominated government bond, the better is the information reliability and the business environment should be closer to being efficient. Others prefer to focus on the company-specific information to determine the amount of general information released to the market. The used method consists of dividing the total return variance of a company's listed stock into its market and company-specific variance components. A relatively high proportion of reliable company-specific information compared to the market component of the total risk would lead the market to be more efficient since it indicates that company-specific information is available and relevant in asset pricing.

has substantially reduced, and this improvement can lead to higher level of market efficiency

Low quality and quantity of information disclosure are also limitations to market efficiency as they may lead investors to misprice financial securities and to make inaccurate investment decisions. In numerous emerging markets, only the annual report from listed firms is required and the regulatory control process is sometimes not rigorous. The publication of quarterly and semi-annual reports is generally encouraged, and is compulsory in very few markets before the end of the 1990s. Recently, the governments of emerging markets have undertaken a vast program of reforms to enhance the transparency of financial markets and the reliability of company information, and as a result to reduce the asymmetric information between domestic and foreign investors. These policies consist of requiring the production and the possibly electronic distribution of international reports and news of all exchange orders as well as of adopting an electronic and continuous trading system.

Untimely financial reporting and inappropriate accounting regulations prevent the possibility of market participants to monitor relevant information for trading. In addition to the fact that companies often publish their financial reports with some time lags, inappropriate accounting regulations in terms of financial instruments valuation for example may induce market frictions and distortions such as information costs and persistent disequilibrium between stock prices and their fundamental value. Since 1994, accounting standards in Brazil, Chile, Mexico, South Korea and Taiwan were found to meet an international level. With the increasing globalization of financial markets, publicly traded firms in some countries like Turkey and Thailand are now required to adopt international accounting standards including the International Financial Reporting Standards. However, many efforts are still needed for countries such as China, India and Indonesia to reform and harmonize their accounting system according to international norms.

Discriminatory taxation affects the capital allocation in a negative way because foreign investors will suffer more or less directly from the taxation disadvantages. This particularly leads to discourage capital inflows necessary for promoting economic growth. The withholding tax also has an unfavorable influence on investors' willingness to exchange and overall market liquidity. At the end of 2003, the withholding tax in emerging markets for dividends varies between 0% (e.g., Argentina, Brazil and South Africa) and 25% (e.g., Israel and Taiwan), and for capital gains between 0% (e.g., Argentina, Bahrain, Peru and Russia) and 34% (e.g., Mexico and Venezuela). Note that though tax levels have been substantially reduced over time for almost countries, they remain high compared to developed markets.

Capital flow restrictions and market regulation can play a significant role regarding market efficiency of emerging countries. They are essentially composed of regulatory issues that limit the access, trading activity and ownership rights of both domestic and foreign investors. Thus, available funds cannot be freely allocated into the most productive uses, leading to slow adjustment of stock prices due to the lack of arbitrage operations and competition between investors.

5.2.2 Usual Tests and Evidence on Market Efficiency

Traditional tests of weak form efficiency are often based on the notion of random walk, autocorrelation and sign changes in both stock prices and returns.

5.2.2.1 Autocorrelation Tests

The autocorrelation test is usually employed to identify the degree of autocorrelation in a time series. It measures the correlation between the current (t) and lagged observations (k) of the time series of stock returns. The amount of autocorrelation is defined as:

$$p_k = \frac{\sum_{t=k+1}^{T} (R_t - \bar{R})(R_{t-k} - \bar{R})}{\sum_{t=1}^{T} (R_t - \bar{R})^2}$$

where k is the number of lags considered, and R_t represents the rate of return which can be calculated as natural log or arithmetic returns. The judgment of whether autocorrelation is present relies essentially on two important tests: the standard error test and the Box Pierce Q test. Indeed, the standard error test measures the autocorrelation coefficient for individual lags and identifies the significant one, while the Box Pierce Q test, measures the significant autocorrelation coefficients at the group level.

In chap. 1, we have performed the autocorrelation tests for a sample of selected emerging markets. Prior to our work, Harvey (1995) also finds evidence of significant autocorrelation in stock returns for the majority of the studied markets. Although it can be implemented easily, the autocorrelation test is not very robust in practice. If the results report for example the absence of the first-order autocorrelation in a stock return series, we cannot straightforwardly conclude that future returns are independent of their realization 1 month ago since serial linkages of stock returns may well take some time-varying and nonlinear forms.

5.2.2.2 Run Tests

The run test is a non-parametric test whereby the number of sequences of consecutive positive and negative returns is tabulated and compared against its sampling distribution under the random walk hypothesis. A run is defined as the repeated occurrence of the same value or category of a variable. It is indexed by two parameters: the type of the run and the length. For stock returns, runs can be positive, negative, or have no change. The length refers to how often a run type occurs in succession.

Under the null hypothesis that successive outcomes are random or independent (i.e., properties of efficient markets), the total expected number of runs follows a normal distribution with the following mean:

$$\mu = \frac{T(T+1) - \sum_{i=1}^{3} n_i^2}{T}$$

and the following standard deviation:

$$\sigma = \left[\frac{\sum_{i=1}^{3} \left[\sum_{i=1}^{3} n_i^2 + T(T+1)\right] - 2T\left(\sum_{i=1}^{3} n_i^3 - T^3\right)}{T^2(T-1)} \right]^{\frac{1}{2}}$$

where n_i and T refers to the number of runs of type i and the total number of observations respectively. The, the run test is carried out by comparing the realized number of runs in the stock return series to its expected number μ. For instance, several studies have rejected the weak form efficiency using run tests and emerging market data (e.g., Mollah 2007 and references therein). One should however note that run tests have a major drawback, that is, any reversion or stagnation in the return series will put an end to a run without any consideration for the length and the size of the change.

5.2.2.3 Random Walk Tests

Broadly speaking, the random walk test consists of testing the autocorrelation in the residuals of a random walk process which models the dynamics of stock price[5]:

$$P_t = P_{t-1} + \varepsilon_t$$

where P_t is the observed stock price at time t. The econometric method commonly used to check for price randomness is none other than that proposed by Box and Pierce (1970), which consists of testing the serial correlation in the residual series issued from the random walk process (ε_t). The empirical statistic takes the following form:

$$SBP(n) = n \sum_{k=1}^{n-1} \rho^2(k)$$

where *SBP(n)* follows a Chi-square distribution with $(n-1)$ degrees freedom. $\rho^2(k)$ refers to the k-order autocorrelation coefficient. If the empirical *SBP* statistic does not exceed the critical value given by Chi-square distribution table at conventional

[5]Stock prices can be also modeled by a random walk with drift or time trend.

significance levels, the random walk hypothesis in stock prices cannot be rejected. This test is employed by, among others, Kawakatsu and Morey (1999) to examine the informational efficiency of emerging markets. Note also that a unit root test can be performed, but it only constitutes a necessary condition for random walk.

The major drawback of the random walk test stems however from the fact that it does not permit to capture the conditional heteroscedasticity in the residual variance. Further, it is possible that the markets are not sufficient even when stock prices move randomly because future returns might be predicted from some complex combinations of their past values such as cointegration and nonlinear dependencies.

5.2.3 Financial Liberalization and Market Efficiency

Before the implementation of market liberalization policies, stock markets in emerging countries are mostly characterized by low liquidity and trading activities. Moreover, they are less attractive compared to developed markets as public capitals appear to be more expensive than bank loans due to a significant number of market frictions. In addition to transaction costs, commission charges and costs related to searching for counterparts are particularly high in these marketplaces. Within this context, financial liberalization, a market reform highly recommended by the World Bank and the International Monetary Fund, is considered as a solution for emerging countries to improve the efficiency of their domestic financial markets.

Since the liberalization of their stock markets in the mid-1980s, there then exists hope that the presence of foreign investors which implies increased market liquidity, market transparency and price competition would enhance the informational efficiency. However, previous works were not always inconclusive on the expected effect of stock market liberalization on informational efficiency in emerging markets. At the theoretical level, two categories of results are often evoked.

First, financial liberalization would lead to an enhancement of informational efficiency thanks to the improvement of three groups of economic and financial indicators:

- Quality of institutions, information and regulations: these factors significantly improve because foreign investors often require, in compensation for their capital flows to emerging markets, a higher degree of market transparency as well as an increased quality of financial disclosure and reporting. Investment conditions and laws protecting minority shareholders must also be properly enforced. All these things involve the application of international accounting standards and adequate trading regulations as well as the development of new institutions capable to insure the well-functioning of financial markets. Together, these changes will allow to reduce asymmetric information between foreign and domestic investors, and to eliminate insider trading prior to the dissemination of relevant information about stock price movements.

- Market liquidity: as foreign capital flows increase following the removal of investment barriers (controls on capitals, foreign exchange rate and interest rates; foreign ownership limitations; access restrictions; etc), liquidity conditions in emerging markets heighten considerably. The liquidity improvement offers both domestic and foreign investors the possibility to exploit all arbitrage opportunities which may exist. As soon as the market arbitrage opportunities disappear, stock prices will converge to their efficient levels. Notice that the increased liquidity also accelerates the speed of market convergence to efficiency since price adjustments to new information will be instantaneous and complete.
- Market size and depth: the increase in the size (capitalization) and depth can also lead to higher level of market efficiency. For example, the adoption of electronic quotation system, which is not the case for many emerging markets prior to market liberalization, contributes to significantly reduce transaction costs and to speed up the full incorporation of new information into stock prices. Sources of market inefficiencies also diminish as market operators specialize in market activities and strengthen their financial knowledge.

Second, stock market liberalization may lead to informational inefficiency as well. This consequence can be explained as follows: more investors in domestic markets and as a result more information asymmetry might amplify stock price deviations from its fundamental value. Further, high liquidity accompanying the free mobility of capital flows could be a barrier to market efficiency because it generates speculative bubbles (i.e., positively correlated returns at the beginning and negatively correlated returns in the follow-up of bubble bursting). Finally, the intensification of irrational behaviors of market participants (herding judgment, speculative trading, etc.) in the postliberalization period may equally impede or slow down the efficiency convergence process.

Empirically, Groenewold and Ariff (1998) investigate the changes in weak form efficiency in four Asian emerging markets (Indonesia, South Korea, Malaysia and Taiwan) as a follow-up to stock market liberalization. Using a standard regression of actual returns on past returns and autocorrelation tests, they show evidence of return predictability from past returns of both domestic and foreign markets over the postderegulation period. These results thus reject the hypothesis that emerging markets become more efficient after financial liberalization.

When testing the predictability of excess actual returns by past returns in nine emerging markets, Kawakatsu and Morey (1999) document insignificant effects of liberalization policies on informational efficiency. Indeed, most of their sample markets were already weak-form efficient prior to actual liberalizations. Note that unit root tests are also performed to control for the robustness of the results from serial correlation tests, and financial liberalization dates of Henry (2000), and Kim and Singal (2000) are used as breakpoints between the pre and postliberalization periods.

By contrast, using Lo and MacKinlay's variance ratio test to assess the weakest efficiency hypothesis, Kim and Singal (2000) demonstrate that market liberalization have made stock prices behave more efficiently in emerging markets. In other

words, their evidence of less dependence in price movements over the more recent period suggests that market liberalization led to more efficient markets.

Overall, empirical results clearly illustrate the divergence of economic expectations about the impact of financial liberalization.

5.3 Structural Reforms and Hypothesis of Evolving Efficiency

So far as there is empirical evidence of return predictability reported by the majority of previous works, the weak-form market efficiency still remains a testable hypothesis in emerging market economy. But why a test of evolving efficiency is suitable for emerging markets? This section highlights the rationale for such test and shows how it can be implemented to test for weak form efficiency in emerging markets.

5.3.1 Rationale of the Evolving Efficiency

It is worth noting that most of existing works have examined the effect of market liberalization on the informational efficiency in emerging markets through the comparison of market efficiency measures over the pre and postliberalization periods. This methodology is however inappropriate for three main reasons. First, dividing the study period into two sub-periods with the official dates of liberalization as breakpoint would produce misleading results. For example, if there is evidence suggesting an enhancement of the efficiency measures, it is hard to believe that the result comes from the unique effect of market liberalization because the later is often undertaken together with other economic and financial reforms (e.g., trade liberalization, privatization, banking system reforms and exchange rate reforms). More importantly, since market liberalization is often announced ahead of official dates of liberalization, stock prices are likely to react to the announcement. Therefore, the obtained result based on the official liberalization date might not be accurate. Second, as emerging countries only liberalized their capital markets gradually (see Chap. 2 for detailed discussions on this topic), stock markets may have different stages of development and as a result, different degrees of market efficiency over time. This implies that models with stable structure of parameters cannot describe the potential of time-varying modifications in the levels of emerging market efficiency. Finally, the motivation for testing evolving market efficiency is supported by this intuition that dynamic changes in the market structures, the sophistication of market participants and the availability of information as well as its quality following market liberalization would induce the level of market efficiency to change through time.

For these reasons, rather than assessing the weak form efficiency in a traditional way, the methodology proposed here focus on the evolving efficiency and the impact of financial liberalization on such efficiency measure.

5.3.2 Econometric Specification

The hypothesis of weak form market efficiency states that if stock returns are predictable from their past realizations, then the market is said to be not weak form efficient. Accordingly, the test of weak form evolving efficiency can be carried out as follows (Fontaine and Nguyen 2006):

$$R_t = \beta_{0t} + \beta_{1t} R_{t-1} + \alpha h_t + \varepsilon_t \ \varepsilon_t \sim N(0, h_t) \tag{5.1}$$

$$\beta_{it} = \beta_{it-1} + v_{it} \ v_{i,t} \sim N(0, \sigma_i^2); \quad i = 0, 1 \tag{5.2}$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 h_{t-1} \tag{5.3}$$

The system of three equations above formulates a state space model with latent factors where (5.1) represents the measurement equation, while (5.2) and (5.3) correspond respectively the state and conditional variance equations. R_t denotes the log returns on stock market index at the time t which is calculated as $\ln(P_t)$–$\ln(P_{t-1})$ with P_t being the index price level at time t. β_{0t} is a constant term measuring the long-term trends in stock markets. β_{1t}, called autocorrelation or predictable coefficient, measures the potentially serial dependency of stock market returns. Both of them are time-varying parameters and governed by a Markov stochastic process as in (5.2). Under the null hypothesis of weak form efficient market, all the values of estimated β_{1t} must be equal to zero or statistically insignificant. h_t refers to the conditional variance of residuals which follows a GARCH(1,1) process proposed by Bollerslev (1986). The return generating process in (5.1) is corrected for the local market risk through the presence of the "*in-mean*" parameter α which will be interpreted as market risk premium related to conditional volatility. Finally, the random variables v_{it} and ε_t represent the noise processes from state and measurement equations. They are assumed to be independent from each other and to have a normal distribution. The above model is general in the sense that it contains the case of constant parameter model when v_{it} does not vary over time.[6]

Given the state space forms of the proposed empirical model, the Kalman Filter technique can be applied to estimate unobserved variables (i.e., state vector β_{it}) and to construct the log-likelihood function under normality assumption. Formally, the Kalman filter principle can be summarized in Fig 5.1:

To relate the notations in this figure to the proposed empirical model, it is essential to note that y_t represents the return series (R_t); $x_t = (1, R_{t-1})'$; $\beta_t = (\beta_{0t}, \beta_{1t})'$; and $n_t = (\varepsilon_{0t}^2, \varepsilon_{1t}^2)'$.

The Kalman filter evaluates unobserved variables or states in two distinct phases: Predict and Update.

[6]Using Monte Carlo experiments, Zalewska-Mitura and Hall (1999) emphasize that this model is able to detect efficiently shifts in market efficiency with the exception of the first few observations.

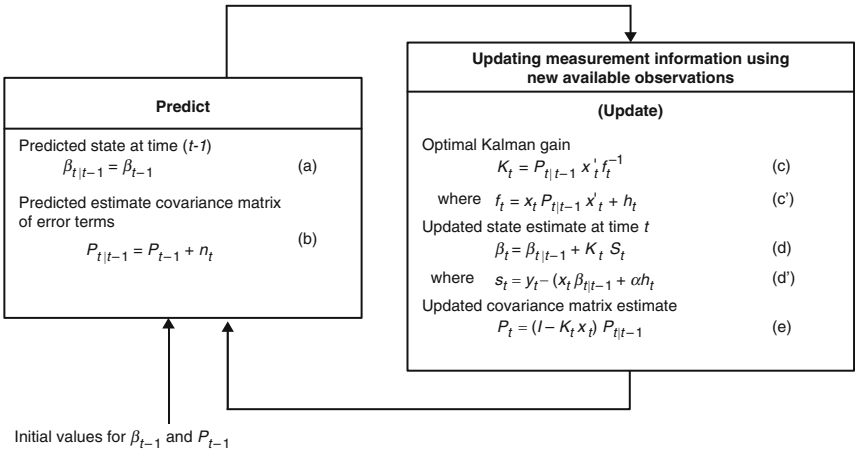

Fig. 5.1 Kalman filter principle

- The predict phase uses the state estimates of the previous timestep to produce the estimates of the state at the current timestep. The previous estimates include the state vector β_{t-1}, known as the best approximation of β_t at time $(t-1)$ and the covariance matrix of error terms (P_t) defined as the differences between the true values of the state vector and their optimal estimators.
- The update phase, also called the correction phase, employs the measurement information (y_t) at the current timestep to refine the prediction made in the predict phase in order to generate more accurate state estimate for the current timestep. The correction relies essentially on the computation of the optimal Kalman gain K_t which takes into account the variance of the measurement equation f_t.

Given the initial values of β_t and P_t, the Kalman filter provides the optimal estimators of the state vector when the observation at time t becomes available. The same iteration is repeated for every new observation up to and including time T with T being the total number of observations for measurement variable. Overall, the vector β_t contains all the estimated values of the state variables. However the estimation of β_t and P_t is not straightforward because it depends on a number of unknown parameters in the state space model: α (the risk premium coefficient), h_t (the conditional variance of return innovations as it depends on unknown coefficients α_0, α_1 and α_2), and n_t (the variance of state equations). Consequently, the model estimation calls for the use of the maximum likelihood estimation (MLE) in which each iteration involves two steps:

- In the first step, the log-likelihood function is derived on the basis of the variance of the measurement variable f_t which considers the predicted state and covariance matrix at time $(t-1)$.

- In the second step, the maximization of the log-likelihood function with respect to the set of unknown parameter, denoted by vector θ, provides the unbiased estimators of unknown parameters which will be used to compute the state vector using the Kalman filter (updating phase).

Suppose that residuals in both measurement and state equations are normally distributed, the log-likelihood function for a T-observation sample is written as

$$\ln L_T(\theta) = \frac{NT}{2} \ln 2\pi - \frac{1}{2} \sum_{t=1}^{T} \ln|f_t| - \frac{1}{2} \sum s_t' f_t^{-1} s_t$$

In practice, since the normality condition is often violated, the quasi-maximum likelihood estimation (QMLE) is preferably used to ensure the robustness of the results. The optimization strategy is based on the BHHH algorithm.

Rockinger and Urga (2000) apply this methodology to test for return predictability in some stock markets of transition economies in Central and Eastern Europe. In comparison with the model proposed here, these authors developed a GARCH(1,1) process which allows for asymmetric volatility, but they did not take into account the market risk premium in the mean equation. By employing similar methodology, Li (2003) finds evidence of time-varying informational efficiency in China's A-Share and B-Share markets, while Jefferis and Smith (2005) show empirical evidence of time-varying efficiency in several African stock markets. However, none of these papers have studied the effect of liberalization dynamics on the changing market efficiency.

5.3.3 Weak Form Efficiency and Transaction Costs

As far as we are concerned by the weak form market efficiency, the question of whether the predictability of stock returns (if really exists) can be exploitable or not is also of interest. Intuition can suggests that some stock return predictability may be present in the data before transaction costs are introduced, but may not be economically significant after taking such costs into account. On the other hand, when emerging markets become more open to foreign investment flows, transaction costs will be lower than before. In this scheme of things, the dynamics of market efficiency are directly linked to the dynamics of transaction costs. But how can we count for the effect of transaction costs within the test of evolving efficiency?

Indeed, this can be done by introducing directly the transaction cost series into the state equations so that it controls for the evolution of time-varying measure of return predictability. Nevertheless, measuring transaction costs in the context of emerging markets is quite challenging due to the lack of good indicators of these costs before liberalization. That is why in this chapter the analysis is restricted in the way that informational efficiency is implicitly driven by internal market

mechanisms. Also, this framework implicitly induce that a bigger inefficiency in the preliberalization period does not imply automatically that it is more exploitable than a lower inefficiency in the postliberalization period characterized by the reduction of transaction costs and other investment barriers.

5.4 Results and Discussions

This section reports the empirical results of the test of evolving efficiency for five selected emerging markets in Latin America and Asia: Argentina, Brazil, Malaysia, Mexico and Thailand. Monthly returns for the S&P/IFC Global Equity Market Indices come from the Standard and Poor's Emerging Market Database (EMDB). Data for Argentina, Brazil, Mexico and Thailand cover January 1976 to March 2000 while they are from January 1986 to March 2000 for Malaysia.

The study period ends in 2000 for two reasons. First, whatever stock market liberalization is a gradual process or not, extending the sample period beyond 10 years following the event date may complicate the analysis because other unexpected macroeconomic and political events are likely to affect the impact of stock market liberalization on market efficiency. Second, the study is constrained by the availability of macroeconomic data for emerging markets when testing for the long-term relationship between stock market liberalization and informational efficiency.

5.4.1 Summary Statistics

Table 5.1 reports descriptive statistics for monthly return series. The sample means for emerging markets range from 0.48% per month for Malaysia to 1.71% per month for Argentina. Argentina also appears to be the riskiest market with a monthly standard deviation of 22.53%.

The significance of sample skewness and kurtosis coefficients coupled with the Jarque–Bera normality statistics show that the distribution of monthly returns is non-normal. The only exception is Malaysia where Jarque–Bera test provides evidence of normally distributed returns.

The results of the Ljung–Box Q-Statistics applied to the first six and twelve lags in return levels, and the first twelve lags in squared returns indicate that serial correlations and nonlinear dependencies exist. However, nonlinear dependencies are more important than the linear ones because the value of the Ljung–Box Q-Statistics for squared returns is generally higher than for the raw returns.

For all the markets, the Engle (1982)'s test for conditional heteroscedasticity rejects the null hypothesis of no ARCH effects in stock returns, and thus justifies the use of GARCH specification in the state space model.

Table 5.1 Stochastic properties of stock market returns

	Argentina	Brazil	Malaysia	Mexico	Thailand
Mean	1.71	0.83	0.48	1.24	0.76
Std.Dev.	22.53	16.03	10.38	13.39	10.17
Skewness	0.07	−0.46	−0.23	−2.08	−0.52
Kurtosis	5.28	2.99	3.37	10.03	3.64
Q(6)	5.27	2.67	16.57*	21.89***	19.50***
Q(12)	10.11	12.65	33.22***	28.53***	48.00***
Q^2(12)	46.74***	44.97***	92.72***	31.58***	181.58***
JB	62.42***	10.07***	2.53	800.56***	18.09***
ARCH(6)	30.43***	6.98	23.95***	35.10***	45.74***
ARCH(12)	38.14***	33.01***	32.95***	37.15***	54.03***

Notes: Mean and standard deviations of monthly returns are reported in percentage per month. Q(6), Q(12) and Q^2(12) are the Ljung–Box tests for serial correlation in levels and squares of returns. JB is the Jarque–Bera test for normality. ARCH(6) and ARCH(12) are Engle (1982)'s tests for conditional heteroscedasticity in returns. Notice that skewness is equal to zero in a normal distribution while excess kurtosis is three if series are normally distributed. The superscripts *, **, *** indicate that coefficients are significant at 10%, 5% and 1% level of significance respectively

5.4.2 *The Evidence of Time-Varying Predictability*

Table 5.2 reports the estimation results of the time-varying coefficient model are presented. The point to emphasize is that the mean value of β_{it} coefficients appears to be very close to zero, suggesting a small amount of return predictability. Moreover, the coefficients remain relatively stable over time as the estimated values of σ_0^2 and σ_1^2 are generally small. The insignificance of risk premium parameters in all markets indicates the absence of expected risk-return relation. It is also shown that GARCH (1,1) model successfully captures the leptokurtic behavior and nonlinear dependencies of stock market returns as the coefficients of conditional volatility process are highly significant.

To apprehend the time-varying behavior of estimated β_{0t} which typically shows the general tendency of stock returns, we plot their time paths together with their 95% confidence intervals and present results in Fig. 5.2. Note that liberalization dates as identified by BH (Bekaert and Harvey 2000), KS (Kim and Singal 2000), and H (Henry 2000) are also added in the graph (see Table 2.1 for detailed information). These coefficients are in general insignificant at 5% level, except for two markets, Brazil and Thailand for which country-specific factors such as transaction costs and macroeconomic variables rather than 1-period lagged return might be relevant in predicting actual stock returns.

Figures 5.3–5.7 depict the time paths of estimated autocorrelation coefficients that reflect the evolution of informational efficiency for each market under consideration. Recall that for an emerging market being weak form efficient, all β_{1t}'s estimates must be equal to zero or at least statistically insignificant at conventional levels. If market liberalization improves market efficiency, we would see that all markets become efficient after liberalization dates. If a market has already been efficient prior to liberalization, it is reasonable to argue that it appears to be more efficient when the absolute value of β_{1t}'s estimates gradually decreases and moves downwards to zero.

Table 5.2 Estimation results of the state space model

Markets	β_0 ($\times 10$)	β_1 ($\times 10$)	α	$\sigma_0^2(\times 10)$	$\sigma_1^2(\times 10)$	$\alpha_0(\times 10)$	α_1	α_2
Argentina	0.07 (0.40)	0.77 (0.07)	0.32 (0.25)	0.00 (0.02)	0.00 (0.13)	0.06^{***} (0.01)	0.32^{***} (0.02)	0.67^{***} (0.00)
Brazil	0.30 (0.08)	0.50 (0.82)	−1.38 (1.35)	0.00 (0.02)	0.00 (0.11)	0.08^{***} (0.02)	0.29^{**} (0.09)	0.40^{***} (0.02)
Malaysia	0.06 (0.09)	0.58 (1.90)	0.52 (0.73)	0.00 (0.01)	0.00 (0.12)	0.01 (0.01)	0.54^{***} (0.12)	0.40^{***} (0.21)
Mexico	−0.03 (0.11)	2.67 (1.13)	0.57 (0.99)	0.00 (0.02)	0.00 (0.20)	0.05^{***} (0.01)	0.43^{***} (0.07)	0.10^{***} (0.00)
Thailand	0.19 (0.23)	1.37 (0.88)	−1.29 (0.82)	0.00 (0.02)	0.00 (0.12)	0.01^{***} (0.00)	0.24^{***} (0.05)	0.63^{***} (0.01)

Notes: The standard deviations are given in parentheses. The superscripts *, **, *** indicate that coefficients are significant at 10%, 5% and 1% respectively

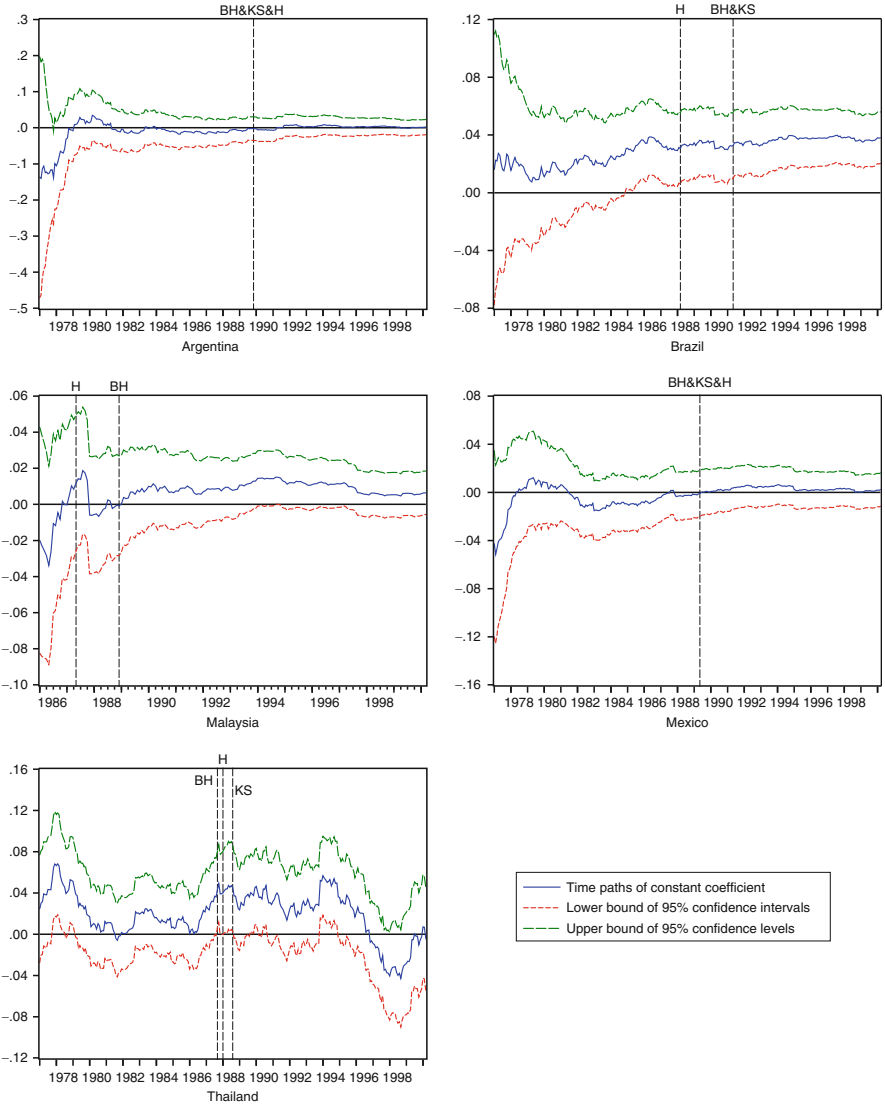

Fig. 5.2 Time paths of β_{0t}

5.4.2.1 Argentina

Figure 5.3 shows that β_{1t} coefficient has evolved over time. A sudden decrease occurred in December 1977. However, this break does not coincide either with liberalization dates nor other political changes. Statistical tests indicate that this market is weak form efficient during the entire estimation period since autocorrelation coefficient gradually falls down to zero and is not significantly different from zero at 5%.

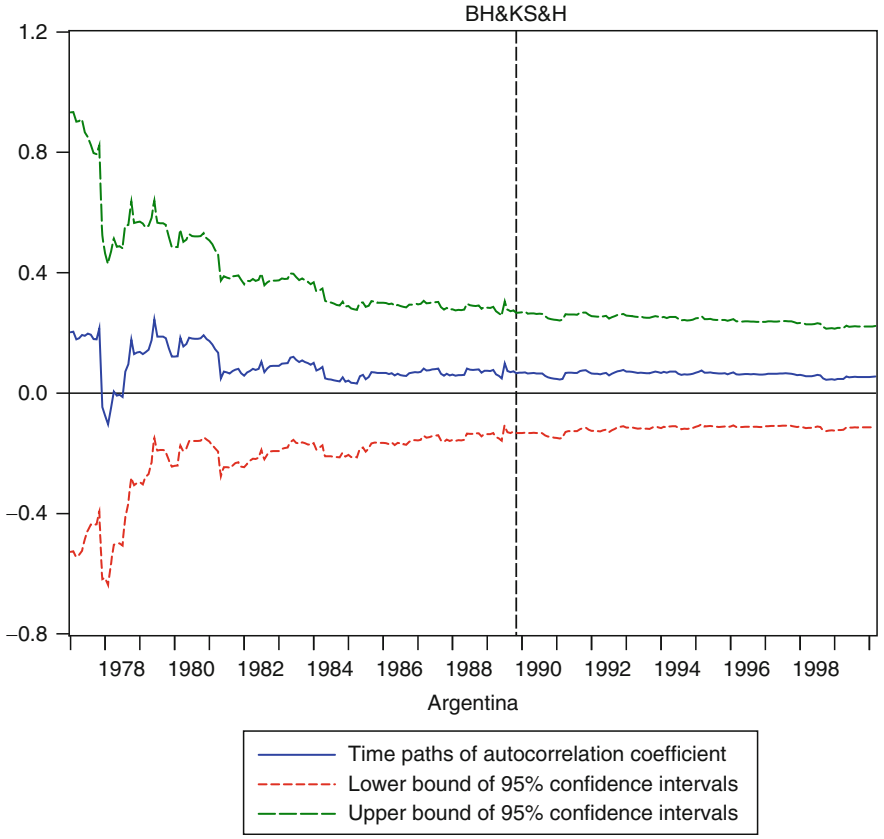

Fig. 5.3 Time-varying return predictability in Argentina

5.4.2.2 Brazil

The evolution of estimated β_{1t} shows some big fluctuations before the first stock market liberalization as indicated by Henry (2000)'s date. Then, this coefficient stabilizes and shows sign of convergence towards zero after the official liberalization date in May 1991. Since all the β_{1t}'s estimates are statistically insignificant at 5% level, the weak form efficiency cannot be rejected for Brazil.

5.4.2.3 Malaysia

Except for some big movements around the first stock market liberalization related to the introduction of a country fund in February 1987, the estimates of autocorrelation coefficient appear to be relatively stable and exhibit a slight ascent at the end of the estimation period. The insignificance of all β_{1t}'s estimates at 5% level indicates that weak form market efficiency is not rejected for entire period.

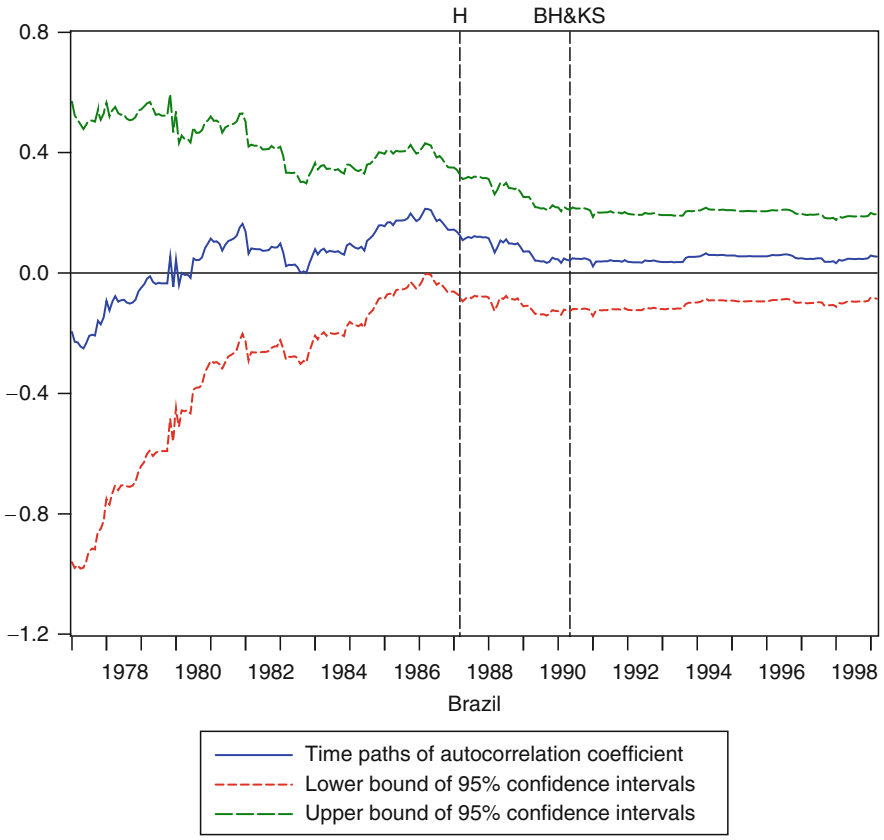

Fig. 5.4 Time-varying return predictability in Brazil

5.4.2.4 Mexico

The pattern followed by Mexican stock market is the most complicated one of this sample. Effectively, the predictable coefficient shows evidence of significance during several short sub-periods before, during and after market openings. These sub-periods include periods from April 1979 through December 1979, from July 1981 through December 1982, from June 1987 through August 1990, and from January 1995 to June 1995. There is also evidence of return predictability on August, September and November 1995. After those sub-periods, the weak form efficiency cannot be rejected until the end of the estimation period.

5.4.2.5 Thailand

The autocorrelation coefficient is very stable and tends towards zero. Only a slight decline of predictability is observed in November 1987, and this might be associated with the announcement of the first country fund introduction in January

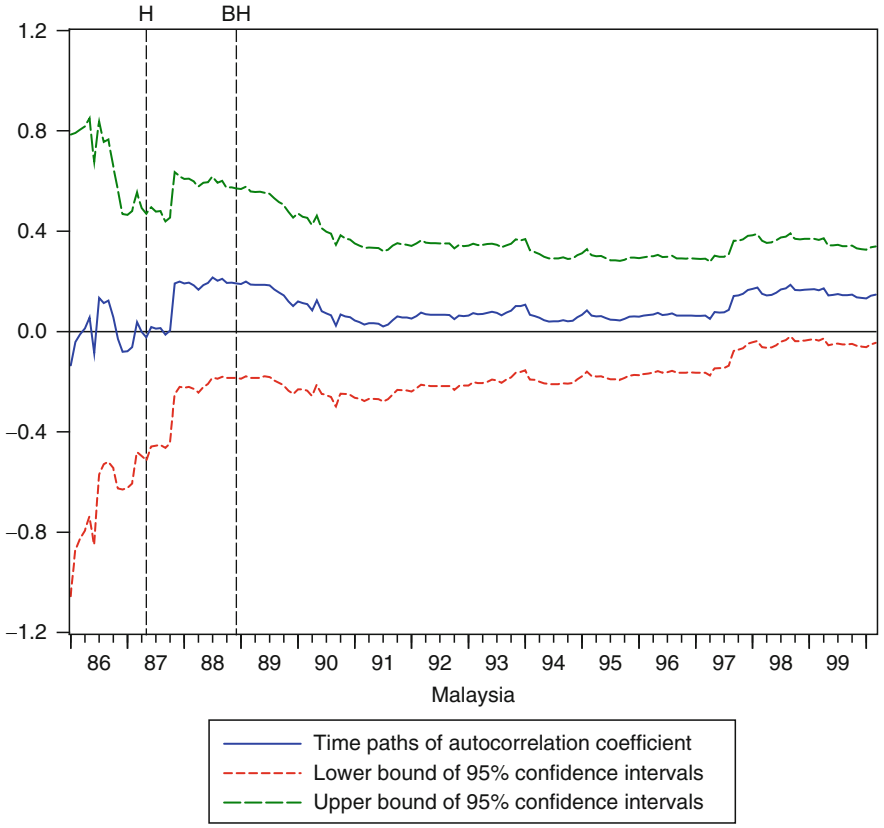

Fig. 5.5 Time-varying return predictability in Malaysia

1988. Accordingly, stock prices in this market behave efficiently with respect to the weak form efficiency.

5.4.3 The Effect of Financial Liberalization

To address the question of whether emerging market become more efficient after stock market liberalization, we perform a powerful regression model. Precisely, the testable model takes the following form:

$$\beta_{1t} = \text{Const.} + \lambda_1 \text{Lib1} + \lambda_2 \text{Lib2} + \sum_{i=1}^{5} \delta_i \text{Proxy}_{it} + \sum_{j=1}^{4} \varphi_j \text{Controls}_{jt} + \varepsilon_t \quad (5.4)$$

where β_{1t} refers to the estimated time-varying measure of weak form market efficiency. Const. is a constant term. Lib1 is a dummy variable which takes the value of one if market is liberalized and zero otherwise. Lib2 is a dummy variable

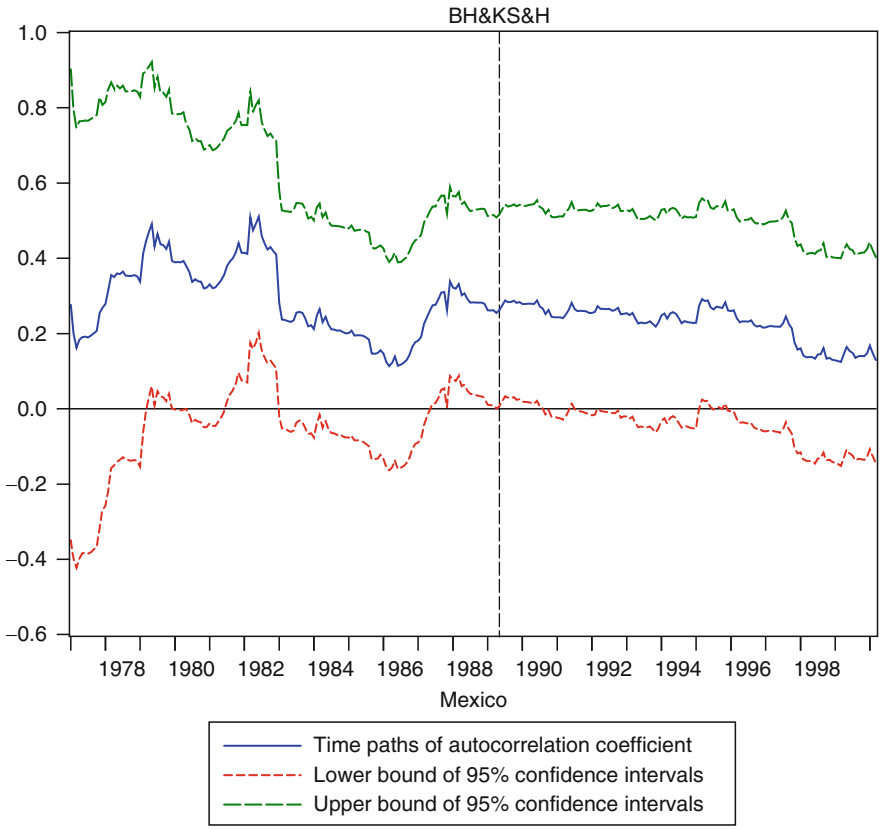

Fig. 5.6 Time-varying return predictability in Mexico

which takes the value of one during the period of host sequential liberalizations and zero otherwise, and it is set to one from T−12 to T+12 where T is the official date of liberalization for each market identified by Bekaert and Harvey (2000). $\text{Proxy}_{i,t}$ refers to proxy variables of market liberalization and includes five variables: *NS*, *ST*, *VT*/*GDP*, *MCAP*/*GDP* and *TURNOVER*. *NS* refers to the natural log of the number of listed stocks on local market. *ST* refers to the natural log of the total number of shares traded during the month *t*. *VT*/*GDP* refers to the ratio of the total value of shares traded (in millions of $US) to GDP. *MCAP*/*GDP* refers to the ratio of emerging market capitalization to GDP. *TURNOVER* equals to the trading value divided by average market capitalization for the period *t* and *t*−*1*. *TR*/*GDP* refers to the ratio of the sum of total imports and exports to GDP. $\text{Controls}_{j,t}$ is the growth rate of four macroeconomic variables including interest rate, real exchange rate, inflation rate and political stability index.

In this setting, Lib1 are designated to capture the immediate effect of market liberalization. The gradual effect of liberalization is controlled by Lib2 and other proxy variables related to market liquidity (*ST*, *VT*/*GDP* and *TURNOVER*), market

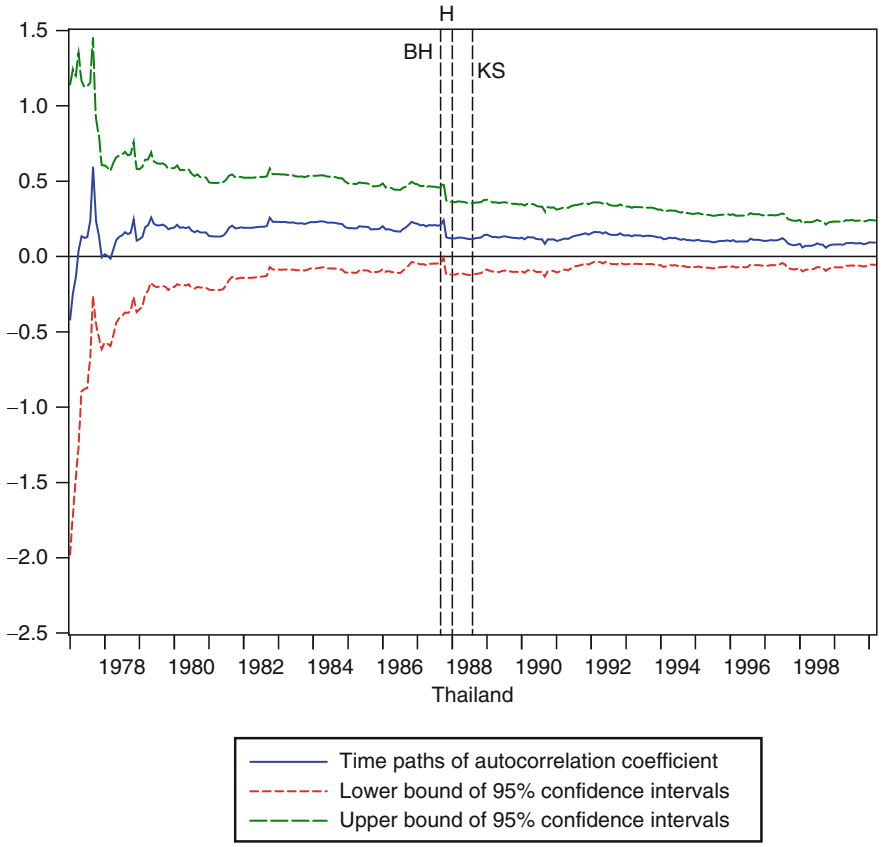

Fig. 5.7 Time-varying return predictability in Thailand

development (*NS* and *MCAP*/*GDP*) and market integration (*TR*/*GDP*).[7] It is expected that those explanatory variables capture all development stages of market liberalization policy. The role of control variables is to isolate the effect of economic and political perspectives in local markets, which might be undertaken simultaneously with market liberalization.

Overall, according to the regression model, stock market liberalization leads to more efficient markets in emerging countries only if explanatory variables related to liberalization are negatively correlated with the efficiency measure.

A reduced form of (5.4) in which only Const. and Lib1 are retained as explanatory variables is then estimated. The regression analysis is examined over the period

[7]Errunza (2001) documents an amelioration of some market indicators such as the number of listed companies, trading value, turnover ratio, and market capitalization to GDP ratio posterior to market liberalization. Bekaert and Harvey (1995) considered the trade to GDP ratio as proxy of market openings when testing the time-varying market integration in emerging market countries.

covering January 1986 to March 2000 given the availability of macroeconomic data. The empirical results not reported here show that none of the coefficients associated with Lib1 is significant at conventional levels. They thus reject the null hypothesis of instantaneous effect on market efficiency of market liberalization. These findings are consistent with the empirical evidence provided by the evolving efficiency test discussed above.

Next, (5.4) where its right-hand-side includes a constant, Lib2, liberalization-proxy variables and control variables is estimated. Table 5.3 reports obtained results. As can be observed, the coefficient of Lib2 is highly significant in four-fifths of the sample markets indicating the gradual correction of return behavior in response to stock market liberalization. More importantly, Lib2 contributes to reduce the predictability of past returns on actual returns in three of these markets (Brazil and Thailand). Lib2 does not create any significant effect to predictable coefficient in Argentina. In this case, it is possible that the period of host liberalizations does not yet cover the effective openings of these markets. In Brazil, for example, the first ADR is only introduced in August 1991, well long after the official liberalization date. In addition, although proxy variables of liberalization have significant effect on the time-varying efficiency measure in most markets, the

Table 5.3 Effects of market liberalization on informational efficiency

Variables	Argentina	Brazil	Malaysia	Mexico	Thailand
Const.	-0.31^{***}	-1.94^{**}	-0.56^{***}	-2.39^{***}	0.22^{***}
	(0.06)	(0.89)	(0.06)	(0.45)	(0.08)
Lib2	-0.00	-0.05^{**}	0.14^{***}	0.04^{**}	-0.02^{*}
	(0.00)	(0.02)	(0.02)	(0.02)	(0.01)
NS($\times 10$)	0.70^{***}	3.40^{**}	0.89^{***}	4.91^{***}	0.03
	(0.12)	(1.37)	(0.22)	(0.90)	(0.70)
ST($\times 10$)	0.00	-0.08	0.24	0.11	-0.14^{***}
	(0.00)	(0.05)	(0.15)	(0.09)	(0.05)
VT/*GDP*	-0.09	-0.14	0.04^{***}	0.13	-0.04^{**}
	(0.06)	(0.15)	(0.01)	(0.13)	(0.18)
MCAP/*GDP*($\times 10$)	0.05	0.04	-0.05^{***}	-0.00	0.02^{**}
	(0.03)	(0.13)	(0.00)	(0.06)	(0.01)
TURNOVER	0.16	-0.04	-1.20^{**}	0.06	0.63^{***}
	(0.12)	(0.39)	(0.51)	(0.36)	(0.15)
TR/*GDP*	0.07^{***}	-0.04	0.01	-0.19^{***}	-0.08^{***}
	(0.02)	(0.20)	(0.01)	(0.04)	(0.03)
EXC	0.01^{*}	-0.02	-0.11	-0.04	0.06^{*}
	(0.00)	(0.02)	(0.08)	(0.04)	(0.03)
INF	-0.01	-0.04	1.47^{***}	0.99^{***}	-0.22
	(0.01)	(0.05)	(0.47)	(0.16)	(0.21)
INT	-0.00^{***}	0.01	0.07	-0.02	0.00
	(0.00)	(0.01)	(0.05)	(0.02	(0.00)
PSI	0.02	0.17	0.14	0.06	0.15^{**}
	(0.02)	(0.13)	(0.29)	(0.17)	(0.07)
Adjusted R^2	0.476	0.529	0.716	0.647	0.763

Notes: The regressions are performed from January 1986 to March 2000. Heteroscedasticity-consistent standard deviations are provided in parentheses. *, **, *** indicate that coefficients are significant at 10%, 5% and 1% level of significance respectively

direction of effect tends to be country-specific. For example, the *TR*/*GDP* provokes an increase of return predictability in Argentina, whereas it helps to eliminate market inefficiencies in Mexico and Thailand. Except for Thailand, the increase of the number of listed companies generates the intensification of return predictability. Moreover, the results also indicate that the changing efficiency is mostly influenced by changes in inflation and exchange rates.

5.5 Implications of the Results

The obtained results are suggestive that there is important improvement in terms of informational efficiency in emerging markets over the recent periods. The convergence speed toward efficiency appears to be higher for markets which have considerably developed in size and liquidity as well as embarked into comprehensive liberalization programs. Even through the results are mostly country-specific, better market conditions prior to market openings seem to guarantee the positive impacts of such policies on informational efficiency. That is, policymakers may have interests to improve the quality of some key factors before making their liberalization decisions. They include financial infrastructure (market regulations, accounting standards, investment laws, etc.), information quality and quantity (financial disclosures, trading mechanisms, etc.) and investor's financial knowledge (trainings, financial education, etc.). By doing so, they can eliminate at best all the barriers or frictions that prevent the convergence to market efficiency.

5.6 Summary

The objective of this chapter is twofold. First, a time-varying parameter with GARCH effects is developed to apprehend the evolving efficiency in five selected emerging markets. Second, the valuation effect of stock market liberalization on the informational efficiency is investigated on the basis of regression analysis.

Empirical results indicate that weak form market efficiency measure varies through time, which is consistent with the gradual changes in emerging markets over the recent decades. However, the speed of convergence toward efficiency depends upon specific conditions in each market. It is also demonstrated that changes in market efficiency are significantly related to market liberalization policies even when control variables are considered.

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Chapter 6
Stock Market Volatility

Abstract The primary objective of this chapter is to discuss the risk notion in finance and to focus particularly on the risk associated with investments in emerging stock markets. After introducing the risk conception as well as its determinants and types, this chapter develops an overview on the most often used measures of risk in finance. A particular attention is then devoted to the volatility emerging stock returns and to explain why this volatility is so pronounced. Next, we focus on the quantification of financial volatility using recent time-series econometric models of volatility. Finally, these modeling techniques are applied to evaluate the degree of volatility and risk in emerging stock markets, and their evolution within the current global financial crisis.

6.1 Introduction

Emerging stock markets represent, according to the discussions of the previous chapters, an interesting and challenging asset class for international portfolio investments with regard to their attractive risk-adjusted return features and their evolving convergence toward weak form efficiency. However, investing in emerging stock markets is not without risk. In this perspective, the investigation of the risk level conditionally on the specific characteristics of emerging markets is of great interest for global investors as they constantly attempt to take advantages of the growth potential in these markets. An accurate assessment of the risk is also useful for emerging markets' policymakers in the sense that they can eliminate the volatility excessive and harmful for financial stability through acting on its economic determinants. This is particularly important during market downturns caused by the intensification of financial crisis effects.

Another rationale for studying emerging market volatility is that risk and return are, according to financial theory and models, two concepts strongly and positively correlated since a highly risky investment should command high expected returns. This relationship seems, a priori knowledge, to be verified for most of emerging

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_6,

markets on the basis of unconditional risk-return analysis provided in Chap. 1. Globally, it is shown that:

- Emerging stock markets offer higher expected returns, but the latter are accompanied by higher volatility than developed markets.
- Stock market volatility differs significantly across emerging countries.
- High volatility and its heterogeneous levels across emerging markets can be explained by the fact that these markets are in general heterogeneous and in different stages of market development. In addition, according to Nguyen (2008) among others, the volatility and risk inherent to emerging markets depend on several specific factors such as country's financial asset concentration in market indices, stock market microstructure, and macroeconomic fluctuations.

This chapter also attempts to clearly characterize the pattern of the risk and volatility in emerging stock markets as understanding the differences between them is the key to investment success.

The chapter is organized as follows. Section 6.2 introduces the risk notion and its main basic measures. Section 6.3 discusses the behavior and sources of the volatility emerging market. Volatility modeling tools of volatility are discussed in Sect. 6.4. Empirical investigation results are presented in Sect. 6.5. Section 6.6 summarizes the chapter.

6.2 Financial Risk and Its Assessment

Measuring the financial risk is central to investment decisions as investments in financial markets are not riskless and the risk level determines, to a large extent, the required rate of returns. In finance, this risk can be appreciated through two main approaches: empirical approach and probabilistic approach.

6.2.1 Empirical Approach

This method has recourse either to the adjustment of the investment project parameters (e.g., cash-flows and discounted rate) or to a sensitivity analysis.

The adjustment method says that either the stream of cash flows or the discount rate must be adjusted for the level of risk inherent to the considered investment project. The cash-flow adjustments rely on the ability of forecasting certain equivalent stream of future cash-flows based on a given level of risk, while the adjustment made on discount rate requires in general the estimation of a risk premium which is directly proportional to the risk of investment project under consideration. In practice, the discount rate adjustment is more suitable since it is difficult to forecast the stream of cash flows with certainty because the latter is often supposed to go up to infinity.

The sensitivity method consists of measuring the inherent financial risk of an investment based on different uncertainty levels associated with the investment outcome. Three possible scenarios are generally elaborated: optimist, probable and pessimist. Then, usual investment choice criteria such as Net Present Value (NPV) and Internal Rate of Return (IRR) are employed to assess and compare the outcome across possible scenarios. This method is however very sensible to the subjective estimations of optimistic and pessimistic values, which render the empirical method unreliable in most of the cases.

6.2.2 Probabilistic Approach

This approach evaluates the risk in a more analytical framework based on mathematical and statistical tools. Let E(.) be the mathematical expectation operator, V(.) the variance and $\sigma(.)$the standard deviation of the NPV. They are respectively defined as follows:

$$E(NPV) = \sum_{i=1}^{n} P_i \times X_i \tag{6.1}$$

where X_i and P_i denote the cash flows and their probability of occurrence.

$$V(NPV) = \sum_{i=1}^{n} P_i \times (X_i - E(X))^2 \tag{6.2}$$

$$\sigma\,(NPV) = \sqrt{\sum_{i=1}^{n} P_i \times (X_i - E(X))^2} \tag{6.3}$$

The financial risk of the considered investment is, in this case, appreciated through the value of the standard deviation of the NPV.

It is also possible to evaluate the risk via financial models such as the CAPM. In particular, the CAPM enables to evaluate both the systematic risk and the specific risk of an investment project.[1]

Another alternative consists of assessing the financial risk based on the application of Monte-Carlo simulations to the specification of the NPV distribution according to its underlying determinants such as market size of the firm, capital expenditure, cost structure, and residual value. Such simulations, even though they are difficult to be implemented in practice, should reasonably yield the required

[1]See Chap. 3 for more details concerning the theoretical foundations and the practical use of the CAPM.

information about the risky characteristic of the future cash flows and, as a result, the expected returns and assumed risks.

The above measures of financial risk are however subject to several pitfalls such as:

- The use of a stream of constant cash flows to estimate the risk of the investment project leads to a static view of investment risk, and limits the possibility of assessing a dynamic investment project
- The correct estimation of the NPV depends on the accuracy of the discount rate used, or equivalently on the estimation of the risk premium
- The measure of the risk is of static and unconditional nature, which does not reflect the true economic reality

One solution to overcome these problems consists of inferring the risk of a particular investment project from the market volatility as a whole. The rationale is that market volatility can be estimated more easily thanks to the availability of financial data. Then a project's risk is proportionally determined through comparing its expected returns to those of the market. Note that at the market level, standard deviation of stock market index is often used as measure of average market risk, but it can be time-varying and conditional on the economic fundamentals. For this reason, this chapter focuses on the econometric techniques available to model the stock market volatility and show how they can be properly applied to emerging markets. The analysis is intentionally conducted under the effects of market deregulations and reforms in order to better explain the changing nature of emerging market volatility.

6.3 Behavior and Sources of Emerging Market Volatility

Recall that return volatility, usually measured by the variance or the standard deviation of changes in stock prices over a given period of time, is a key concept in finance that enables to quantify the degree of unpredictable change of the expected returns on a stock investment. It thus constitutes an indicator of the total risk of a listed stock.[2] The higher is the return volatility, the higher is the risk.

Over the past, stock returns in emerging markets are often more volatile than those in developed markets. In practice, several reasons explain this higher volatility. First, the succession of financial turmoil and crises such as the Mexican crisis in 1994, the Asian crisis in 1997, the Russian crisis in 1998, and the Argentinean crisis in 2001 has caused strong variations in stock prices, implying an excess volatility in

[2]It should be noted that, by definition, the risk of a particular investment refers generally to the probability of realizing profit and capital losses due to the occurrence of a risk event (market crash, default, terrorism, changes in regulation, etc.). From this point of view, it has two components – uncertainty and risk exposure (or amount at risk when the risk event realizes) – and the volatility concept is mostly related to the degree of uncertainty about the possibility of losing.

emerging markets. Dramatic changes in political and country risks also affect significantly emerging stock market volatility.

Second, the free mobility of cross-border capital flows resulting from financial liberalization waves and other market reforms can be also an important source of market volatility and instability. Most of previous studies report a significant relationship between financial liberalization and volatility, but do not unanimously agree on the sign of the liberalization effects. Indeed, some authors show an increase of volatility after liberalization policy (Miles 2002), while other studies point out a reduction of volatility (Bekaert and Harvey 1997; Kim and Singal 2000) or some stability (De Santis and Imrohoroglu 1997; Bekaert and Harvey 2000).

Third, the specific characteristics of emerging economies and their financial systems including especially the variability of macroeconomic factors, growth rate, financial results, and dividend distribution rate may contribute to render emerging markets more volatile (Schwert 1989; Hamilton and Lin 1996).

Finally, in the light of recent results from behavioral finance, Shiller (1990) suggests that a non-negligible part of stock volatility is induced by investors' psychological and judgment biases such as mimetic behavior, overconfidence, overvaluation, undervaluation, and irrational exuberance. These behavioral anomalies seem to have important effects on the volatility of emerging markets since they are more likely to appear in these markets than in developed markets.

It is worth noting that the evaluation and explanation of excessive volatility is closely dependent to the volatility measures used. In practice, the most popular approach is to obtain volatility estimates through using categories of statistical parametric models that have been proposed in the ARCH/GARCH (Generalized Autoregressive Conditional Heteroscedasticity) and stochastic volatility literature. Another method of extracting information about volatility is to calculate the daily volatility from the sample variance of intraday data, and the said volatility measure is called "realized volatility". Finally, some studies attempt to extract information about volatility from option pricing models in which volatility of the underlying asset is treated as unknown and its market price is used to derive the volatility. In this case, the volatility obtained is called "implied volatility" since it can be interpreted as the market expectation for the future volatility.

Overall, of the above approaches, GARCH-based volatility models are mostly employed in estimating and forecasting financial volatility in emerging markets. Many studies, Kim and Singal (2000); Kassismatis (2002); Jayasuriya (2005); Nguyen and Bellalah (2008), assert, among others, that GARCH models provide a good description of emerging stock market volatility. Given the purpose of this chapter, the approach taken here is to estimate the volatility from GARCH-class models.

6.4 Time-Varying Volatility Models

In this section, both linear and nonlinear ARCH/GARCH models are introduced to characterize the stylized empirical features of emerging stock market volatility which have been documented in the finance literature: heavy tails in unconditional

distribution of returns, time-variations, volatility clustering (i.e., large changes in the volatility tend to be followed by large changes, of either sign, and , small changes tend to be followed by small changes), asymmetric effects (i.e., "bad news" have more important effects on the volatility than the "good news" do), and nonlinear dependencies in volatility.

6.4.1 Linear ARCH Models

To start, it is essential to remark that an Autoregressive Moving Average of orders p and q, noted ARMA(p,q) provides an useful characterization of the dynamics of financial variables. It can be written as:

$$\Phi(L)Y_t = \Theta(L)\,\varepsilon_t \tag{6.4}$$

where ε_t is a white noise process; $\Phi(L)$ and $\Theta(L)$ refer to the polynomial lag operators; and

$$\Phi(L) = 1 - \varphi_1 L - .... - \varphi_p L^p$$
$$\Theta(L) = 1 - \theta_1 L - .... - \theta_p L^q$$

Note that the variance of the ARMA models is supposed to be constant over time, and for this reason ARMA models might reproduce the dynamic variation of financial time series with biases. To overcome this shortcoming, a correction is made on the variance process by using the linear ARCH model. Indeed, the latter extends the linear ARMA models in such manner that it endogenously defines a time-varying conditional variance according to a predetermined set of available information. Precisely, for an ARCH model, the white noise process ε_t has the following properties:

$$\begin{aligned} E(\varepsilon_t\,|\Omega_{t-1}) &= 0, \\ V(\varepsilon_t\,|\Omega_{t-1}) &= \sigma_t^2 \end{aligned} \tag{6.5}$$

where the set of available information is defined as

$$\Omega_{t-1} = (\,\varepsilon_{t-1},\, ...,\, \varepsilon_{t-q})$$

Thus, the linear ARCH model defines two equations: an equation for the mean which can follow an ARMA model for example and an equation for the conditional variance. The main property of a linear ARCH of order q is to define the variance process of a time-series as a linear combination of q lagged values of the squared residual of the mean equation. This has great interest in reproducing successive phases of high and low volatility. Formally, Engle (1982) proposes an ARCH(q) as:

$$\sigma_t^2 = \beta_0 + \sum_{i=1}^{q} \beta_i \, \varepsilon_{t-i}^2 \tag{6.6}$$

where $\beta_0 > 0$ and $\beta_i \geq 0$ for $\forall\, i$. The coefficient constraints insure the positivity of the conditional variance. In addition, if $\sum_{i=1}^{q} \beta_i \, 1$, it is obvious to show that the conditional variance σ_t^2 is finite.

ARCH models are then generalized by Bollerslev (1986) to obtain Generalized ARCH, noted GARCH(p,q), through introducing the lagged values of the conditional variance into the variance equation. From an econometric viewpoint, this generalization, similar to the extension of an AR model to an ARMA model, is particularly important to improve the explanatory power of the ARCH models.

Concretely, the variance equation of a GARCH(p,q) is defined as:

$$\sigma_t^2 = \beta_0 + \sum_{i=1}^{q} \beta_i \, \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \delta_j \, \sigma_{t-j}^2 \tag{6.7}$$

where $\beta_0 > 0, \beta_i \geq 0,$ and $\delta_j \geq 0$ for $\forall\, i$ and $\forall j$. In addition, the stationary condition must hold for Bollerslev (1986)'s GARCH(p,q) model in order to avoid infinite variance, that is

$$\sum_{i=1}^{q} \beta_i + \sum_{j=1}^{p} \delta_j < 1$$

The imposed stationarity constraint implies that the unconditional variance of the considered financial time series is finite, whereas its conditional variance evolves through time.

ARCH and GARCH models were used in a large number of studies to investigate the dynamics of financial variables. However, some authors such as Nelson (1991), and Cao and Tsay (1992), among others, point out some limitations of these models particularly regarding the definition of the conditional variance as a quadratic combination of the mean-equation errors. As a result, this specification is adequate only if volatility variations have the same sign and size. But, the evidence of instability and asymmetric responses in stock market volatility suggests that GARCH models might not be suitable in such situations. Moreover, the constraints of positivity on ARCH and GARCH coefficients restrict the dynamics of the conditional volatility in the sense that the sign of the volatility is not counted for in linear ARCH models. For this purpose, several extensions of GARCH models introducing nonlinearity were developed and the most popular specifications are the Exponential GARCH (EGARCH) and the Threshold GARCH (TARCH).[3]

[3]See Senrana (2001) for Quadratic GARCH (QGARCH) models.

6.4.2 Nonlinear ARCH Models

The main advantage of EGARCH and TARCH models is the possibility of capturing any asymmetry in the conditional variance process. In other words, cyclical behavior of conditional stock volatility can be now properly reproduced. The positivity constraints on GARCH coefficients are also no more required within the context of EGARCH model.

6.4.2.1 EGARCH Models

The EGARCH model developed by Nelson (1991) allows for asymmetric responses of stock market volatility to negative and positive changes in the residuals of the mean equation. Since the conditional variance is expressed in logarithm, the positivity constraints required for GARCH models can be removed.

Formally, an EGARCH(p,q) is written as follows.[4]

$$\ln(\sigma_t^2) = \beta_0 + \sum_{i=1}^{q} \beta_i \, g(z_{t-i}) + \sum_{j=1}^{p} \delta_j \ln(\sigma_{t-j}^2) \tag{6.8}$$

where

$$g(z_t) = \varphi \, z_t + \gamma[|z_t| - E|z_t|] \tag{6.9}$$

and $z_t = \frac{\varepsilon_t}{\sigma_t}$

By doing so, the conditional variance is an asymmetric function of lagged disturbances ε_t via the function $g(z_t)$ which is linear in z_t with slope coefficient $(\varphi + \gamma)$ if z_t is positive, and with slope $(\varphi - \gamma)$ if z_t is negative. Overall, both signs and sizes of the residual innovations are now allowed to affect the time-variation of the conditional volatility through respectively the value of φ and γ.

6.4.2.2 TGARCH Models

The TGARCH model, introduced by Zakoian (1994), is obtained by replacing the quadratic specification of the conditional volatility equation in standard GARCH model by a two-regime linear function. Each regime reproduces the dynamics of volatility according to shocks of same nature.

[4]The introduction of $z_t$rather than $\varepsilon_t$enables, according to Nelson (1991), the verification of second-order stationarity for EGARCH models.

Formally, a TGARCH(p,q) model is based on the modeling of the conditional standard deviation instead of conditional variance, such as:

$$\sigma_t = \beta_0 + \sum_{i=1}^{q} (\beta_i^+ \varepsilon_{t-i}^+ - \beta_i^- \varepsilon_{t-i}^-) + \sum_{j=1}^{p} \delta_j \sigma_{t-j} \tag{6.10}$$

where:

$$\varepsilon_t^+ = \max(\varepsilon_t, 0)$$
$$\varepsilon_t^- = \min(\varepsilon_t, 0)$$

Once again, the effect of a shock ε_{t-i} on conditional variance depends simultaneously on its sign and size.

6.4.3 ARCH-M Models

In order to model the volatility dynamics of financial variables while taking into account the relationship between their mean and variance, Bollerslev et al. (1988) have developed an ARCH-in-mean model, noted ARCH-M. The latter is economically interesting because it controls for one of the most fundamental relationships in finance: the risk-return tradeoff. Practically, the conditional variance term is directly introduced into the mean equation to set up an ARCH-M (or GARCH-M) model.

Formally, assuming that the conditional mean can be described by an ARMA process, a GARCH-M model can be represented by the following system:

$$\begin{aligned} \Phi(L) Y_t &= \Theta(L)\varepsilon_t + \alpha\sigma_t^2 \\ \sigma_t^2 &= \beta_0 + \sum_{i=1}^{q} \beta_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \delta_j \sigma_{t-j}^2 \end{aligned} \tag{6.11}$$

where Y_t is a stationary variable, and $\Phi(L)$ and $\Theta(L)$ are respectively the AR and MA lag polynomials.

Other varieties of GARCH-class models can also have an "in-mean" specification based on the same principle, such as EGARCH-M, and TGARCH-M models.

To conclude this section, one should note the usefulness of the Integrated GARCH (IGARCH) model, introduced by Engle and Bollerslev (1986), in reproducing the dynamics of a typical unit-root conditional variance process. Indeed, the presence of unit root permits to capture the infinite-memory phenomenon that might be neglected when employing usual GARCH models. The IGARCH models are then extended to develop the Fractionally IGARCH (FIGARCH) models which

capture different patterns of long memory in conditional volatility of financial time series and particularly intraday data.[5]

6.4.4 Volatility Modeling and Tests

6.4.4.1 ARCH Test

This test was introduced by Engle (1982) in order to check for the conditional heteroscedasticity in the variance process of financial variables. Let Y_t be a time series whose mean equation is supposed to be generated by an ARMA model, and assume further that the conditional variance of Y_t follows an ARCH process:

$$\begin{aligned} \Phi(L)Y_t &= \Theta(L)\,\varepsilon_t \\ \sigma_t^2 &= \beta_0 + \sum_{i=1}^{q} \beta_i \varepsilon_{t-i}^2 \end{aligned} \tag{6.12}$$

The purpose of the ARCH test is to test the null hypothesis of homocedasticity ($\beta_1 = ... = \beta_q = 0$) against its alternative of heteroscedasticity or time-varying conditional variance for which $\beta_i \neq 0 \,\text{for}\, \forall\, i = 1, ..., q$. ARCH effects are said to be present in the data if the null hypothesis is rejected at conventional significance levels.

In practice, this test is carried out in three steps:

- *Step 1*: the mean equation is estimated, the model residual series $\hat{\varepsilon}_t$are saved and the squared residuals $\hat{\varepsilon}_t^2$ are computed.
- *Step 2*: $\hat{\varepsilon}_t^2$ is regressed on a constant term as well as on its lagged realizations.
- *Step 3*: the empirical statistics of the ARCH test, $T \times R^2$, is computed, where T and R^2 denote respectively the number of observations and the determination coefficient of the regression performed in the second step.

Under the null hypothesis, the statistics $T \times R^2$ follows a $\chi^2(q)$ distribution where q denotes the lag number retained in the second step. If $T \times R^2$ is inferior to $\chi^2(q)$, the null hypothesis cannot be rejected. The ARCH specification for modeling conditional is necessary when $T \times R^2 \geq \chi^2(q)$.

6.4.4.2 Estimation Procedure

In general, the choice of GARCH models (i.e., the determination of p and q orders or the selection between competitive models) are based on several statistical tests and information criteria such as Akaike Information Criteria (AIC), Bayesian

[5]See Gouriéroux (1992) for more detailed discussions about this model.

Information Criterion (BIC), autocorrelation functions, and Ljung-Box's serial correlation test.

Once the model specification is chosen, GARCH models can be estimated using different available procedures: Least Square (LS), Maximum Likelihood (ML) and non parametric methods. The ML and two-step LS methods are the most often used in practice.[6] Indeed, the ML method is based on the estimation and maximization of a log-likelihood function using the BHHH (Berndt–Hall–Hall–Hausman) or BFSG (Broyden–Fletcher–Goldfarb–Shanno) optimization algorithms. Note that since the return distribution is usually non-normal, the Quasi-Maximum Likelihood (QML) method is particularly suitable for estimating GARCH models because it provides robust estimators even when the normality assumption of the mean equation is violated.

As for the two-step LS method, it differs from the ML method in that the estimators are easy to obtain since they involve solving a set of two linear equations: a mean equation and an ARMA equation for the variance. In the first step, the estimation of both mean and variance equations by LS method enables to obtain convergent estimators. In the second step, the estimation is improved while taking into account the conditional heteroscedasticity.

6.4.5 Empirical Evidence on Emerging Market Volatility Using GARCH Modeling Approach

A number of empirical studies have focused on the volatility dynamics in emerging countries and investigated the impact of financial liberalization on emerging stock volatility. Using GARCH-class models, Bekaert and Harvey (1997); Kim and Singal (2000); Kassimatis (2002) show that the volatility in emerging markets is time-varying and highly persistent over time, and it tends to decrease after financial liberalization. These findings are however contrasted by those of Miles (2002) who also uses GARCH models and provides evidence of significant increase in market volatility in three fifth of his sample markets. More recently, Nguyen and Bellalah (2008) report that emerging market volatility is not only time-varying, but it is also subject to structural changes due to internal shocks caused by their ongoing financial and economic reforms. As far as the effect of financial liberalization is concerned, the cross-sectional results show a decreasing tendency of the volatility, especially when emerging markets become more mature and open to foreign capital flows. Note that these results are controlled for the potential effects of other reforms that have been taken at the same time of market liberalization policies.

Nguyen and Bellalah (2008) remark that the above divergence of empirical results is essentially due to differences in terms of sample markets, financial

[6]See Gouriéroux (1992); Bollerslev et al. (1994) for detailed discussions about the particularities of GARCH estimation methods.

liberalization dates used, and methodological approaches. However, what is commonly accepted is that a GARCH(1,1) appears to be appropriate for characterizing the volatility of emerging market returns (Bollerslev and Wooldridge 1992). In addition, some authors put forward some storeroom concerning this volatility modeling for emerging markets in regard to their integration degree with the world market (Nguyen 2008 and references therein). Overall, a highly recommended GARCH model for modeling emerging market volatility would be the one that:

- Take into account the degree to which emerging markets are integrated with world stock markets (i.e., partial market integration is a plausible consideration for most of actual emerging markets)
- Consider the risk-return relationship through the presence of an "in-mean" component
- Allow for the dynamic spillovers in mean and variance between emerging and world market

6.5 Empirical Applications of GARCH Modeling

This section employs GARCH-class models to examine the stock market volatility in emerging countries. The methodology used also enables the selection of the best-fit models for characterizing the volatility in these markets.

6.5.1 Data and Preliminary Analysis

The sample includes five emerging countries: two Asian countries (China and India), two Latin America countries (Chile and Mexico), and one African country (South Africa). Data used consist of monthly MSCI indices and are obtained from Datastream International (Thomson Financial). As the study period runs from January 1993 to June 2009, the intended analysis permits not only to evaluate emerging market volatility around the global financial crisis sparked by the 2007 subprime mortgage crisis, but also to implicitly test the impact of stock market liberalization on the estimated volatility. All indices are expressed in US dollars in order to provide homogeneous data and to avoid currency risk effects. The world stock market index (MSCI World) is also included in the sample for several reasons. First, it provides the possibility to examine the existing linkages between selected emerging markets and the world market both before and after the financial crisis. Second, the use of the world market index permits to assess the responses of emerging market volatility to "shocks" and innovations in world stock markets. Finally, it would offer an appropriate framework for comparing the volatility levels between emerging and developed markets insofar as the latter count for more than 90% of the MSCI World index.

Note that a country-by-country analysis, based on continuously compounded returns on MSCI stock market indices introduced above, is adopted henceforth in order to implicitly take into account the economic and financial specificities of each emerging market. Results from usual unit root tests indicate that all return series are stationary, so that there is no need to differentiate them.

The inspection of the stock return dynamics in Fig. 6.1 suggests three important facts:

- Considered markets experience long swings at the end of the study period, suggesting that the recent financial crisis has increased stock market volatility.
- Emerging stock markets seem to be more volatile than the world stock market. This finding is consistent with the analysis of unconditional volatility in Chap. 1, even though the Indian market shows the more stable volatility.
- In addition, these graphics show some volatility regrouping indicating *a priori* an ARCH effect in the data.

Table 6.1 reports the statistical properties of stock market returns. According to Jacque-Bera test for normality, all return series exhibit departure from the normal distribution. In particular, the significance of excess kurtosis coefficient (i.e., values higher than 3) indicates that the return distribution has fatter tails than normal bell curve. The negativity of almost all skewness coefficients (except for China) is suggestive of the fact that return distribution is asymmetric to the left with few extreme and negative values. In other words, this asymmetry may induce nonlinear serial dependencies in stock returns and higher reaction of stock returns to negative shocks than to positive shocks.

With regard to standard deviations, the findings show that, except for Chile, emerging stock markets are two times more volatile than the world market. Of all markets considered, China experienced the highest volatility (10.9% on a monthly basis). However this market realized lowest returns over the study period. The remaining emerging markets offer in general higher returns than the world market. This confirms *a priori* the results of previous studies on emerging markets' risk-return characteristics.

The correlation matrix among sample markets is reported in Table 6.2. The analysis of cross-market correlations shows that selected emerging markets exhibit substantial comovements with the world market.

Next, ARCH tests with different lag numbers are performed to check whether conditional heteroscedasticity is relevant in emerging markets. To do so, the conditional mean for stock market returns of each market under consideration is estimated at first, and then ARCH test procedure is applied. The current and lagged world market returns are introduced in the mean equation for emerging market to capture the world-local market dependency. The results of the mean equation estimation and the ARCH tests for considered markets are presented in Table 6.3 according to their best-fit models.

Tables 6.3 and 6.4 suggest two important findings. On the one hand, stock returns of all emerging markets under consideration are closely and significantly

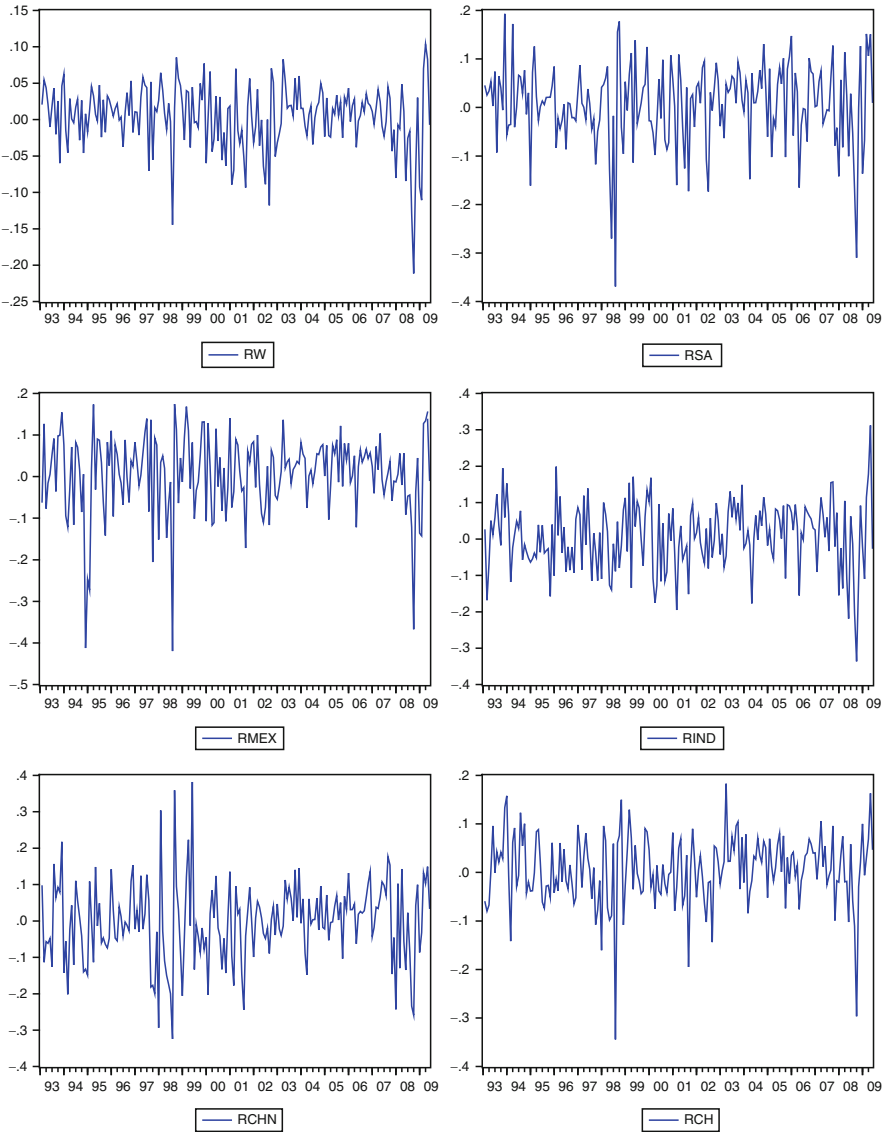

Fig. 6.1 Emerging and world stock market returns

associated with that of the world stock market. This is indicative of instantaneous and lead-lag effects from the world market to emerging markets. The instantaneous mean spillovers (also referred to as CAPM effects in finance literature) are highly significant for all emerging markets at the 1% level, suggesting further evidence of financial integration with the world markets. The dependency of emerging markets to the world market is positive and more significant for Latin American and South

Table 6.1 Stochastic properties of stock market returns

	RCH	RCHN	RIND	RMEX	RSA	RW
Mean	0.005	−0.002	0.006	0.005	0.006	0.003
Median	0.005	0.001	0.013	0.020	0.009	0.010
Maximum	0.182	0.381	0.312	0.174	0.192	0.103
Minimum	−0.344	−0.323	−0.336	−0.419	−0.368	−0.211
Standard deviation	0.071	0.109	0.092	0.095	0.084	0.044
Skewness	−0.968	0.040	−0.279	−1.393	−0.959	−1.138
Kurtosis	6.533	4.015	3.611	6.807	5.383	5.764
Jarque-Bera	133.30	8.52	5.63	182.76	76.86	105.28
P-value	0.000	0.010	0.050	0.000	0.000	0.000

Notes: RW, RSA, RMEX, RIND, RCHIN and RCH respectively denote stock returns of the World, South Africa, Mexico, India, China and Chile

Table 6.2 Correlation matrix

	RCH	RCHN	RIND	RMEX	RSA	RW
RCH	1.000	0.501	0.523	0.580	0.561	0.582
RCHN		1.000	0.412	0.451	0.574	0.472
RIND			1.000	0.420	0.453	0.480
RMEX				1.000	0.562	0.643
RSA					1.000	0.643
RW						1.000

Notes: RW, RSA, RMEX, RIND, RCHIN and RCH respectively denote stock market returns of the World, South Africa, Mexico, India, China and Chile

African regions as previously suggested by the correlation matrix. On the other hand, the hypothesis of ARCH effects is not rejected for all emerging countries at conventional levels of significance. Consequently, the volatility of emerging stock markets tends to change over time, and a GARCH-class model is *a priori* necessary and suitable for reproducing this volatility dynamics.

6.5.2 GARCH-Based Models for Emerging Market Volatility

In what follows, several ARCH and GARCH models are fitted for emerging market volatility by jointly estimating the variance and mean equations by ML method. Also, it is important to note that only the estimation results of the most appropriate models are presented.

The empirical results presented here are consistent with past studies in that a GARCH(1,1) provides a good description of emerging market volatility (Chile, India, and South Africa) as well as of the world market (Tables 6.5–6.8). Figure 6.2 displays, for example, the time-path of the conditional volatility in South Africa which shows strong reaction of this market to the Asian financial crisis of 1997–1998.

Table 6.3 Estimation results of the mean equation

	Chile	China	Mexico	India	South Africa	World
Constant	0.002 (0.004)	−0.007 (0.006)	0.001 (0.005)	0.002 (0.006)	0.002 (0.004)	0.003 (0.003)
Local market lags						
1-lag			0.025 (0.055)	0.035 (0.071)		
2-lag			0.086 (0.055)			
World market lags						
Current return	0.938^{***}(0.093)	1.171^{***}(0.154)	1.377^{***}(0.118)	0.941^{***}(0.130)	1.221^{***}(0.103)	
1-lag				0.283^{*}(0.148)		0.182^{**}(0.070)
R^2	0.344	0.227	0.424	0.258	0.419	0.033
Adjusted R^2	0.341	0.223	0.415	0.246	0.416	0.028
Log-likelihood	282.479	181.936	236.044	218.651	262.018	334.622
F-stat.	102.293^{+++}	57.425^{+++}	46.924^{+++}	22.293^{+++}	140.891^{+++}	6.662^{++}
AIC	−2.847	−1.826	−2.379	−2.190	−2.639	−3.394
BIC	−2.834	−1.793	−2.313	−2.123	−2.606	−3.361

Notes: Standard deviations are reported in parenthesis. *, ** and *** indicate that associated coefficients are significant at 10%, 5% and 1% respectively. $^{+}$, $^{++}$ and $^{+++}$ indicate the rejection of the null hypothesis of the associated statistical test at 10%, 5% and 1% respectively. F-stat. refers to the empirical statistics of the test of the hypothesis that all of the slope coefficients in linear regression (excluding the constant) are zero. AIC and BIC are the Akaike and Schwarz information criteria of the estimated model

Table 6.4 ARCH test for sample markets

	Chile	China	Mexico	India	South Africa	World
R^2	0.064	0.114	0.125	0.015	0.048	0.087
F-stat.	3.234	6.025	13.582	2.865	4.911	6.056
P-value (F-stat.)	0.013	0.000	0.000	0.092	0.008	0.001
ARCH(1)				2.852	9.489	
$\chi^2(1)$				0.091	0.008	
ARCH(2)			24.142		9.489	
$\chi^2(2)$			0.000		0.008	
ARCH(3)						16.927
$\chi^2(3)$						0.001
ARCH(4)	12.426	21.931				
$\chi^2(4)$	0.014	0.000				
AIC	−7.558	−5.408	−5.701	−6.580	−6.804	−8.354
BIC	−7.474	−5.324	−5.649	−6.546	−6.753	−8.286

Notes: ARCH(p), equal to ($T \times R^2$), refers to the empirical statistics of the test for conditional heteroscedasticity applied to q lags of the linear regression residuals $\chi^2(q)$ refers to the p-value of the associated ARCH(q) statistics. T is the number of observations used to estimate the linear regression. F-stat. refers to the empirical statistics of the test of the hypothesis that all of the slope coefficients in linear regression (excluding the constant) are zero

Table 6.5 Estimated GARCH(1,1) model for Chile

Variable	Coefficient	Standard deviation	z-statistics	P-value
Mean equation				
Constant	0.006	0.004	1.530	0.126
RW	0.946	0.056	16.682	0.000
Variance equation				
Constant	0.000	0.000	0.978	0.327
ARCH(1)	0.115	0.061	1.893	0.058
GARCH(1)	0.825	0.103	7.997	0.000
R^2	0.340	Mean dependent var.	0.005	
Adjusted R^2	0.327	Std. dev. dependent var.	0.071	
Log likelihood	290.232	AIC	−2.895	
F-stat.	24.821	BIC	−2.812	
P-value (F-stat.)	0.000	Durbin–Watson stat.	1.825	

A GARCH(1,1)-M specification appears to be the most suitable for capturing the Chinese volatility dynamics since the "in-mean" factor (conditional variance) is significantly priced in this market (Table 6.9). Indeed, all estimates are statistically significant and have appropriate statistical properties. The non-negativity constraints for the coefficients of GARCH models are respected, and there are no ARCH effects in the estimated residuals.

Finally, the Mexico's volatility dynamics in Fig. 6.3 seems to be nonlinear and asymmetric notably because of the succession of several crises and the intensity of financial liberalization in this country according to the estimation results from an EGARCH(1,2) specification (Table 6.10). This pattern was somewhat expected as

Table 6.6 Estimation results from GARCH(1,1) model for India

Variable	Coefficient	Standard deviation	z-statistics	P-value
Mean equation				
Constant	0.003	0.006	0.553	0.580
RW	0.966	0.130	7.420	0.000
RW(−1)	0.373	0.125	2.978	0.003
Variance equation				
Constant	0.001	0.000	1.693	0.090
ARCH(1)	0.074	0.048	1.545	0.122
GARCH(1)	0.792	0.083	9.508	0.000
R^2	0.256	Mean dependent var.	0.006	
Adjusted R^2	0.236	Std. dev. dependent var.	0.092	
Log likelihood	222.580	AIC	−2.210	
F-stat.	13.093	BIC	−2.109	
P-value (F-stat.)	0.000	Durbin–Watson stat.	1.891	

Table 6.7 Estimation results from GARCH(1,1) model for South Africa

Variable	Coefficient	Standard deviation	z-statistics	P-value
Mean equation				
Constant	0.002	0.004	0.513	0.607
RW	1.158	0.087	13.277	0.000
Variance equation				
Constant	0.001	0.001	1.704	0.088
ARCH(1)	0.194	0.063	3.043	0.002
GARCH(1)	0.485	0.214	2.261	0.024
R^2	0.418	Mean dependent var.	0.006	
Adjusted R^2	0.406	Std. dev. dependent var.	0.084	
Log likelihood	268.352	AIC	−2.674	
F-stat.	34.521	BIC	−2.590	
P-value (F-stat.)	0.000	Durbin–Watson stat.	2.045	

Table 6.8 Estimation results from GARCH(1,1) model for world stock market

Variable	Coefficient	Standard deviation	z-statistics	P-value
Mean equation				
Constant	0.006	0.003	1.942	0.052
RW(−1)	0.067	0.091	0.735	0.462
Variance equation				
C	0.000	0.000	0.926	0.354
ARCH(1)	0.161	0.042	3.837	0.000
GARCH(1)	0.831	0.050	16.532	0.000
R^2	0.014	Mean dependent var.	0.003	
Adjusted R^2	−0.006	Std. dev. dependent var.	0.045	
Log likelihood	350.138	AIC	−3.522	
F-stat.	0.697	BIC	−3.438	
P-value (F-stat.)	0.594	Durbin–Watson stat.	1.749	

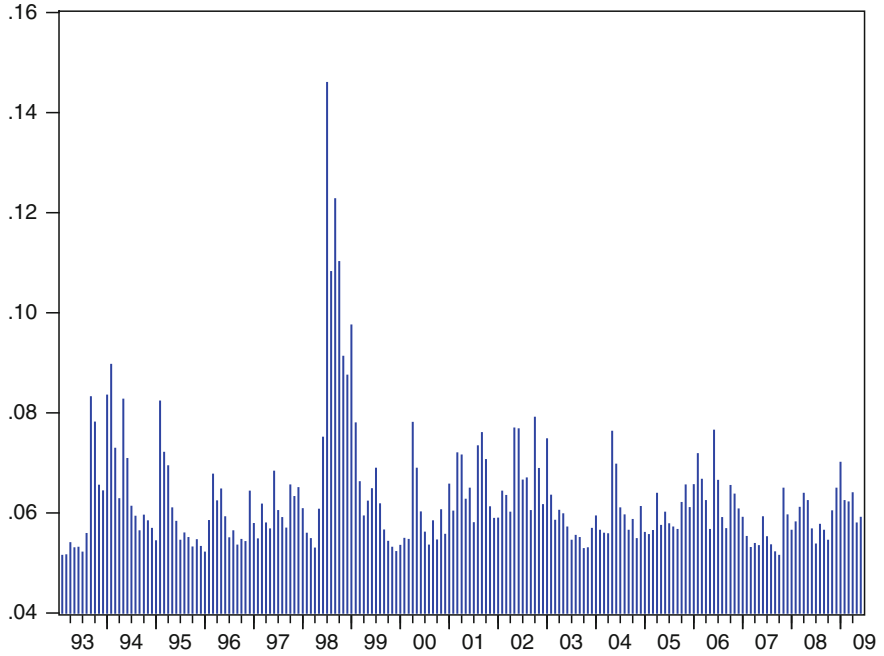

Fig. 6.2 Conditional standard deviation in South Africa

Table 6.9 Estimated results from GARCH(1,1)-M for China

Variable	Coefficient	Standard deviation	z-statistics	P-value
Mean equation				
Constant	0.018	0.008	2.177	0.029
RW	1.171	0.142	8.257	0.000
"in-mean"heteroscedastic term	−2.586	1.199	−2.156	0.031
Variance equation				
Constant	0.000	0.000	1.287	0.198
ARCH(1)	0.164	0.061	2.676	0.007
GARCH(−1)	0.808	0.071	11.387	0.000
R^2	0.256	Mean dependent var.	−0.003	
Adjusted R^2	0.236	Std. dev. dependent var.	0.109	
Log likelihood	210.148	AIC	−2.072	
F-stat.	13.146	BIC	−1.972	
P-value (F-stat.)	0.000	Durbin–Watson stat.	1.903	

Mexican stock market index has a highest and the most negative asymmetric coefficient (skewness = −1.393). Overall, Mexican market was the most volatile during the period of peso devaluation of 1994–1995.

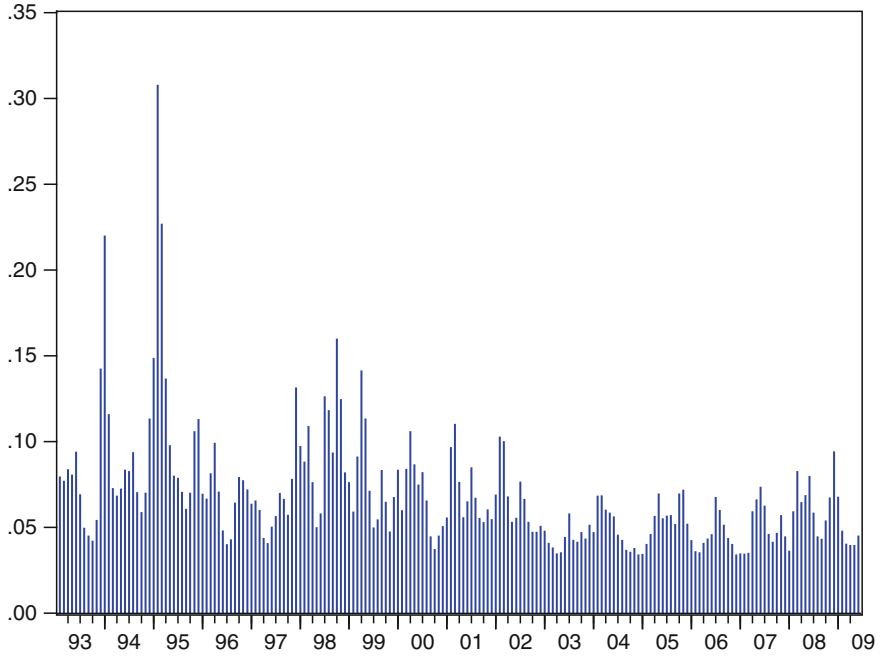

Fig. 6.3 Conditional standard deviation in Mexico

Table 6.10 Estimation results from EGARCH(1,2) model for Mexico

Variable	Coefficient	Standard deviation	z-statistics	P-value
Mean equation				
Constant	0.006	0.003	1.970	0.048
RW	1.354	0.080	16.807	0.000
Variance equation				
β_0	−1.140	0.408	−2.795	0.005
β_1	0.543	0.137	3.955	0.000
β_2	0.225	0.105	2.132	0.033
β_3	−0.320	0.079	−4.008	0.000
δ_1	0.872	0.064	13.521	0.000
R^2	0.412	Mean dependent var.	0.005	
Adjusted R^2	0.393	Std. dev. dependent var.	0.095	
Log likelihood	269.269	AIC	−2.662	
F-stat.	22.206	BIC	−2.546	
P-value (F-stat.)	0.000	Durbin–Watson stat.	1.808	

$\ln(\sigma_t^2) = \beta_0 + \sum_{i=1}^{q} \beta_i\, g(z_{t-i}) + \sum_{j=1}^{p} \delta_j \ln(\sigma_{t-j}^2)$
$g(z_t) = \varphi\, z_t + \gamma[|z_t| - E|z_t|]$

6.6 Summary

The aim of this chapter is to study the volatility of emerging stock markets and their main determinants. After presenting a wide range of econometric techniques available to apprehend stock market volatility in general, we focus particularly on

the GARCH-based volatility models and show how the latter can be properly applied to emerging markets.

The models presented are then applied to stock market data of five emerging markets (Chine, India, Mexico, Chile and South Africa) and the world stock market index. The results typically suggest that emerging market volatility is time-varying and highly persistent for most of the considered markets, while it exhibits asymmetric and nonlinear patterns in the case of Mexico. As it was shown, the high level of volatility could become an important obstacle for international capital flows to emerging markets, policymakers and market authorities must keep an eye on this parameter and undertake sound policies that enhance, among others, the market transparency and efficiency. A good quality of these factors permits, indeed, to avoid harmful effects of any excessive volatility unexplained by the fundamental fluctuations.

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Chapter 7
Globalization and Market Integration

Abstract This chapter introduces the concept of stock market integration. Overall, markets are integrated if investments with similar characteristics provide similar returns. It also presents the expected benefits and costs of market integration. In theory, market integration should increase financial and economic efficiency, and lead to a higher economic growth. However, market integration may increase asset return volatility, and cause financial instability and contagion effects. We then discuss the different methods used to assess the market integration degree. Finally, we empirically examine the issue of market integration in Latin American emerging stock markets.

7.1 Introduction

The recent period is characterized by strong evolutions of financial markets and financial globalization. Globalization and financial market have now become so closely linked that they soon become inseparable. On the one hand, capital movements intensify cross-border each year more, while on the other hand, national economies are more and more open to foreign capital flows. The internationalization of financial markets is the result of a double phenomenon:

- The accelerated deregulation of national money and financial markets
- The direct national market interconnection, particularly by the formation of large external capital markets – the Euromarkets

The creation of the Euromarkets started in the early 1950s. The Soviets, who had feared at the time of the Korean War freezing their US assets in American banks, have moved assets in banks in London. But the real start of the Euromarkets is given by the will of the British banks to adapt to new needs. In fact, the British government increasingly hampered by the weakness of the pound in 1957, imposed severe restrictions on loans in pounds granted to nonresidents. Banks are geared towards the US dollar. In the 1960s, the US problems will foster the development of

M. EI H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_7,

Euromarkets. In 1958, seeking to fight against inflation, the administration of President Kennedy introduced the regulation Q, which had limited the compensation of bank deposits in the United States and prompted investors to seek more attractive opportunity outside the United States; they will find it on the Euromarkets. In July 1963, President Johnson establishes the interest equalization tax. This tax affects the interests of investment in securities of US. Therefore, investors are turning to the Euromarkets. The market experienced strong growth from $1.5 billion in 1958 to $160 billion in 1973. The removal of regulations and taxes in 1974 did not develop paralysis of the Euromarkets. On the contrary, the latter continued to rise to $4,645 billion in 1995. Thereafter, the Euromarkets will see its real evolution with the successive oil crises. The oil-importing countries pay their energy bills by borrowing. This allows exporting countries to put their surpluses in international banks. The Euromarkets ensured the recycling of petrodollars thanks to its flexibility and its perfect adaptation to the needs of borrowers and lenders.

The reality of Euromarkets is complex. There are many compartments which are distinguished from each other by issuing special procedures or assets of a different nature. The internationalization of the stock markets was done using techniques that do not require the issuance of new securities, by listing on foreign exchanges for instance using the American Depositary Receipts (ADR). This market has emerged in the second half of the 1970s. The first real international placement of shares occurred in 1976 with an emission by Alcan (Aluminum Canada) of 5 million shares placed primarily in the United States and Europe. The international emission market has grown considerably since its creation. In 1986, the market reached $1.6 billion. From the 1990s, the implementation of very large-scale deregulation and privatization in several OECD countries and many emerging countries led to the development of international stock markets.

The internationalization of financial markets is favored by many institutional and behavioral factors. The information technology and electronic interconnection globalize the world economies and, first, the financial markets. The geographical space is gradually replaced by the virtual space of the information: financial information is processed and disseminated in real time at the global level and the transfer of property values is conducted now by computer. When comparing the globalization of financial markets to that of good markets, we find that trade in financial assets has increased over the past 15 years three times faster than trade in goods. Countries that have received most capital flows over the 1990s are China, Mexico, Brazil, Korea, Malaysia, Argentina, Thailand and Indonesia. The sudden reversals of capital flows have become a recent feature of international financial markets. In 1996, $70 billion were invested in Indonesia, Korea, Malaysia, Philippines and Thailand. During the second half of 1997, more than $100 billion were rushed back again. Since early 1999, capital inflows to these countries have found a rate almost comparable to that of before 1997. Since 2000, these emerging markets are receiving increasing capital flows.[1]

[1]See Chap. 2 for further discussions about the evolution of foreign private capital flows to emerging market economies.

Investors interested in improving the risk-adjusted return performance of their portfolios are looking for new investment opportunities and risk diversification. The new communication technologies accelerate the information flow and allow a considerable reduction in transaction costs. Thus, profitable arbitrage opportunities are immediately seized. The speed and ease with which capital moves from one financial place to another conduct naturally to the internationalization and the integration of financial markets especially as the profit opportunities are becoming rare. Moreover, the existence of many regulatory restrictions until recently pushed more trends for the internationalization of financial transactions. Therefore, under the pressure of technological and financial innovations, governments in many industrialized countries, especially the United States, began to liberalize their markets. This increased interdependence of national financial markets and therefore their integration into a unified global market. This internationalization is marked by respect for the unity of time and place: the market operates 24 h on twenty-four and arbitrage operations ensure the unity of the mega-global financial market.

Emerging countries start to participate effectively in the movement of financial globalization since the 1990s. According to World Bank documents, the net flow of international capital in the direction of non-OECD countries rose from $98 billion in 1990 to $300 billion in 1997. This movement was accompanied by a progressive predominance of private capital flows (nearly 85% of total flows in 1997), through direct investment, bank loans, bond issues and portfolio investment. The development of emerging markets was part of a general trend of financial liberalization in developing countries, including internally a movement of deregulation of interest rates and exchange rates. The development of capital markets has been encouraged by the modernization of the money market, the foreign exchange market, the creation of traditional financial markets (stocks and bonds), or even derivatives markets (Singapore and Hong Kong). However, it is mainly the characteristic of the stock markets that have been globalized. The development of bond markets has faced several obstacles: budget surplus of some emerging countries, regulatory constraints, lack of credibility of the State, and lack of rating agencies.

Recently, growth forecast for emerging countries in the years to come are much higher than those for developed countries. Empirical studies assess that emerging stock market indices are positively correlated with economic growth. At the same time, the share of local market capitalization in the GDP, although it remains below the levels of industrialized countries, has risen sharply. Analysts expect it to strongly increase in future years. In other words, emerging markets have strong potential for international diversification of portfolios and will play a greater role in financial markets integration.

7.2 The Notion of Financial Integration

In the economic and financial literature, there is no precise definition of the concept of integrated financial markets. Bourguinat (1999) defines the international financial integration as “the process of communication more and more advanced of

domestic capital markets which led to a global financial market." According to Kindleberger (1987), financial integration is such as "in a market, there is a single price, and if there is a single price, there is a single market." These two definitions, as general as they are, can identify a condition for integration of financial markets: equal prices of the product treated. This equality of prices is based on the law of one price that the price of an asset, expressed in a given currency on two different national markets, is identical.

7.2.1 The Law of One Price

The problem of integration of financial markets is generally regarded as giving rise to two issues: the substitutability of assets and capital mobility. The international financial integration will be as stronger as both conditions are met. Unfortunately, the financial literature in most of the time implicitly refers to the two extreme cases of financial integration: perfect integration and strict segmentation. However, the zero integration and perfect integration of financial markets are only theoretical cases. In reality, financial markets are located between these two extremes.

7.2.1.1 Capital Mobility

Capital mobility means equal access for all agents to all assets: capital moves without geographical barriers. A market is more integrated when it does not involve tax discrimination. This capital mobility is based on two elements: the rationality of agents and equal treatment.

In economic theory, the agent is a rational actor maximizing his expected utility. It is characterized by a preference that he seeks to achieve within the constraints limiting the options available. Mobility can take place only if the agents are willing to move and they have the opportunity to move.

The second condition of the mobility of capital is equal treatment. This equality implies the agent can move freely from one financial market to another without incurring a higher cost than if he remained on the same financial market. Mobility will be more important when discriminations are eliminated. Barriers to mobility can be represented in many forms such as exchange controls, taxation, and transaction costs.

The mobility of capital has been improved since the 1970s following the deregulation of financial markets and the development of new telecommunication technologies that have led to a considerable reduction of costs in both developed and emerging countries.

7.2.1.2 Substitutability

Two assets are substitutable if they are indistinguishable in terms of risk attached to them. The substitutability of assets implies the possibility of moving, either within a single currency area, from a domestic asset to another, or to play at the international

level, the substitution of preferred habitats. This substitutability of assets extends the investors investment opportunities.

For international portfolio management, two securities are substituted if they provide the same contribution to portfolio risk, and that, whatever its composition. In this sense, the remuneration of each asset is the only factor in the choice of the investor. The more the assets are substitutable, the more the similarities between their characteristics.

Thus, if the assets are perfectly mobile and perfectly substitutable, investors will move to the securities offering the best risk-return couple. Ultimately, the international financial market will be more integrated than the assets that are traded are more mobile and more substitutable. The standardization of financial products, the ease with which information flows and the increased mobility of capital investors naturally lead to the internationalization of their operations. The arbitrage opportunities are immediately exploited by investors. Arbitrage is a technique that involves buying and/or sell (and to lend or borrow) on two different markets (or at two different times) to operate a price difference, so as to make a profit in principle without risk. In the absence of arbitrage opportunities, the law of one price is maintained: two assets with the same characteristics but belonging to two different countries have necessarily the same price.

Formally, consider two assets with at every moment the same characteristics, the first traded on the domestic market and the second on the foreign market. Let $P$and P^* be respectively the price of the national asset and the foreign one. If the law of one price is verified, then we have:

$$P = SP^* \tag{7.1}$$

where S refers to the exchange rate measured by the number of units of national currency per one unit of foreign currency.

In the absence of friction, any deviation from equality (7.1) represents an opportunity for profit. If agents are rational and fully informed of prices in each market, then arbitrage transactions should multiply and ceases only when the difference between the exchange rate and the price ratio will be exactly equal to the transaction costs.

However, the reality differs somewhat from (7.1) because of costs of different kinds. But the law of one price can exist at least in a weak form. So in this case, markets are integrated if the price differential between the two markets is justified by the costs. This version of the relative law of one price is:

$$P = S.P^*.\lambda \tag{7.2}$$

where λ is the point beyond which the arbitration will be profitable. The logarithmic transformation of (7.2) leads to:

$$p = p^* + s + \gamma \tag{7.3}$$

where γ represents the deviation "authorized" from the law of one price in its strong form. The various costs determine the boundaries of an interval within which the arbitrage is not profitable, thus $-c_1<\gamma<c_2$. Note that $c_1$and c_2 are not necessarily symmetric.

Equation (7.3) can be rewritten as

$$-c_1<p-p^*-s<c_2 \tag{7.4}$$

Beyond the bounds $c_1$and c_2, the arbitrage opportunities arise. $c_1$and c_2 thus represent points of entry and exit of funds. The law of one price, it is taken as strong or weak, should lead to transfer costs close to uniform pricing.

Ultimately, on perfect markets where the assets are sufficiently mobile and substitutable, the law of one price should be respected. But unfortunately, in reality, market frictions persist and various factors may be sources of market segmentation. Indeed, there are imperfections in the functioning of the market, and therefore they have considerable influence in the assessment of systematic risk. The identification of these barriers is important to understand international portfolio diversification strategies. Several forms of imperfection can be distinguished:

- Transaction costs related to international operations: transport costs, postage, telephone, etc.
- The different risks arising from investing abroad: currency risk, regulatory changes, etc.
- The nonequivalence of financial assets (domestic and foreign assets): maturity, returns, risks, etc.
- The discriminatory tax treatment: tax on capital movements, exchange rate controls, etc.

Hence, financial integration should increase as the markets will be deregulated and unprotected.

7.2.2 Factors Increasing Financial Integration

Two markets are integrated if financial assets with the same characteristics return the same performance. The descriptions of the process of integration of international capital markets often focus more specifically on the actions of public authorities, particularly in terms of legislation and regulation. However, this should not obscure the fact that if the legislative and regulatory environment of the financial system creates the necessary condition for the integration, market operators contribute to the promotion of financial integration. In practice, achieving an optimal level of financial integration requires an effective interplay between market forces, collective action and public action.

In accordance with the principle of an open market economy with perfect competition, the first determinant of financial integration is an expression of market

forces. Operators benefit directly from the lower cost of capital resulting from increased competition. They have access to a large range of financial instruments and increased opportunities for portfolio diversification. Financial service providers can exploit economies of scale and scope potential offered by a larger market. The expression of market forces should lead to the elimination of inefficiencies associated with market segmentation. There are situations in which market forces are not sufficient alone to eliminate inefficiencies. In this case, collective action complementing and strengthening the free market is necessary.

This section discusses very briefly some factors, in addition to the regulatory and operational factors, accelerating integration of national financial markets.

7.2.2.1 New Technologies

The new technologies of information and communications have enabled the emergence of new trading systems more efficient and less expensive. For example, many stock exchanges have recently chosen to eliminate their room and replaced market with a fully electronic transaction system. In addition, we have witnessed, in recent years, several alliances between financial centers to guard against international competition. Taken together, these changes will facilitate trade and increase the integration of stock markets.

7.2.2.2 Market Competition

The financial environment has changed significantly in recent decades. On the one hand, the availability of the same securities on various financial markets facilitates greatly the trading of foreign securities. On the other hand, the emergence of derivatives has made possible the negotiation of similar securities issued by the various international stock markets. All these factors push the investors to take advantage of price differences that may exist between the international financial markets and thus create more interdependence between these markets. In addition, these securities often enable investors to overcome institutional barriers.

7.2.2.3 Derivatives

The increase in the number of financial derivatives positively affects the level of financial integration. Indeed, some derivatives may be substituted for securities traded on markets. This type of financial products is unique because unlike the securities issued by companies, derivatives are an initiative of financial engineering. At this level, derivatives increase competition between different financial markets and facilitate their integration.

7.2.2.4 The Institutionalization of Savings

The fund management of savings is now an important financial reality. The presence of investment funds intensifies financial integration because they have efficient means to exploit any international arbitrage opportunities. Institutional investors control more than individual investors information and transaction costs especially on foreign financial markets.

7.3 Advantages and Disadvantages of Financial Integration

The liberalization of national financial markets is characterized by the gradual removal of various barriers to foreign investment and a removal of restrictions on capital movements. These reforms have led to major changes in the financial environment and began the process of financial integration. The consequences of this integration are considerable. Until the crash of October 1987, the focus was narrowed to the positive effects of the experience. Following numerous crises in the 1980s and 1990s, judgments have become more cautious. The purpose of this section is to highlight the main advantages and disadvantages of international financial integration in order to understand why financial integration would be desirable by both investors and policy makers.

7.3.1 Benefits of Financial Integration

The major advantage of international financial integration comes from the fact that it improves market efficiency. In other words, financial integration allows the savings to go to its "natural" destination where it is the most desired. This ensured, thanks to the expanded range of investment instruments, to the increased liquidity of markets, to the increased speed of transmission of information and their inclusion in the prices of financial assets as well as to the lower financing costs because of increased competition between financial institutions and the progress of direct finance. Three benefits are associated with financial integration: better risk diversification, better allocation of capital and greater economic growth.

7.3.1.1 Risk Diversification and Efficiency of Financial Markets

The monotone internationalization of financial markets allows investors to better manage their portfolios by offering stronger international diversification opportunities and higher liquidity. The theory of portfolio management teaches us that the acquisition of a diversified portfolio of securities is the best strategy to achieve the best return-risk ratio. Naturally, the international diversification meets this goal.

Again, technological and financial innovations as well as product standardization have helped an unprecedented enlargement of investment opportunities. The unit of time and space should lead to greater efficiency of financial markets.

Financial integration allows the global and domestic investors access to new opportunities for risk diversification. On the one hand, international investors can take advantage of new opportunities to reduce the risk of their portfolio. On the other hand, domestic investors may, in turn, stabilize their incomes by investing in financial assets issued and traded in other countries. They can also use international markets to avoid oscillations of the national economy and hedge against the adverse effects associated with its development.

Furthermore, this integration is often accompanied by structural and institutional reforms to ensure a competitive market. These reforms concern in most of the time the transaction system, transmission of information and compliance of rules and procedures for exchanges with international standards. Other phenomena such as learning effects in terms of knowledge and technology promote the impact of financial integration on the development of the local market. The same is true with respect to the increase in dual listings and capital raising through ADR, GDR and EDR. All these elements contribute to improving the overall efficiency of the financial market.

7.3.1.2 Better Allocation of Capital (Economic Efficiency)

In terms of economic efficiency, the integration of international financial markets leads to a better allocation of productive resources and better allocation of capital. The allocational efficiency of markets is obtained especially following the dramatic reduction of transaction costs and improved service quality. The cost reduction has made arbitrage transactions easier and faster, thereby improving resource allocation.

Economic efficiency is demonstrated through several mechanisms, directly or indirectly linked with the international financial integration. The first direct link between international financial integration and overall economic efficiency is of course investment. Indeed, the integration of financial markets is expected to increase the level of investment and improve profitability. First, financial integration in the sense of greater openness of markets encourages investment and foreign direct investment flows (FDI). In addition to these direct effects, FDI have other long-term positive effects through facilitating the transfer and dissemination of managerial know-how and technology. Then, the integration of national markets allows the savings to be more mobile and more efficient. Finally, following the reasoning above, financial integration directs funds to the most profitable projects. The combination of these three elements promotes economic growth.

The second channel is the link between financial integration and productivity. Indeed, the dissemination of information in real time, and the reduction of costs and barriers to financial innovations increase the competition between investors.

This latter would, in turn, encourage firms to improve their productivity and seek to reduce the risk inherent to investments undertaken.

7.3.1.3 Economic Growth

Another benefit of financial integration is the possible causal relationship between the "best" allocation of capital and economic growth. Financial integration accelerates the allocation of investment flows to their most productive uses and leads to the lowest cost of capital. This promotes the economic growth of regions and countries that attract these funds. Several empirical studies corroborate this opinion and show that liberalization of financial markets and equal access of investors to domestic and foreign assets increase the average annual growth rate in real terms.

To sum up, the objective behind the promotion of integration of financial markets is to facilitate allocation and more efficient use of resources. More specifically, financial integration has important implications for the roles played by financial markets as resource allocation in time and space, providing information and incentives for risk management purpose. Thus, integrated markets are characterized by, among others, significant network synergies, cost reduction, larger investment opportunities, liquidity, and market efficiency. Moreover, integration benefits the whole economy, particularly through the externalities created by the financial sector to the nonfinancial sector. Indeed, while the integration benefits primarily to the financial community, its impact is much broader. The integration is particularly likely to raise the level of financial development of the area in which it occurs and, hence, generates a higher level of sustainable noninflationary growth. There are effectively theoretical and empirical evidence of the existence of a causal relationship between financial development and economic growth. These benefits and significant impact of financial integration on the overall economy may justify government intervention to promote optimal development of the process. Through this action of governments can come in many forms, the exclusive and essential public action is the definition of an appropriate legislative and regulatory framework for creating a free market and financial stability.

7.3.2 Disadvantages of Financial Integration

Although it promotes economic efficiency and financial strength, international financial integration has some drawbacks. The volatility and instability of financial markets are the major disadvantages of financial integration.

The relationship between financial integration and volatility is complex. It depends on the stage of development of the markets. As financial integration is usually accompanied by an increasing openness of markets and increased private capital flows, it coincides in most of the time with an excess of volatility and a strong dependence on other countries. This typically occurs in the initial phase of

integration of national financial markets, and it is particularly true for emerging countries. In a later phase, international financial integration has a certain learning effect of eliminating some sources of inefficiency of the markets and thereby reduces volatility.

The banking and monetary system plays a key role in establishing the link between volatility and the international financial integration. Banks are the main channel of transmission and amplification of shocks which results in increased volatility and sensitivity to global factors. Indeed, international financial integration significantly improves the ability of banks to grant credits and use of new financial techniques such as securitization, which generally increases the portfolio volatility due to the heterogeneity of investors and to the complexity of financial instruments traded. In addition, the direct competition in national and international markets would encourage local banks to take additional risks.

To sum up, financial integration has paradoxical implications on the volatility of financial markets. It is presented both as an accelerator and a factor reducing volatility. On the one hand, financial integration makes markets more volatile because of their increased reliance on private capital flows. On the other hand, it tends to reduce this volatility once the integration process started. Indeed, financial market integration accelerates the volatility in that it increases the sensitivity of securities traded on the global market risk factors. In addition, deregulation and international capital flows spontaneously amplify financial instability. It also reduces the volatility of financial markets by increasing the efficiency of the financial system thanks to reforms and structural changes. Taking the period 1985–2008 as a reference, we find that finance is increasingly switch tracks more or less long periods of stability, short but severe and widespread decline.

Ultimately, the main benefits associated with the process of financial integration are related to improving economic and financial efficiency. Financial markets are becoming more productive and efficient. Therefore, international financial integration seems to have positive implications on the investment process as a whole. Its disadvantages are twofold. The first point is the resulting higher volatility. The second point refers to the financial instability and rapid transmission of crisis between national markets. Tradeoffs between the advantages and disadvantages of financial integration should be made by policymakers. These decisions are often based on quantitative measures of the degree of integration.

7.4 Assessment of the Degree of Financial Integration

Financial journals report that stock markets are increasingly integrated and that there is a strong link between economic globalization and integration of financial markets. In theory, international financial integration implies that the risk-adjusted return is identical for all markets. The risk premium is independent of the national investment (Bekaert and Harvey 1995). To assess the present stage of integration, it is normally necessary to assess the impact of geographical considerations on the

prices of financial assets and the behavior of market participants. One way to proceed is to check if the law of one price holds. Under the law, similar assets should have the same return.

Whether a stock market is integrated into the world market or segmented is crucial for many actors: economic policymakers, and finance professionals and researchers of both domestic and foreign markets. Indeed, the extent of financial integration seems to have four international interests. First, estimating the level of integration of national financial markets is the basis of any optimal strategy of portfolio diversification and research of economic efficiency. Second, assessing the level of integration of international financial markets is necessary, even indispensable, in any issue relating to the valuation of international financial assets and firms. Third, the study of financial integration allows the quantification of changes in the institutional and operational framework of the markets studied and the investigation of the effectiveness of various policies. Finally, empirical assessment of the international financial integration permits us to understand the dynamics of the integration process of national financial markets, to identify the significant risk factors and to explain the formation of the associated risk premiums.

This section discusses the empirical and qualitative aspects of financial integration. Its aim is to show that the process of financial integration is not a spontaneous process but it is a self-sustaining process. The assessment of the degree of integration of stock markets is a purely empirical question that must be associated with a capital asset pricing model.

7.4.1 Qualitative Aspects of Financial Markets Integration

Our examination on the dynamics of the integration of financial markets should include qualitative aspects of integration. These aspects include the institutional, operational and organizational markets. In the last three decades, financial globalization has changed the behavior of both investors and policymakers in economic policy. In addition to the emergence of new risks and the intensification of existing risks, financial globalization has resulted in major expansion of the scope of arbitrage. Now, international investors realize arbitrage transactions not only between the various investment opportunities in all countries, but also between the various financial services offered there.

By definition, a stock market is a meeting point between supply and demand for capital. Its function is the valuation of financial assets, organization of regulations and delivery of securities. The market structure influences the different strategies of supply and demand of securities and therefore the determination of prices of financial assets. In general, a market is competitive when it enables to discover the equilibrium price, to reduce transaction costs and volatility, and to increase liquidity.

Financial globalization would have three main impacts: development of financial markets, a strong presence of foreign investors and increasing access to foreign

markets. Regarding the first implication of financial globalization, it is clear that it increases the capital flows, transaction volumes and market capitalization of emerging markets in particular. The second implication of financial globalization is a presence of more foreign investors, resulting in a higher share of foreign investors in market capitalization and transaction volumes. The third implication reflects the involvement of domestic investors' access to international markets. This expansion of investment opportunities and financing would have allowed financial firms to have a lower financing cost and investors to diversify their risky portfolios.

Accordingly, financial globalization has three main challenges to stock market authorities: the challenge of competitiveness and attractiveness, the challenge of reliability and the challenge of stability. The challenge of competitiveness and attractiveness stems from the competition between emerging markets and developed markets in both the organization and listings of new issues. This competition reflects a kind of arbitrage made by international investors. The challenge of competitiveness and attractiveness requires that authorities set up an organization of the overall market capable to attract global investors. The same framework should also allow the listing of local firms. As for the challenge of reliability, the stock exchange authorities must also gain confidence of investors and companies. This includes providing good protection of investor interests. One of the negative consequences of opening up markets to foreign investors is the volatility. These fluctuations in asset prices of financial assets are essentially due to potential inefficiencies. The challenge of stability is that the stock market put in place a general framework for minimizing the harmful impacts caused by these inefficiencies.

Once the challenges of financial globalization apprehended, we can understand the delicate relationship between financial integration and the architecture of financial markets. Financial integration appears as both a cause and a consequence of changes in the operational framework of the market. These changes were made primarily to meet the demands of financial globalization. Now the architecture of markets must be consistent with international standards in order to pass the new emissions and attract global investors. The market authorities must adopt organizational policies to bridge the gap with international standards. Specifically, experiences and best practices from developed markets have provided the basis for the establishment of standards. Besides these problems of integration of different markets, market administrators face the problem of vertical integration: harmonization of various market segments.

Once launched, the process of financial integration of capital markets affects the architecture of financial markets. In particular, the opening of national markets to foreign investors and free access of domestic investors to foreign financial markets lead to an alignment with international standards in terms of intermediation, information disclosure, liquidity, etc. It is obvious that this new context is conducive to accelerating the process of financial integration.

In practice, many reforms have been undertaken both in developed and emerging markets to meet the demands of new market players in a context of financial integration: the global investors. These strategies lead to arbitrage between national financial markets not only on the basis of returns and risks of financial assets, but

also on the basis of various attributes of these places such as liquidity, transparency, transaction costs, and volatility. This dynamics has enabled the emerging countries to improve their financial markets.

Furthermore, the national regulatory frameworks have stimulated the process of international financial integration by establishing the free movement of capital and by enhancing the monitoring and control of financial operations. In a globalized context, the market regulators have, in addition to their traditional roles of encouraging equity issuance, insuring financial stability and protecting savings, an active role in promoting the competitiveness of market places. In particular, they must ensure that all investors have equal access to various market segments. Changes in the regulatory framework must be compatible with the development of an efficient, transparent and equitable market. This determines the equity investors' confidence and the competitiveness of the market in a context of increasing financial integration.

To sum up, in a context where national financial markets are less and less relaying on their independence because competition is becoming more and more direct, legislators should ensure that regulations are adequate to be competitive. These adjustments drive the process of financial integration. Indeed, an efficient and competitive financial market allows, via an international financial integration resulting in a better allocation of resources and a fair valuation of financial assets, to promote economic growth.

7.4.2 Empirical Aspects of Financial Integration

The empirical assessment of financial integration answers many questions: what is the current level of financial integration? What is the trend of integration? What are the factors? Although the law of one price is the theoretical criterion the most relevant for testing integration of markets, the studies of international financial integration are often based on other concepts. But in all the cases, financial integration will be as stronger as the law of one price will be verified.

In practice, three main methods are commonly used to test for financial integration and international mobility of capital. The first examines the impact of barriers on international capital flows. These restrictions may take various forms including for example taxes, exchange controls, and ownership constraints. The logic of this method is that the more financial markets are open, the more they tend to be integrated. The existence of frictions limits arbitrage and thus affects negatively the level of financial integration. The results of empirical studies using this method show that the restrictions on international capital flows have been considerably relaxed, in recent years, in both developed and many emerging countries.

The second method, initiated by Feldstein and Horioka (1980), directly tested the relationship between savings and investment in an open economy. The logic of this method is simple. If capital is perfectly mobile and domestic financial markets are increasingly open, the investment in a country does not depend on domestic savings. So there is no crowding out, as if domestic savings are low, a small increase in interest rate is sufficient to attract the savings from international

financial investment. As against, if capital is immobile, domestic savings are linked to national investment and international capital movements are justified only by the difference between the two variables. Thus, there is financial integration in the sense of Feldstein and Horioka (1980) if the investment and domestic savings are independent. The results of studies using this approach generally conclude in favor of market segmentation.

The third method compares the evolutions in asset returns across national stock markets. This approach is based on the extension of the domestic financial theory (CAPM) to the international context. Two variants can be distinguished. The first compares the risk premiums in various markets and the movements of interest rates while the second examines the marginal rate of intertemporal substitution. The asset valuation relationships are derived either under strict segmentation, or under full integration and more recently under partial financial integration.

Any way, to test the stock market integration and therefore whether the law of one price holds or not, the behavior of asset prices with similar characteristics, but treated in different markets, must be compared. In case of market integration, risk-adjusted returns must converge across countries. It is important to mention that the risk concerned here refers to the systematic risk and not the total risk. Indeed, the risk of an asset can be decomposed into two parts: systematic risk and idiosyncratic risk. The latter is not priced and can be eliminated by diversification. The comparison of financial assets should be based on the systematic risk. In principle, whenever the risk factors that affect financial assets are identified, their impact can be quantified before making comparisons. However, there is great uncertainty on the number and nature of these risk factors.[2] To identify these risk factors, the use of international asset pricing models is required.

However, in the financial literature, assessing the degree of international financial integration is often made from the analysis of correlations between returns of different national financial markets. This approach, initiated by Grubel (1968) based on the theory of risk diversification Markowitz (1952, 1959), relies on the intuition that if financial markets are integrated, then they must move together. If the returns are not perfectly correlated, then rational operators may reduce the risk of their portfolios by diversifying internationally. The additional gains of diversification are related to the level of integration or segmentation of national markets and in particular the importance of local risk factors and the interdependence between markets.

The use of correlation analysis of national financial markets as a method for measuring the degree of international financial integration can be deduced from the law of one price and the lack of arbitrage opportunities. Several empirical studies have found low correlations between national stock markets, particularly between developed and emerging markets, and among emerging markets. These results were interpreted as confirming the hypothesis of segmentation of these markets. It should be however noted that the correlation coefficients should be considered with great

[2]See Chap. 3 for more discussions about the determination of risk factors in international asset pricing models.

caution. Indeed, each market is influenced by purely domestic factors. In addition, random shocks can affect only certain sectors of the market. For instance, according to Roll (1992), industrial sectors have much to say about the explanation of the observed low correlations between national markets.

7.5 An Empirical Assessment of Financial Integration of Emerging Stock Markets in Latin America

Empirical investigations of interdependencies between emerging and developed stock markets have recently gained ground in finance literature. This increase of interests and motivations can be explained by various reasons that include the portfolio diversification issues and the recurrence of financial crises. Since the 1980s, emerging markets have been widely seen as the most exciting and promising area for investment, especially because they are expected to generate high returns and to offer good diversification opportunities. Consequently, these markets have known a considerable expansion, but also serious crises.

In order to better understand the emerging stock market co-movements, we focus here on the Latin American markets. These markets rank among the most mature markets within the universe of emerging countries and they actually attract a particular attention from global investors thanks to their great openness.The issue of market co-movements in Latin America has been investigated by several recent studies (Chen et al. 2002; Fujii 2005).

This chapter directly infer time-varying correlations the using a multivariate Dynamic Conditional Correlation GARCH model (DCC-GARCH) developed by Engle (2002) instead of modeling the co-movement by VAR and realized correlations as in past empirical works. Moreover, it also attempts to test for structural breaks in co-movements and tries to link the obtained breaks with important economic events and facts. Finally, the methodology used enables the investigation of the differences in market co-movements between normal and crisis periods.

7.5.1 Methodology

The time-varying correlations from a DCC-GARCH model are employed to measure co-movements between Latin American markets, and between them and the world.

Assume that returns from k markets are multivariate normally distributed with zero mean and conditional variance–covariance matrix H_t, our multivariate DCC-GARCH model is presented as follows:

$$\left\{ r_t = \mu_t + \varepsilon_t,\ \ \varepsilon_t | I_{t-1} \rightarrow N(0, H_t)\ H_t \equiv D_t R_t D_t \right. \tag{7.5}$$

where:

- r_t is the $(k\times 1)$ vector of the returns
- ε_t is a $(k\times 1)$ vector of zero mean return innovations conditional on the information available at time $t-1$
- $\mu_{i,t} = \delta_{i0} + \delta_{i1} r_{i,t-1} + \delta_{i2} r_{w,t-1}$ for emerging market i and $\mu_{w,t} = \delta_{wo} + \delta_{w1} r_{w,t-1}$ for the world with r_i and r_w are returns respectively on market i and world
- D_t is a $(k\times k)$ diagonal matrix with elements equal to the conditional standard deviations and R_t is the $(k\times k)$ conditional correlation matrix

D_t and R_t are defined by:

$$D_t = diag(h_{11t}^{1/2} ... h_{kkt}^{1/2}) \tag{7.6}$$

where h_{iit} is chosen to be a univariate GARCH(1,1);

$$R_t = (diag Q_t)^{-1/2} Q_t (diag Q_t)^{-1/2} \tag{7.7}$$

where $Q_t = (1 - \alpha - \beta)\,\bar{Q} + \alpha u_{t-1} u_{t-1}^{'} + \beta\, Q_{t-1}$ refers to a $(k\times k)$ symmetric positive definite matrix with $u_{it} = \varepsilon_{it}/\sqrt{h_{iit}}$, $\bar{Q}$is the $(k\times k)$ unconditional variance matrix of u_t, and α and β are non-negative parameters satisfying $\alpha + \beta \prec 1$ (stationary condition for GARCH process). Unknown parameters are estimated using the quasi-maximum likelihood (QML) method which corrects for any departure from the normality condition imposed in the mean equations.

Once conditional correlations become available, we test for structural breaks using Bai and Perron (2003)'s procedure. The test aims at determining the number and location of breaks. Let's suppose that there are m breaks $(n_1, ..., n_m)$ in the dependant variable, the problem of dating structural breaks turns to find the break-points $(\tilde{n}_1, ..., \tilde{n}_m)$ that minimize the following objective function

$$(\tilde{n}_1, ..., \tilde{n}_m) = \arg\min_{(n_1,...,n_m)} RSS_n(n_1, ..., n_m)$$

where RSS_n is the resulting residual sum of squares based on the m linear regressions of the following form:

$$y_t = \beta x_t^{\mathrm{T}} + \varepsilon_t \quad (t = 1, ..., n) \tag{7.8}$$

where:

- y_t refers to the estimated conditional correlation series at the time t;
- $x_t = (1, y_{t-1})^{\mathrm{T}}$ is the (2×1) vector of observations of the independent variables with the first component equal to unity;
- β is the (2×1) vector of regression coefficients;
- And ε_t is assumed to be $iid(0, \sigma^2)$.

The null hypothesis of "*no structural break*" is tested against the alternative that the regression coefficients change over time. The Bayesian Information Criteria (BIC) is used to select breakpoints and the optimal number of breaks.[3]

7.5.2 Data and Results

Monthly stock returns for the six main Latin American markets (Argentina, Brazil, Chile, Colombia, Mexico, and Venezuela) and the MSCI world market over the period January 1985 to August 2005. Returns are continuously compound and calculated on MSCI indices from Datastream International. They are expressed in US dollar to avoid the effects of currency risk.

Table 7.1 contains parameter estimates and a number of diagnostic tests. The coefficients relating emerging market returns to the one-lag local and world returns are insignificant, except for Colombia. The GARCH coefficients are significant for all countries, except Venezuela. This is on line with previous results in the literature. The coefficients α are relatively small in size, which typically indicates that conditional volatility does not change very rapidly. However, the coefficients β are large, indicating gradual fluctuations. In addition, α and β satisfy the stationary conditions.

Diagnostics of standardized residuals show that the indices of kurtosis are lower than those for the raw returns. The Jarque-Bera test (JB) still rejects the normality, which entirely justifies the use of the QML for model estimation. Tests for the absence of autocorrelation and ARCH effects are also carried out. The results indicate that the DCC-GARCH specification used is flexible enough to capture the dynamics of emerging market returns.

Conditional correlations within some Latin American markets and with the world market are plotted in Fig. 7.1. These correlations are relatively low, 21.54% on average, and vary considerably over time from a couple of countries to another. The average of correlations between Latin American markets and the world is 25.30%. The average of correlations within Latin American markets is only 20.04%. The highest conditional correlation is between Mexico and Chile (42.75%) and the lowest one is between Argentina and Colombia (6.76%). More interestingly, the evolution of these correlations witnesses some periods on negative values. This should mean high diversification gains from investing in Latin American countries.

Further, there is a clear upward trend in correlation from 1994 and onwards as a result of market liberalization and increased globalization. The lowest average correlation can be found between 1985 and 1993. Moreover, there are sudden increases in correlation following the Asian and Brazilian crises in 1997–1998 and, to less extent, the market crash in 1987 and the Latin American crises in 1994 and 2001.

[3]See Bai and Perron (2003) for detailed discussions.

Table 7.1 Estimation results of the DCC-GARCH model

	Argentina	Brazil	Chile	Colombia	Mexico	Venezuela	World
Panel A –Mean equations							
δ_0	0.024^{***}	0.023^{***}	0.018^{***}	0.010^{*}	0.020^{***}	0.001	0.010^{***}
	(0.009)	(0.010)	(0.005)	(0.005)	(0.007)	(0.013)	(0.003)
δ_1	0.030	0.0299	0.041	0.283^{***}	0.089	0.070	−0.008
	(0.086)	(0.074)	(0.061)	(0.062)	(0.063)	(0.092)	(0.067)
δ_2	−0.163	−0.048	0.122	0.351^{***}	−0.017	0.093	–
	(0.285)	(0.287)	(0.108)	(0.106)	(0.143)	(0.221)	
PanelB – GARCH process							
ω_0	0.001	0.0010	0.000	0.001^{**}	0.001^{*}	0.019^{***}	0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.006)	(0.000)
ω	0.218^{**}	0.167^{***}	0.045	0.145^{***}	0.231^{***}	0.221	0.079^{***}
	(0.110)	(0.057)	(0.031)	(0.042)	(0.072)	(0.264)	(0.034)
ω_2	0.771^{***}	0.811^{***}	0.876^{***}	0.703^{***}	0.695^{***}	−0.097	0.885^{***}
	(0.085)	(0.041)	(0.058)	(0.089)	(0.059)	(0.103)	(0.039)
α	0.033^{***}						
	(0.006)						
β	0.961^{***}						
	(0.005)						
Panel C – Specification tests applied to estimated residuals							
Mean	−0.052	−0.075	−0.020	−0.001	−0.033	0.014	−0.022
Std-Deviation	1.033	1.018	1.016	0.967	1.038	0.970	0.996
Skewness	0.601^{***}	-0.665^{***}	-0.318^{**}	0.288	−1.377	-0.998^{***}	-0.806^{***}
Kurtosis	3.951^{***}	2.134^{***}	1.089^{***}	1.248^{***}	4.925^{***}	4.599^{***}	2.552^{***}
JB	174.803^{+++}	64.820^{+++}	16.308^{+++}	19.356^{+++}	326.38^{+++}	257.691^{+++}	93.397^{+++}
Q(12)	2.937	6.654	17.235	9.496	18.974^{+}	9.281	13.286
ARCH(12)	6.462	10.262	14.842	5.303	3.708	7.628	5.804

Notes: Robust standard errors are in parentheses. $\overline{\omega}_0$, $\overline{\omega}_1$ and $\overline{\omega}_2$ refer to GARCH(1,1) parameters. $^{*,\ **}$ and *** indicate significance at 10%, 5% and 1% levels. $^{+,\ ++}$ and $^{+++}$ indicate the rejection of the null hypothesis of statistical tests (autocorrelation, normality and no-ARCH effects) at 10%, 5% and 1% levels

Next, we test for structural changes in co-movements between Latin markets and the world. The selected optimal breakpoints for each market and their 95% confidence intervals are reported in Table 7.2. The null hypothesis of stability is rejected. For Argentina, five significant breakpoints are obtained and for all the other countries four breakpoints are detected.

When relating the estimated break dates in emerging-world market co-movements to the liberalization dates in Table 2.1, it is observed that the official liberalization dates fall into the 95% confidence intervals for the estimated break dates in three markets: Brazil, Colombia and Mexico.[4] As markets open up and become more liberalized and integrated with the rest of the world, one may expect that the

[4]Official liberalization dates for Brazil, Colombia and Mexico are respectively May 1991, February 1991 and May 1989.

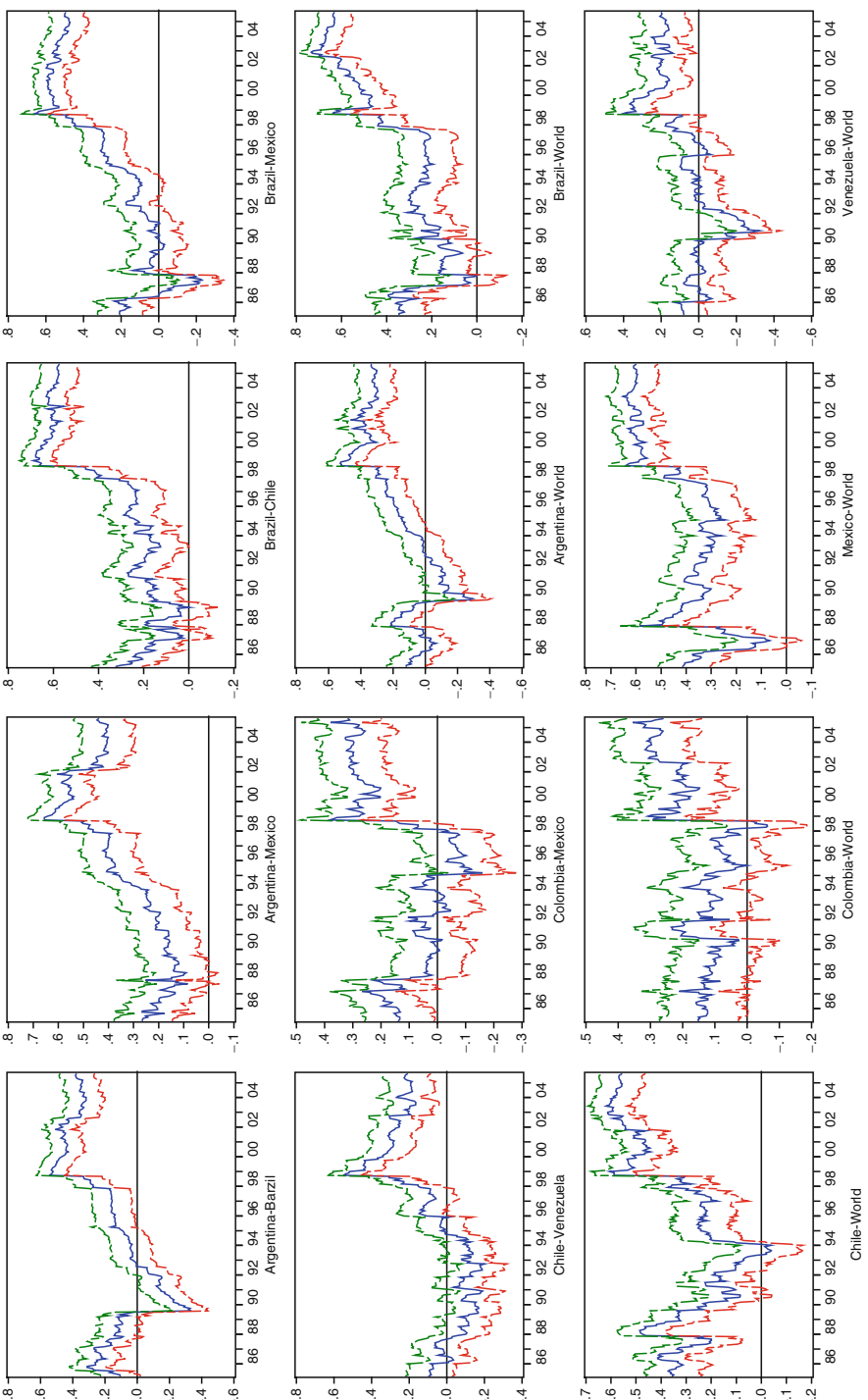

Fig. 7.1 Dynamic conditional correlations for selected couple of markets

Table 7.2 Test for structural changes in the co-movements with the world market

Market	Optimal number of breakpoints	Estimated break dates	95% confidence intervals for break dates
Argentina	5	1989:07	[1989:05–1989:08]
		1992:07	[1992:05–1992:09]
		1995:07	[1995:06–1995:09]
		1998:09	[1998:07–1998:10]
		2002:08	[2002:07–2003:01]
Brazil	4	1988:02	[1988:01–1990:03]
		1991:03	[1991:01–1991:06]
		1997:11	[1997:10–1997:12]
		2001:10	[2001:09–2001:12]
Chile	4	1990:02	[1989:12–1990:04]
		1994:04	[1994:03–1994:08]
		1998:09	[1998:08–1998:10]
		2001:10	[2001:09–2002:02]
Colombia	4	1990:09	[1988:02–1992:01]
		1995:03	[1994:12–1995:06]
		1998:09	[1998:08–1998:10]
		2002:08	[2002:07–2002:11]
Mexico	4	1988:02	[1987:12–1989:07]
		1992:02	[1991:12–1992:08]
		1995:09	[1994:02–1995:12]
		1998:09	[1998:08–1998:10]
Venezuela	4	1989:11	[1989:06–1989:12]
		1992:11	[1992:10–1993:04]
		1997:07	[1997:04–1997:08]
		2000:07	[2000:06–2004:02]

Notes: The Bai and Perron (2003)'s procedure is used to estimate the optimal number of breakpoints in the dynamic conditional correlation series

correlation of a country with the world market increases. Our results confirm partially this opinion. In Chile, the date where the first ADR was introduced (March 1990) is bounded by the 95% confidence interval of the first break date. In Argentina and Venezuela, none of the estimated break dates is related to market liberalization events. Finally, note that the break date observed in all studied markets following the Asian and Brazilian crises in 1997–1998.

7.6 Summary

Markets are integrated if investments with similar characteristics lead to identical returns. The returns are, of course, expressed in the same currency. The simplest test of financial integration might be to compare the risk premium of two perfectly correlated portfolios that are formed from all the assets of two separate national markets. If the markets in question are perfectly integrated, then the risk premiums are identical at any point of time. However, given the risks specific to each country, it is impossible in practice to form two national portfolios perfectly correlated.

For this reason, in the literature, tests of financial integration are rather based on asset pricing models. The use of these models is of interest as the definition of the integration of international financial markets has revealed two distinct levels. On the one hand, market integration implies an identity of risk factors influencing expected returns on financial assets in all markets. On the other hand, it also implies, in its strict version, not only the identity risk factors but also the equality of risk premiums associated with these factors. The use of international asset pricing models allows to assess quantitatively the level of international financial integration by examination simultaneously risk factors and risk premium between the different markets.

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Chapter 8
Dynamics of Market Integration and International Asset Pricing

Abstract In the chapter, we discuss some problems associated with international asset pricing. Indeed, investors from different countries face different investment and consumption opportunities. Thus, international models should make assumptions regarding market integration and purchasing power parity (PPP). Then, we present some international extensions of the CAPM and assess the pricing error when the investor uses the domestic CAPM to price assets while his market in not strictly segmented. Finally, we use a partial integrated international CAPM to investigate the evolution of the market integration degree of a Latin American emerging market (Mexico) into the world market.

8.1 Introduction

Following the works of Markowitz (1952, 1959) on the optimization of wealth in the mean-variance framework, Sharpe (1964) and Lintner (1965) independently develop the capital asset pricing model (CAPM). This model is one of the pillars of the financial valuation. By specifying a condition of equilibrium, the CAPM states that the expected returns of an asset is equal to the return on risk-free asset plus risk premium. Assuming that capital markets are perfectly integrated, several international extensions of the CAPM have been proposed. The first generation of the International CAPM (ICAPM) assumes that investors, regardless of their nationalities, use the same price index to calculate the real returns of different assets. Examples include the models proposed by Grauer et al. (1976), and Friend et al. (1976). In these models, the optimal portfolio for any investor is a combination of global market portfolio and the domestic risk-free asset. Other versions of the ICAPM were proposed by Solnik (1974a), Sercu (1980), and Adler and Dumas (1983). Unlike previous models, the second generation models are more general and cover issues related to deviations from the purchasing power parity (PPP).

Another specific feature of international capital markets is the existence of certain forms of national sovereignty, which can take many forms: exchange

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_8,

controls, taxes imposed on investment by nonresidents, etc. These barriers to international investment mean that investors encounter different investment opportunities and therefore choose different optimal portfolios depending on their country of residence. These barriers may limit the arbitrage between domestic and foreign assets, and thus drive to the segmentation of national markets.

Thus, the extension of domestic asset pricing models to the international context is challenged by many problems. Indeed, international investors do not value the same financial asset in the same way. This heterogeneity in the perception of risk and return of the same asset is primarily due to differences in investment and consumption opportunities offered to investors in different countries.

8.2 Basic Problems of Asset Pricing in an International Environment

The extension of the domestic CAPM to international context requires additional assumptions about the behavior of asset prices and the nature of markets: PPP holds or not and whether there are or not barriers to international investment. The rationale is that on the international market, the return of a financial asset is assessed differently by investors according to their nationalities. In other words, investors are distinguished by their belongings to a particular nation. Unfortunately, the definition of this criterion of distinction is not always the subject of consensus among economists. Modern financial theory has retained the following definition:

> A nation is an area where investors use the same price index to deflate the returns of various financial assets, or equivalently an area where a currency has the same purchasing power.

It follows that the international versions of asset pricing models are entirety based on a basic assumption of whether the PPP holds or not.

Similarly, investment opportunities may be used as a criterion of distinction. These investment opportunities are defined by a distribution of future wealth of the investor. The existence of restrictions to international investment makes the returns and risks of financial assets depending on the nationality of investors.

8.2.1 The Relationships of the PPP

According to Cassel (1923), the concept of PPP refers, in its simplest form, to the similarity of consumption opportunities in different countries. Stulz (1981) defines the set of consumption opportunities for investors as all goods for which the latter may have access, their prices and distributions of future prices. Thus, the major causes of deviations from PPP are the differences in the composition of consumption baskets of different countries in the relative prices of these goods and changes

over time in these prices. In international finance, two versions of the PPP may be distinguished: the absolute PPP and relative PPP.

8.2.1.1 Absolute PPP and the Law of One Price

In its absolute version of the PPP, the exchange rate between the currencies of two countries is equal to the ratio of price indexes of these two countries. Thus, at every moment we have:

$$\sum_{i=1}^{D} \omega_i^d p_i^d = S \sum_{i=1}^{E} \omega_i^e p_i^e \tag{8.1}$$

where p_i^d and ω_i^d (respectively p_i^e and ω_i^e) are the price and the weight of good i in the domestic (respectively foreign) country respectively. D (E) is the number of domestic (respectively foreign) goods. S refers to the nominal exchange rate.

Equation (8.1) establishes a relationship between the price indices of both domestic and foreign countries. The absolute version of PPP should be distinguished from the law of one price (LOP) which requires that the price of any individual good is the same in both countries:

$$p_i^d = S p_i^e \tag{8.2}$$

The LOP can be interpreted as a condition of instantaneous arbitrage. This arbitrage implicitly assumes the absence of any friction. The PPP, which was established as a weighted average of individual prices, is in some way, an average of the LOP. However, the PPP can be breached even if the LOP holds for all individual goods. This may, for example, be due to different consumption baskets: nationals and foreigners have different tastes.

8.2.1.2 Relative PPP

The PPP in its relative form establishes a relationship between inflation in both countries and the exchange rate. Inflation is calculated using variations of a price index. The latter is supposed to measure the average price of a basket of national consumption. The relative PPP is that the inflation differential between two countries is exactly offset by exchange rate movements of currencies of both countries.

$$s = \frac{S_t}{S_{t-1}} = \frac{1 + \pi_t^d}{1 + \pi_t^e} \tag{8.3}$$

where π_t^d and π_t^e are respectively the rate of domestic and foreign inflation.

If the relative PPP holds, the variation of exchange rates reflects perfectly the inflation differential and therefore it has no influence on the real returns of financial assets.

8.2.2 The International Asset Pricing

The main difficulty of international asset pricing comes from PPP. The fact that the PPP is not respected leads to a new dimension in the valuation relationship which did not exist in the domestic models. This new dimension comes from the method by which real returns are determined. The foreign nominal returns are first expressed in national currency. Then, these returns are adjusted for local inflation to get real returns. Thus, because of deviations from the PPP, investors from different countries look differently real returns of the same asset. Similarly, the risk depends on the nationality of the investor. Indeed, for a foreign investor, the risk associated with holding domestic assets is composed of three elements: the risk associated with the nature of the asset, the risk of uncertainty on prices and exchange rate fluctuations. For a domestic investor, the risk of holding the asset is limited to the first two risks. This heterogeneity in the perception of returns and risks associated with the same financial asset affects the relationship of evaluation.

Thus, the heterogeneity of consumer tastes in different countries is at the heart of the international asset pricing. To do this, financial theory defines the nation as a group of consumers using the same CPI to deflate the nominal returns on assets. In other words, consumption opportunities constitute a criterion of distinction between nations. If the PPP is verified, a financial asset has the same risk-return for all investors in all countries. Therefore, extending the domestic asset pricing model to the international framework requires only a few additional assumptions. On the contrary, if the PPP is not verified, the relationship of assessment depends on the nationality of the investor.

Alternatively, investment opportunities can serve as a criterion for distinguishing between the nations. According to Stulz (1995), investment opportunities mean the different distributions of wealth available to the investor. In an international context, the imperfections (taxes, transaction and information costs, exchange control, etc.) can segment the markets and therefore affect the asset pricing relationship. Indeed, the existence of barriers to international investment means that investors face various investment opportunities and therefore choose different optimal portfolios, depending on their country of residence.

Thus, any international asset pricing model should make assumptions concerning these two points: consumption opportunities and investment opportunities that investors face. Therefore, international models are traditionally classified regarding these two assumptions. Stulz (1995) distinguishes three groups of international asset pricing models:

- The model assuming that investors in all countries have the same consumption and investment opportunities
- Models that explicitly consider various consumption opportunities

– And models that examine the impact of barriers to international investment, and thus different investment opportunities

Finally, it should be noted that the empirical tests of the PPP include the work of Genberg (1978), Adler and Lehman (1983), and Stockman (1987). The results show significant deviations from the PPP in the short term. These deviations vary more than 5% during fixed exchange rates and more than 20% during periods of floating exchange rates. However, it is well documented that if the fact that the PPP is not verified in the short term appears to be a consensus among researchers, the results are more heterogeneous in the long term.

8.3 Equilibrium International Asset Pricing Model (ICAPM)

It is argued that the return on any foreign asset fluctuates not only because of asset-specific risk, but also because of unexpected variations in currency exchange rates. International investors should be rewarded for their exposure to systematic risk, i.e. undiversified risk for which investors are rewarded with a premium. Financial theory argued however that asset-specific volatility is not a proper measure of systematic risk as it contains a country-specific part that can be diversified by including the foreign assets in an international portfolio. That is why authors think that risk can appropriately be measured only within the context of an international asset-pricing model (ICAPM).

International asset pricing model stems from the generalization of the traditional capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965) to an international framework. This section discusses the international capital asset pricing model (ICAPM) of Sercu (1980), and Adler and Dumas (1983) that assumes full integration.

Consider that international investors maximize the expected utility of future real consumption while both nominal returns and domestic inflation in each country follow standard Brownian motions. Moreover, we consider that there are L+1 countries and $N = n$+L+1 assets, where the first n assets are risky dividend-paying equities, the next L assets are nominal deposits denominated in the nonreference currencies, and the last element is the return of the international market portfolio.

Let y_i^c be the price of asset i measured in the reference currency c, R_i^c the nominal return of that asset and $E\left(R_i^c\right)$ and σ_i^c its instantaneous first and second moments. Then, R_i^c follows the following process:

$$R_i^c dt \equiv \frac{dy_i^c}{y_i^c} = E\left(R_i^c\right) dt + \sigma_i^c dz_i^c; \quad i = 1, 2, ..., n \tag{8.4}$$

where the variable z_i^c follows a standard wiener process.

In addition, the inflation rate of each country, measured in the reference currency, is assumed to follow the same process. Formally, denote with I_k^c the general price index in country k measured in the reference currency, π_k^c the inflation

rate denominated in the reference currency, and $E\left(\pi_k^c\right)$ and $\sigma_{\pi k}^c$ its instantaneous first and second moments, then

$$\pi_k^c dt \equiv \frac{dI_k^c}{I_k^c} = E\left(\pi_k^c\right) dt + \sigma_{\pi k}^c dz_{\pi k}^c; \quad k = 1, 2, ..., L+1 \tag{8.5}$$

where the variable $z_{\pi k}^c$ follows a standard wiener process.

Note that π_k^c is stochastic in the sense that its variations reflect variations in the local inflation measured in the local currency π_k, and/or variations in the exchange rate between the currency of country k and the reference currency c.[1]

Finally, the investment problem of an international investor can be written as follows:

$$\underset{C_{k,\bar{\omega}_k}}{Max} \int_t^T U(C_k, I_k, \tau_k) \tag{8.6}$$

$$\text{Subject to} \quad dW_k^c = \left[\sum_{i=1}^n \bar{\omega}_i\left(E(R_i^c) - R_f^c\right) + R_f^c\right] W_k^c dt - C_k\, dt + W_k^c \sum_{i=1}^n \bar{\omega}_i \sigma_i^c\, dz_i^c$$

where C_k is the nominal consumption flow, W_k^c is the level of nominal wealth in country k expressed in the reference currency, $_i$ is the part of wealth invested in equity i, and $U(C_k, I_k, \tau_k)$ is an utility function assumed to satisfy the traditional assumptions, specifically, to be homogenous of degree zero in C_k and $I_k$to rule out money illusion.

Solving this optimization problem delivers the optimal portfolio allocation and, therefore, the demand function for equities for each international investor. Given the aim of the article, we specifically look at the premium that each investor requires to hold any risky asset. Assuming the supply is exogenous and markets are in equilibrium condition, i.e. for each asset, demand equal supply, and derive, by aggregating individual demands over all investors, the following expression:

$$E(R_i^c) - R_f^c = \delta_m\, Cov(R_i^c, R_m^c) + \sum_{k=1}^L \delta_k Cov(R_i^c, \pi_k^c) \quad \forall i \tag{8.7}$$

where R_m^c is the nominal excess return on the world portfolio of all traded stocks. δ_m and δ_k are defined as:

$$\delta_m = \theta_m = \frac{1}{\sum_{k=1}^L \frac{W_k^c}{W^c} \times \frac{1}{\theta_k}} \text{ and } \delta_k = \theta_m \left(\frac{1}{\theta_k} - 1\right) \frac{W_k^c}{W^c}$$

[1] If I_k^c is the price level in country k expressed in the local cuurency, then $I_k^c = I_k \times S_k$; where S_k is the nominal exchange rate which measures the price in the local currency of one unit of the reference currency. Thus, $\frac{dI_k^c}{I_k^c} = \frac{dI_c}{I_c} + \frac{dS_k}{S_k} + \frac{dI_c}{I_c} \times \frac{dS_k}{S_k}$ and, $\pi_k^c \cong \pi_k + \frac{dS_k}{S_k}$

where θ_k is the coefficient of relative risk aversion for investors from country k and θ_m is an average of risk aversion coefficients for each national group weighted by the corresponding relative wealth.

Note that in the traditional CAPM framework of Sharpe (1964) and Lintner (1965), the covariance between the return on asset i and the return on the worldwide portfolio represents the market risk component, then δ_m is interpreted as the world market covariance risk.[2]

8.4 International Versus Domestic CAPM

This section investigates the pricing error made by the investor when he assumes that the market is strictly segmented and then uses the domestic CAPM whereas the market is perfectly integrated, and as a result the true model is the ICAPM.

8.4.1 Assumptions and Notations

For simplicity, the PPP is assumed to hold, that is, the investors in all countries face the same set of consumption opportunities.If the investor believes, wrongly, that the market is strictly segmented, the returns of financial assets are given by the domestic CAPM of Sharpe (1964):

$$E(R_i) - R_f = \alpha_i + \beta_i^d [E(R_d) - R_f] \tag{8.8}$$

where R_i is the return of asset i, R_f the risk-free rate, R_d the return on the domestic market portfolio and β_i^d the domestic beta of asset i given by

$$\beta_i^d = Cov(R_i, R_d)/Var(R_d).$$

If the CAPM holds and the market is strictly segmented, α_i must be zero. On the contrary, if the market i is perfectly integrated into the global market, the returns are given by the ICAPM of Grauer et al. (1976):

$$E(R_i) - R_f = \beta_i^w [E(R_w) - R_f] \tag{8.9}$$

where R_w is the return of the world market portfolio and β_i^w the global beta of asset i given by

$$\beta_i^w = Cov(R_i, R_w)/Var(R_w).$$

[2]Equation (8.7) holds for the market portfolio, then δ_m can also be interpreted as the world market risk.

8.4.2 Pricing Error

When the investor uses the CAPM whereas the ICAPM is the true model, the pricing error is given by:

$$\alpha_i = [\beta_i^w - \beta_d^w \beta_i^d] \, [E(R_w) - R_f] \tag{8.10}$$

where $\beta_d^w = Cov(R_d, R_w)/Var(R_w)$.[3]

This relationship shows that systematic pricing errors are possible when the investor evaluates the financial assets under the CAPM, while the domestic market is not strictly segmented. To determine a band of variation of these errors, suppose that the returns follow a normal distribution and write the two versions of the model in the form of market models such as

$$R_i - R_f = \alpha_i + \beta_i^d [R_d - R_f] + \xi_i^d \tag{8.11}$$

and

$$R_d - R_f = \beta_d^w [R_w - R_f] + \xi_d^w \tag{8.12}$$

where ξ_i^d and ξ_d^w are the residuals of the models.The following pricing relation is obtained from (8.11) and (8.12):

$$R_i - R_f = \alpha_i + \beta_i^d [\beta_d^w (R_w - R_f) + \xi_d^w] + \xi_i^d \tag{8.13}$$

and the global beta is given by

$$\beta_i^w = \beta_i^d \beta_d^w + \frac{Cov(\xi_i^d, R_w)}{Var(R_w)} \tag{8.14}$$

and finally the pricing error is expressed as

$$\alpha_i = \frac{Cov(\xi_i^d, R_w)}{Var(R_w)} \, \left[E(R_w) - R_f\right] \tag{8.15}$$

According to this expression, the domestic CAPM correctly assesses assets with residuals independent from the world market portfolio, but underestimate the assets with residuals positively correlated with this portfolio. At this level, one can conclude that even if the basic assumptions of the model are verified, the domestic CAPM is not valid for a strictly nonsegmented market. Indeed, as long as the

[3]See Stulz (1995) for further details and discussions.

residuals of the market model of the assets in question are correlated with the global market portfolio, the pricing error is not zero. The band of variation of this error is:

$$|\alpha_i| \leq \sqrt{(1 - R_{id}^2)(1 - R_{wd}^2)\frac{Var(R_i)}{Var(R_w)}}(E(R_w - R_f) \tag{8.16}$$

where R_{ij}^2 is the determination coefficient of regression of the return of asset i on that of asset j.

8.5 The ICAPM: A Tool for Analysis of Portfolio Choice and Market Integration

The problem of investor choice assumes that the latter optimizes its investment by taking into account the expected returns and risk of its portfolio. Portfolio theory shows that the nonsystematic risk can be eliminated through diversification. In other words, only the necessary risk-taking is paid. The ICAPM is the best model that allows decomposing the total risk of an asset in a systematic risk and a specific diversified risk. Thus, the ICAPM has become the tool used to analysis international portfolio diversification.

As for integration of financial markets, we saw that integration is based on the law of one price. This law is the fundamental theoretical criterion for assessing the degree of integration. It stipulates that the integration of two markets is perfect if and only if two assets, one from each market, with the same risk have the same expected risk premium, in a reference currency. Thus, financial integration test requires the identification of risk premiums.

The most logical and easiest way to study the integration of financial markets is to compare the risk premia, expressed in the same currency, of two perfectly correlated portfolios, consisting of the assets of two different national markets. If these two markets are integrated, then the risk premia are identical in any point of time. Thus, the study of the process of convergence in risk premia expected on perfectly correlated portfolios help to appreciate the dynamics of market integration.

Unfortunately, in practice it is very difficult, even impossible, to constitute national portfolios perfectly correlated. For this reason, financial economists generally use ICAPM to test for integration. By establishing relationships between risks and returns, this model allows to compare the expected risk premiums on different portfolios. Thus, the use of these models allows to involve the assessment of financial integration in the international assessment of assets and to identify the links in terms of risk factors and premiums associated with these factors. This approach is of interest in our case. Indeed, the definition of financial integration, as outlined above, reveals two distinct levels. Firstly, the integration involves in the weak sense the identity of risk factors affecting returns. Secondly, integration in the

strict sense requires not only the identity of the risk factors, but also the equality of risk premiums associated with these factors.

Under the ICAPM, the problem of integration implicitly refers to the question of asset pricing by a global or a domestic model. If the market is strictly segmented, the global risk factors do not affect the domestic assets and they are assessed using the domestic model (CAPM). However, if markets are perfectly integrated, assets are valued relative to global common factors of risk and therefore the ICAPM holds.

Naturally, the first integration tests have worked to oppose an international model for a national model. The general principle of these tests is that if markets are integrated, then the national market portfolio does not have significant explanatory power in a valuation model incorporating the global market portfolio. Naturally, these approaches do not test the equality of risk premia of different markets, but simply help to say if the markets are strictly segmented or fully integrated.

Other studies have focused on the impact of barriers to international investment. Indeed, the concept of financial integration implicitly assumes that investors have equal access to all financial assets in all markets of all countries. A good exercise is to investigate how the existence of barriers affecting the relationship of evaluation from the CAPM and therefore the optimal choice for investors. Barriers to international investment may take different forms: discriminatory taxes, transaction costs and information, exchange controls, taxes on investment by nonresidents, etc. If the additional costs caused by these barriers are higher than the potential gains from international diversification of portfolio, arbitrage between different markets is no longer, and differences in returns remain untapped. These arbitrage opportunities are not exploited and form sources of segmentation. In the financial literature, three forms of segmentation are traditionally distinguished: the segmentation by access costs (segmentation due to different costs of access to foreign markets), segmentation by area (investors have access to assets of a particular area) and segmentation by agent (in each country there are two categories of investors: those who have access to international markets and those that are limited to national markets).

However, it should be noted that these barriers are not the same in all countries and can often be misused by investors. In addition, they have been, at least in industrialized countries, sharply reduced in recent years. In addition, restrictions on international capital flows are real sources of financial segmentation when they are asymmetric, meaning that they affect in different way domestic and foreign investors.

Another avenue of study is to examine the process of convergence in risk premia of different markets. Risk premiums used are generated from the excess returns of risky assets on a risk-free asset or from the regression models. If the risk premiums of markets converge, markets are integrated. It is however believed that this argument of convergence of risk premia is vulnerable. Indeed, financial integration is that two portfolios of similar risk have the same risk premium. Therefore, a vital step to any discussion of the convergence process of risk premiums is to form portfolios from different markets, but having, at each point of time, the same risk. This task is very difficult, even impossible in practice. Thus, the study of convergence in risk premia does not bring information on market integration. Moreover,

the situation of financial integration is not incompatible with different risk premiums. This is due to the differences in volatility due to the fact that the convergence of risk factors and the convergence of premia associated with these factors do not have the same speed.

More recent and ambitious works use the concept of market price of risk. The latter is defined as the premium per unit of systematic risk. Merton (1980), and Adler and Dumas (1983) showed that the price of risk is a measure of the average risk aversion of investors. If markets are perfectly integrated, then the price of risk must be the same in all countries. To illustrate this, reconsider the ICAPM in its simplest version (PPP holds). This relationship can be rewritten as follows:

$$E(R_{it}) - R_{ft} = \delta \; Cov(R_{it,}R_{mt}) \tag{8.17}$$

where R_i is the return on portfolio i, R_m the return on the global market portfolio, R_f return on risk-free asset and $\delta = (R_{mt} - R_{ft})/Var(R_{mt})$measures the premium per unit of market risk.

This formulation allows the decomposition of the risk premium of a portfolio i, $(E(R_{it}) - R_{ft})$, as the product of the price of risk (covariance), and the risk (measured by the covariance). It follows that the risk premium depends on two elements. The first element, the price of global market risk, is independent of the asset in question and depends only on the average of all assets whereas the second element depends directly on the asset being studied and measures its systematic risk. This decomposition allows overcoming the difficulty of forming correlated portfolios from different national markets. It permits to examine the market integration hypothesis using portfolios with different risks. We can therefore state that markets are perfectly integrated if and only if

$$\delta = (E(R_m) - R_f)/Var(R_m) = (E(R_{it}) - R_{ft})/Cov(R_{it,}R_{mt}); \quad \forall i.$$

This approach suggests that financial integration will equal the price of risk and not necessarily by risk premiums. As the price of risk is the aggregation of risk aversion of all investors (Merton 1980; Adler and Dumas 1983), the homogenization of behavior leads to the same price of risk and not necessarily identical to risk premiums. This is due to the differences in volatility between the different markets.

8.6 An Empirical Investigation of the Integration of an Emerging Market into the World Market

The choice to concentrate the study on Mexico is motivated by several reasons. Mexico is the biggest Latin American emerging market almost fully accessible to foreign investors. In the last two decades foreign investment barriers were reduced, country funds were introduced and depository receipts were listed in order to

improve the integration of Mexico into the world market. Integration should drive to a lower cost of capital, bigger investment opportunities, and higher economic growth (Bekaert and Harvey 2003). Studying the Mexican stock market leads to a better view of the integration process.

As discussed in Sect. 4.2.3, other factors may account for a high level of financial integration of the Mexican stock market into the world market: improved economic and social stability, institutional economic reforms, liberal policies that implied a commercial and financial deregulation of the economic activity as well as privatization. Stock market capitalization has increased remarkably over time and 44% of the domestic securities were in the hands of foreign investors by the end of 2005. As for international trade activity, Mexico's exports reached a record of $250 billion in 2006 and 85% of these exports were destined to the US. This performance is mainly due to the North-American Free Trade Agreement (NAFTA).

All these factors suggest an increasing degree of stock market integration of Mexico into the world capital market.

8.6.1 Methodology

According to previous discussions, the CAPM predicts that the expected excess return on an asset is proportional to its systematic risk (Sharpe 1964; Lintner 1965). Under integration hypothesis, an international conditional version of the CAPM can be written as follows (Adler and Dumas 1983; Harvey 1991):

$$E\left(R_{it}^{l}/\Omega_{t-1}\right) = \delta_{w,t-1} Cov\left(R_{it}^{l}, R_{wt}/\Omega_{t-1}\right), \quad \forall i, \tag{8.18}$$

where R_{it}^{l} and R_{wt} are respectively the excess returns on asset l in country i and on the world market, $\delta_{w,t-1}$ is the price of world market risk. Expectations are taken with respect to the set of information variables Ω_{t-1}.

Conversely, under segmentation, the domestic CAPM holds:

$$E\left(R_{it}^{l}/\Omega_{t-1}\right) = \delta_{i,t-1}\ Cov\left(R_{it}^{l}, R_{it}/\Omega_{t-1}\right), \quad \forall\, l, i, \tag{8.19}$$

where R_{it} refers to the excess return on market portfolio of country i and $\delta_{i,t-1}$ is the price of domestic risk.

At the national level, (8.19) becomes:

$$E(R_{it}/\Omega_{t-1}) = \delta_{i,t-1}\ Var\left(R_{it}/\Omega_{t-1}\right), \quad \forall i. \tag{8.20}$$

Recent studies suggest that returns should be influenced by both global and local factors as emerging markets are reasonably integrated with the world market (Bekaert and Harvey 1995; Carrieri et al. 2007). This leads to the specification of partially segmented framework where the returns are given by

$$E(R_{it}/\Omega_{t-1}) = \varphi_{i,t-1}\,\delta_{w,t-1} Cov\,(R_{it}, R_{wt}/\Omega_{t-1}) + (1-\varphi_{i,t-1})\,\delta_{i,t-1}\,Var(R_{it}/\Omega_{t-1}), \forall i \tag{8.21}$$

where $\varphi_{i,t-1}$ is a measure of market integration.

If $\varphi_{i,t-1} = 0$, only domestic variance is priced and the market i is segmented whereas if $\varphi_{i,t-1} = 1$, only the world risk is priced and the market i is integrated. Finally, if $0 < \varphi_{i,t-1} < 1$, the market i is partially segmented.

Next, consider the econometric methodology. Equation (8.21) has to hold for both Mexican and world markets and it can be rewritten under rational expectations as

$$\begin{aligned} R_{m,t} &= \varphi_{t-1}\,\delta_{w,t-1} h_{m,w,t} + (1-\varphi_{t-1})\,\delta_{i,t-1}\; h_{m,t} + \varepsilon_{m,t} \\ R_{w,t} &= \delta_{w,t-1} h_{wt} + \varepsilon_{w,t} \end{aligned} \tag{8.22}$$

where $\varepsilon_t = (\varepsilon_{m,t}, \varepsilon_{w,t})'/\Omega_{t-1} \sim \mathrm{N}(0, \mathrm{H_t})$; H_t is the (2×2) conditional covariance matrix of returns; $h_{m,w,t}$ is the conditional covariance between Mexican and world markets; $h_{m,t}$ and $h_{w,t}$ are respectively the conditional variance of Mexican and world markets. H_t is given by

$$\mathrm{H}_t = C'C + aa' * \varepsilon_{t-1}\varepsilon'_{t-1} + bb' * \mathrm{H}_{t-1}, \tag{8.23}$$

where C is a (2×2) lower triangular matrix and a and b are (2×1) vectors.

Finally, we follow previous works to specify the evolution of prices of risk (Harvey 1991; Carrieri et al. 2007). These prices are modeled as a positive function of information variables:

$$\delta_{w,t-1} = \exp(\kappa'_w Z_{t-1}) \text{ and } \delta_{i,t-1} = \exp\left(\kappa'_i Z^i_{t-1}\right)$$

where Z and Z^i are respectively a set of global and local variables included in Ω_{t-1}. As in Hardouvelis et al. (2006), the time-varying function $\varphi_{i,t-1}$ is conditioned on a set of variables that affect market integration

$$\varphi_{i,t-1} = 1 - Exp(-(\delta'_i Z^*_{i,t-1})^2)$$

where $Z^*_{i,t-1}$ is a set of variables expected to be correlated with market integration. By construction $0 \le \varphi_{i,t-1} \le 1$, $\varphi(\pm\infty) = 1$ and $\varphi(0) = 0$. These features are counted for in the construction of variables. Precisely, the model assumes further that deviations of variables from zero, independent of their sign, reduce the degree of integration. The quasi-maximum likelihood (QML) method is used to estimate the model.

Once the time-varying degree of market integration becomes available, tests of structural breaks are implemented to detect sudden changes in its time-path.

Let y_t be the degree of integration. The following mean-shift model with m breaks $(T_1, T_2, ..., T_m)$ is considered[4]:

$$y_t = \mu_j + u_t, \quad t = T_{j-1} + 1, ..., T_j, \tag{8.24}$$

where $j = 1, ..., m+1$, $T_0 = 0$ and $T_{m+1} = T$. μ_j refer to the regression coefficients with $\mu_i \neq \mu_{i+1} (1 \leq i \leq m)$, and u_t is the error term.

The estimation method developed by Bai and Perron (1998) is based on the ordinary least-squares principle. It consists in estimating the regression coefficientsμ_j and the break dates $(T_1, T_2, ..., T_m)$ under the condition that $T_i - T_{i-1} \geq [\varepsilon T]$ where is an arbitrary small positive number and [.] denotes integer part of argument.[5]

Bai and Perron (2003) propose a test-based selection procedure to estimate the number of breaks. Precisely, they suggest to first look at the results of tests $UD\max F_T$ or $WD\max F_T$ to see if at least one structural break exists.[6] The number of breaks is then determined based upon a sequential examination of a test $\sup F_T(l+1/l)$ which tests the null hypothesis of l breaks against the alternative that an additional break exists. The optimal m break dates are such that the test $\sup F_T(l+1/l)$ is not significant for any $l \geq m$.[7]

Note that this test is only slightly different from the structural change test presented in Sect. 7.5.1 in that it does not consider the first lag of the time series considered.

8.6.2 Data and Results

8.6.2.1 Data

Monthly stock returns for Mexico and world markets over the period January 1988–February 2008. Returns include dividend yields and are computed in excess of the 30-day Eurodollar deposit rate.[8] In order to preserve comparability with previous studies, the choice of global, local and integration information variables is mainly drawn from previous works. The set of global information includes a constant, the MSCI world dividend price ratio in excess of the 30-day Eurodollar deposit rate (WDY), the change in the US term premium spread (DUSTP), the US default

[4]A quick look at Fig. 8.1 shows evidence of mean-shift in the dynamics of estimated integration measure.

[5]The estimated coefficient $\hat{\mu}_j$ measures the average integration degree in the regime j.

[6]The hypothesis of no break versus an unknown number of changes given a maximum number of breaks M for m is tested.

[7]For the application of the testing procedure, see Bai and Perron (2003).

[8]Similar results were obtained using the US T-bill as a proxy of the risk-free rate.

premium (USDP) and the change on the month Eurodollar deposit rate (DWIR). The set of local information includes a constant, the Mexican dividend price ratio in excess of the local short-term interest rate (LDY), the change in the Mexican short-term interest rate (DLIR) and the change in industrial production (DIP). The set of integration variables includes a constant, the difference between the world and the Mexican dividend yields (DDY), the difference between the G7 and the Mexican real short-term interest rates (DIR) and the volatility of the exchange rate *vis-à-vis* the US dollar (VER). The data used are obtained from Datastream International and MSCI databases.

8.6.2.2 Time-Varying Degree of Integration

Table 8.1 contains parameter estimates and diagnostic tests. The ARCH and GARCH coefficients reported in Panel B are significant. Panel A shows the mean equation parameter estimates. Panel C presents standardized residual diagnostics. Panel D reports some specification tests. Most information variables are significant. The world and domestic prices of risk are significantly time-varying. On average, they are respectively equal to 3.47 and 2.34. Thus, Mexico is partially integrated into the world market: both global and local risks are priced. Diagnostics of standardized residuals show that compared to returns series, the non-normality is reduced and there is no residual autocorrelation.

Wald test shows that the Mexican degree of integration into the world market is significantly time-varying (Fig. 8.1). The average degree of integration is 57%. Mexico was segmented at the beginning of our sample with a degree of integration on average less than 50%. This market has recently become highly integrated and its degree of integration has exceeded 75% in the last 2 years.[9] This result is intuitive given the removal of all restrictions on foreign direct purchases of non bank stocks and DR listings since mid-1990s and, in particular, the degree of US investor participation in Mexican stocks. Next, we study structural breaks in this degree of integration.

8.6.2.3 Structural Breaks

Table 8.2 summarizes the results of the structural break procedure for $m = 5$ and $= 0.10$. Four break dates are obtained: December 1992, December 1994, May 2001 and December 2005.[10] The detected breaks can be related to important

[9]Adler and Qi (2003), and Carrieri et al. (2007) have shown a higher integration of Mexico in the recent period.

[10]These dates are illustrated in Fig. 8.1. They are precisely estimated since the corresponding confidence intervals cover a few months before and after.

Table 8.1 QML estimates of the model

Panel A: Mean equations					
(a) Price of world risk	Const.	WDY	DUSTP	USDP	DWIR
Price of market risk	0.354^{***}	1.012^{***}	-0.655	0.679^{**}	-0.867^{*}
	(0.023)	(0.234)	(1.098)	(0.367)	(0.411)
(b) Price of Mexican risk		Const.	LDY	DLIR	DIP
Price of Mexican risk		0.405^{**}	-1.156^{**}	-0.044^{*}	-0.542
		(0.189)	(0.427)	(0.031)	(1.067)
(c) Degree of Mexican market integration		Const.	DDY	DIR	VER
Degree of integration		0.201^{***}	0.312^{**}	1.944^{*}	-0.493^{**}
		(0.023)	(0.142)	(1.114)	(0.226)
Panel B: GARCH process					
	Mexico	World			
a	0.103^{***}	0.133^{***}			
	(0.045)	(0.035)			
b	0.597^{***}	0.821^{***}			
	(0.201)	(0.114)			
Panel C: Residual diagnostics					
	Mexico	World			
Skewness	-0.477^{***}	-0.417^{***}			
Kurtosis	1.549^{***}	1.164^{***}			
J.B.	33.393^{***}	34.122^{***}			
$Q(z)_{12}$	7.35	12.62			
$Q(z^2)_{12}$	12.21	13.09			
Panel D: Specification tests					
Null hypothesis	χ^2	df.	p-value		
Is the price of world risk constant?					
$H_0: \quad \delta_{w,j} = 0 \quad \forall j>1$	47.56	4	0.000		
Is the price of Mexican risk constant?					
$H_0: \quad \delta_{d,j} = 0 \quad \forall j>1$	7.75	3	0.043		
Is the degree of integration constant?					
$H_0: \quad \varphi_j = 0 \quad \forall j>1$	76.10	3	0.000		

Notes: *, ** and *** denote significance at 10%, 5% and 1%. QML robust standard errors are in parenthesis. Q is the Ljung-Box test for autocorrelation of order 12 for the standardized residuals and for the squared standardized residuals squared. In order to preserve space, estimates of C (constants in GARCH process) are not reported

economic events. The North-American Free Trade Agreement (NAFTA) negotiation and reduction of capital movement barriers from 1990 to 1994 improved the Mexican market integration. However, the peso was fixed to US dollar, which was incompatible with the high inflation and affected the Mexican economy competitiveness. As a result, Mexico's integration decreased in 1995 due to the crisis and peso devaluation.

The degree of integration has increased since 2001. Several factors may justify a high integration of the Mexican market into the world in the recent period: the improvement of economic and social stability, the institutional reforms, and trade and financial liberalization policies. Also, several multinational enterprises have recently chosen Mexico to extend their activities in the United States.

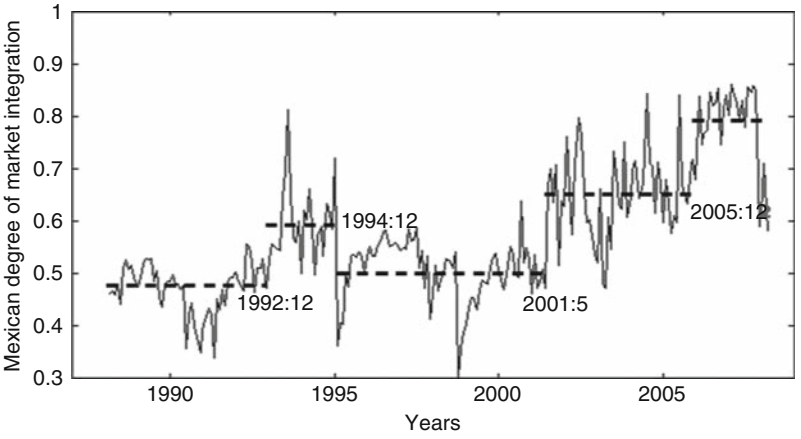

Fig. 8.1 Time-varying Mexico's degree of market integration

Table 8.2 Structural break identification

Break dates	$\hat{T}_1$	$\hat{T}_2$	$\hat{T}_3$	$\hat{T}_4$
	1992:12	1994:12	2001:5	2005:12
	(1992:7-1993:2)	(1994:7-1995:6)	(2000:12-2001:7)	(2005:7-2006:4)
Regression coefficients	$\hat{\mu}_1$	$\hat{\mu}_2$	$\hat{\mu}_3$	$\hat{\mu}_4$
	0.471	0.601	0.504	0.651
	(0.006)	(0.014)	(0.006)	(0.010)
	$\hat{\mu}_5$			
	0.790			
	(0.015)			

Notes: The 95% confidence intervals for the break dates and the standard errors (robust to serial correlation) for coefficients are in parenthesis

8.7 Summary

In the chapter, we have discussed some problems associated with international asset pricing. As investors from different countries face different investment and consumption opportunities, international models should make assumptions regarding market integration and purchasing power parity. So, we have presented some international extensions of the CAPM. The first generation of the International CAPM assumes that investors, regardless of their nationalities, use the same price index to calculate the real returns of different assets. In these models, the optimal portfolio for any investor is a combination of global market portfolio and the domestic risk-free asset. Unlike previous models, these second generation models are more general and include issues related to deviations from the PPP.

Another particularity of international asset pricing is market segmentation. Indeed, the existence of barriers to international investment leads investors to choose different optimal portfolios depending on their country of residence because they have access to different sets of assets or investment opportunities.

These barriers may limit the arbitrage between domestic and foreign assets, and thus drive to the segmentation of national markets. To accurately price financial securities, market segmentation should be taken into account when assessing financial assets in particular in emerging markets.

We also assessed the pricing error when the investor uses the domestic CAPM to price assets while his market in not strictly segmented. Finally, we have used a partial integrated international CAPM to investigate the evolution of the market integration degree of a Latin American emerging market (Mexico) into the world market.

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Chapter 9
International Financial Crisis and Contagion

Abstract This chapter has two main objectives. On the one hand, it proposes a brief investigation and overview of emerging markets within the previous and actual financial crises. On the other hand, this chapter brings a comprehensive discussion on the contagion issue among emerging markets as well as between emerging and developed markets. The empirical investigation of the links between financial crisis and contagion effects enables not only a better understanding of the dynamics of emerging stock prices, but also the assessment of the potential market-deepening linkages.

9.1 Introduction

Previous chapters have shown that diversification benefits tend to decrease in recent years due to their increasing integration into global economic and financial system as a result of their market opening policies (Bekaert and Harvey 1995; Gerard et al. 2003; Carrieri et al. 2007). Substantial increases in cross-market linkages raise an intriguing question of whether emerging market asset class still remains attractive from a foreign investor's viewpoint. The answer to this question is of great importance since higher integration would expectedly leads financial markets to comove closely, and thus diminish the interest of emerging markets. More importantly, international market correlations are likely to rise to very high levels during times of crisis or financial turbulences. Another important issue, also related directly to the increased integration of emerging markets to the global financial system, is the potential of contagion effects resulting from their increased dependences on regional and global factors. Thus, the distinction between fundamentals-based comovements and contagion is a useful exercise as it enables policymakers and investors to protect against harmful impacts of financial contagion. This investigation is particularly relevant to today's international financial crisis because emerging markets continue to experience vulnerabilities to external shocks, albeit they have become more mature and competitive over time. Within this context, this

M. El H. Arouri et al., *The Dynamics of Emerging Stock Markets*,
Contributions to Management Science,
DOI 10.1007/978-3-7908-2389-9_9,

chapter attempts to assess the strength of financial crisis impacts on emerging stock markets by taking the 2007–2009 global financial crisis as a case study. It also discusses the extent of international stock market linkages in crisis times (both short- and long-run relationships), and in that event the major mechanisms of the crisis shock transmission from the US to emerging market economies. Finally, the chapter seeks to detect whether there are contagion effects during the said crisis. The focus is on stock markets of the United States and four emerging markets (Argentina, Mexico, South Korea, and Thailand), and the empirical investigation relies on the use of g a multivariate cointegration model.

Section 9.2 provides an overview of financial crisis effects on emerging market economies. Section 9.3 studies the issue of financial contagion in emerging markets. Section 9.4 discusses empirical results and their policy implications. Concluding remarks are given in Sect. 9.5.

9.2 Financial Crises and Emerging Markets

This section provides a comprehensive review of past crises in emerging market countries and discusses the potential impacts of the current global financial crisis (2007–2009) on the dynamics of their financial markets.

9.2.1 Brief Overview of Past Financial Crises

Emerging countries have further developed their financial markets and considerably strengthened their economic structures over the past decades. However, financial and banking systems in most of these countries still remain extremely vulnerable to systemic risks and sudden shifts in global financial market conditions such as sudden economic downturn, local governance problems, exchange rate crises, changes in investor's risk aversion, and global liquidity. They also have strong dependence on developed markets, especially in terms of capital sources and export activities. For these reasons, financial crises, even those which take roots in developed markets, often induced serious effects on emerging markets.

Since the beginning of the 1980s, emerging market economies have been subject to a number of severe financial crises. The latter have become more frequent in the 1990s and share at least three features that differ from crises in the 1980s:

- Many emerging countries went into crisis with relatively sound economic fundamentals
- Most of the crises were not anticipated
- The impacts of these crises on both financial sector (capital reversals) and economic activity (GDP contractions) were much larger than expected

Among these crises, the Mexican crisis in 1994–1995 and Asian financial crisis in 1997–1998 which have been rapidly spread to other emerging regions are often cited in view of their dramatic effects on macroeconomic and political stability. They particularly induced high liquidity risk and strong fluctuations in foreign exchange markets for most affected emerging countries, and consequently led to excessive price volatility in financial markets, and high public and external debt. Other crisis events in the universe of emerging markets include the Russian crisis in 1998, the Brazilian crisis in 1999, and the Argentina crisis in 2001.

Reinhart and Rogoff (2008) compare financial crises of the last three decades in both emerging and developed markets, and find that the latter have many origins in common: housing and equity price bubbles, rising leverage in terms of both public and external debt, and deterioration of current account balance as a share of GDP. Emerging markets suffer in general from the global crises through the unfavorable impacts of three main factors: the sharp declines in the export prices of raw materials and finished products, the decrease in demand from developed countries and the uncontrolled fall the US dollars as a main currency of pricing for most merchandise trade products of emerging countries.

Indeed, changes in commodity prices have important influences on national revenues of many emerging economies, especially those in Latin American region, as they are highly dependent on exports of raw and primary products. Slowing trajectory of economic growth in developed countries during crisis periods also leads to a reduction of demand for raw materials and finished products from emerging countries, which causes significant decrease in their export revenues. The negative impact is much higher for emerging countries with high degree of dependence on the US economy, particularly when the latter enter in economic recession.

It is equally important to note that crisis effects are generally different from one emerging country to another. For example, some countries with more solid fundamentals such as the Philippines, Taiwan, and Malaysia are less vulnerable to financial crises than South Korea, Kazakhstan, Brazil, and Central European countries (Hungary, Croatia, Lithuania, Romania, and Ukraine). As for the current international crisis from which emerging market economies are not spared, it does also generates another type of economic mess and tensions between developed and emerging financial systems as discussed in the next section.

9.2.2 How Does the Current International Financial Crisis Affect Emerging Market Dynamics?

The subprime mortgage crisis started in July 2007 following massive failures of the US real estate and banking sectors has transformed into an international financial crisis that affects, in the first stage, the most advanced economies in Europe due to their high financial dependences. Through several mechanisms, this crisis gradually

spreads, in the second stage, to emerging areas and seems to set up a new deal for these countries. This observation clearly rejects some specialist expectations that emerging countries are decoupled from the global financial crisis due to their relatively sound economic and financial indicators. Major arguments for decoupling hypothesis are as follows:

- Emerging markets have high growth rates as well as strong trade and fiscal balances
- The actual foreign reserves of emerging markets have reached a new record exceeding three trillions in 2007 compared to only one trillion in 2000, and representing about 72% of the world total reserves

In practice, the recent economic slowdown in the US and major European countries exerts heavy influence on emerging countries, which leads to sharp slump in economic growth and financial markets. For example, China's exports fell by 17.5% in February 2009 from a year earlier while South Korea's exports declined by 32.8% in January 2009. Notice also that the net exports account for one-third of the GDP growth in South Korea and almost half in Thailand.

The current global crisis is transmitted to emerging markets through several channels, of which the most important are:

- First, the rise of inflation and particularly sudden increases in fuel and food prices yields dramatic changes in emerging countries because of their considerable dependence on oil imports
- Second, some emerging countries feel the impact of declines in commodity prices caused by the global recession (i.e., the case of Latin American emerging countries) whereas the others suffer from the sharp decreases in their main exports of finished products and services (i.e., the case of most Asian emerging countries)
- Finally, less dependence on international capital flows does not mean that the impact of the US crisis is not large on emerging markets since the latter experienced higher financial integration with the world financial system during recent periods

From an analytical viewpoint, Caramazza et al. (2004), among others, provide evidence in support the above propositions. As a consequence of financial crisis, they suggest significant reduction of emerging market trade and exports due to the decline in the world demand. According to these authors, emerging markets also face some financial liquidity problems which result from the diminution of capital inflows necessary to finance their economies.

Summarizing all, the effects of the current crisis on emerging markets are significant, but they can be asymmetric as well due particularly to the regional differences. What have been observed is that export-dependent Asian markets seem to be more affected by the crisis than commodity-price dependent Latin American markets. Furthermore, the excess comovement observed during times of crisis is another source of potentially contagion risk, whenever the excess amount cannot be explained by economic fundamentals or past, actual and future expectations about

the degree of emerging market integration with global markets. Together, these assessments point to the emergence of a new puzzle that the efforts made by emerging markets to reduce their dependences on the US economy through developing domestic demands do not permit to spare them from the current global crisis.

The next section focuses on contagion issues in emerging markets within the context of the today's global financial crisis.

9.3 Contagion in Emerging Markets

The cross-market financial linkages constitute a channel through which shocks in the US can be transmitted to emerging markets. The crisis transmission using this channel is particularly immediate thanks to the free mobility of cross-border capital flows, greatly eased by the ongoing process of market openings in emerging countries. Thus, a decline in the US asset prices would lead to lower and more volatile asset prices in emerging markets. As emerging markets are now more open to foreign capitals and they experience higher comovements with world stock markets in recent periods, there is room to expect some rapid and large responses to the original shocks, suggesting some potential of contagion[1].

The discussions as follows focus on contagion definitions and channels with a particular interest on the analysis of finance links between emerging and US stock markets to explore the possibility of crisis transmission.

9.3.1 Contagion Definitions and Factors

In its broadest sense, contagion refers to a situation in which there is spread of financial panics and vulnerability between markets. Other views of contagion are often concerned by the way to detect contagion in financial markets. For example, financial contagion arises when the propagation of crisis shocks from one market to another cannot be explained by changes in fundamentals. Also, contagion occurs when the probability of crisis in a specific country increases given the occurrence of a crisis event elsewhere. Also, contagion can be defined by a significant increase in comovements of international financial markets conditional on the occurrence of a crisis event in one market or a group of markets, but it involves the structural changes in transmission mechanisms of shocks after the crisis. This type of contagion is referred to as shift contagion.

A growing literature has investigated the contagion hypothesis in developed and emerging countries. Their results are, however, often inconclusive due particularly

[1] See, for example, Chen et al. (2002), Johnson and Soenen (2003), Barari (2004), and Fujii (2005).

to the coexistence of different concepts of contagion and to the use of different testing approaches of contagion effects (Kaminsky and Reinhart 2000; Forbes and Rigobon 2002; Corsetti et al. 2005; Yang and Bessler 2008; Chiang et al. 2007).

As far as contagion factors are concerned, there are at least four main factors in addition to the strength of existing economic and financial links across markets (e.g., trade integration, similarities of economic structures, dual listings, cross-market portfolio investment flows, etc.). The first factor is related to the existence of "monsoonal" effects that occur when all countries are affected by a common shock such as oil shocks and sudden shifts in the US interest rates. Spillover effects resulting from usual financial and economic linkages between different countries are viewed as another channel by which a crisis affecting one country is rapidly transmitted to other countries. The third factor that may cause contagion effects is linked to the mimetic behavior of market participants. That is, the decision of a panic investor in a crisis country to withdraw capital could provoke panics in other markets. Finally, geographical proximity contributes significantly to amplify the rapidity and seriousness of contagion effects.

The advent of the global financial crisis in 2007–2008 whose consequences are unprecedented as compared to previous crises raises the question of whether it affects market interdependence and contagion effects between emerging and developed countries. If almost specialists agree with the potential effects, they tend rather to diverge on the magnitude of the effects as well as on the possibility of contagion.

9.3.2 Contagion Effects Within the Current Financial Crisis

Taken together, emerging markets export about 68% of their international trade flows to the USA and the European Union. It is then expected that a major shift in consumption demand of these developed countries would significantly lower economic growth in emerging economies. The latter respond, however, differently to the current crisis. Big emerging countries such as Brazil, China and India have rapidly stimulated internal market demand and accelerated public investments to reduce the economic recession risks and to improve their banking systems. Some European emerging countries that benefited from European Union's economic stimulus plan and those who got into debt in local currency such as Argentina were also able to quickly address the crisis's effects and avoid market crashes. The remaining emerging countries have somewhat to deal with heavy influence of the crisis and experience important changes in their economic and financial systems over the last period.

The potential of contagious effects in emerging markets within the current crisis can be illustrated notably by the wave of economic slowdown, stock market collapse, contractions in international trade activity, and local currency devaluation. For example, the growth forecasts for emerging countries have been largely reduced in a follow-up of serious recession in developed countries, from 5.2% in 2008 to 0.01% in 2009 at a group level according to IMF World Economic Outlook

Table 9.1 IMF's GDP growth projections (in percentage)

	2008	2009	2010
Emerging countries	5.2	0.01	3.2
Emerging Asia	6.3	2.5	5.0
Emerging Europe	4.0	−4.8	0.7
Emerging Latin America	4.0	−1.7	1.6
Emerging Middle East	5.3	0.5	2.4
Emerging Africa	4.8	1.5	3.7
China	9.0	6.5	7.5
India	7.3	4.5	5.6
Developed countries	0.8	−3.8	0.01
US	1.1	−2.8	−0.05
EU	1.1	−4.0	−3.0
World	3.2	−1.3	1.9

Notes: IMF World Economic Outlook, April 2009

in April 2009 (Table 9.1). In two markets of the BRIC group, the projections of GDP growth decrease from 9.0 and 7.3% in 2008 to 6.5 and 5.5% for China and India respectively. As it can be observed, the forecast growth rate varies substantially across emerging regions, but Emerging Asia is expected to provide the best performance, followed by Emerging Africa and Emerging Latin America. Altogether, emerging market economies, being rather victims than origins of this current global crisis, would expectedly constitute a cushion against the deterioration of the global growth outlook.

Obviously, testing and measuring the impacts of the current financial crisis on emerging stock markets from a financial point of view is of paramount importance. To do so, Sect. 9.4 carries out an empirical study of the short- and long-run relationships between the US markets and four of the most important emerging markets (Argentina, Mexico, South Korea and Thailand) in a multivariate cointegration approach.

9.3.3 Contagion Tests and Previous Findings

Empirical tests of contagion can take several forms. The first way consists of comparing the correlation coefficients of financial variables between pre- and postcrisis periods, and a significant increase in cross-market correlations (also referred to as comovement) during the postcrisis period is viewed as evidence of contagion. Some authors test the contagion effects by focusing on the probability of crisis in a specific country increases given the occurrence of a crisis event elsewhere. If this probability significantly increases, there is then evidence to support the existence of contagion effects. Contagion can be also identified by sudden peaks in volatility spillovers from the crisis country to financial markets of other countries. Finally, financial contagion can be investigated on the basis of the increase in cross-market linkages which is not explained by fundamentals using a

conditional asset pricing model or on the basis of extreme correlations among stock markets.

At the empirical results, using International Capital Asset Pricing Model (ICAPM), Bekaert et al. (2005) provide significant evidence of contagion effects during the Asian financial crisis in 1997–1998. More recently, Arouri and Jawadi (2010) extend this methodology by taking into account the exchange risk and the asymmetry characterizing stock returns. The authors examine twenty emerging stock markets and point out significant evidence of contagion effect for most of them particularly during the Mexican and Asian crises.

Corsetti et al. (2005) test the contagion hypothesis around the Hong Kong stock market crisis of October 1997 on the basis of bivariate correlation analysis and do not reject contagion effects in five of 17 sample markets. Using Dynamic Conditional Correlation approach, Chiang et al. (2007) show significant contagion effects among nine Asian emerging countries over the period 1990–2003. Stock market contagion effects between the US and Asian markets are also investigated by Iwatsubo and Inagaki (2007) using NYSE-traded stock issued by Asian firms. The objective is to distinguish between contagion and fundamentals-based comovements. Their empirical results indicate significant bilateral contagion effects in both return and volatility. In particular, it is shown that the intensity of contagion was greater during the Asian crisis than after the crisis, and that the contagion from the US to Asian markets is more important than in the inverse direction.Some studies asymmetrical the contagion hypothesis was tested. Several studies also applied cointegration tools to investigate the contagion relationship between emerging and the world stock markets (See Arouri and Jawadi 2010 and references therein).

9.4 Empirical Investigation

In this chapter, the contagion hypothesis between emerging and the US stock markets around the current global crisis is tested using simultaneously univariate and multivariate cointegration techniques. The main advantage of this modeling approach is that it enables to gauge the financial interdependences between sample markets, and to discuss the magnitude of shock transmission around the current financial crisis based essentially on their integration degree. Unlike attempts of related studies that examine the issue of stock market contagion only on the short-term basis, the focus of this chapter is on both short- and long-run dynamic relationships. It is important to note that the rejection of the cointegration hypothesis is informative of the fact that the US and emerging stock markets are a priori segmented, whereas the validity of a multivariate VAR model suggests further evidence of market comovements and contagion in the short term. More particularly, if the comovements of sample markets are particularly high and cannot be explained by their fundamental-based market interdependences, results are then interpreted as evidence of significant contagion arising from shock transmission during the current financial crisis.

9.4.1 *Data Used and Statistical Properties*

The empirical study employs monthly MSCI stock market indices for four emerging markets (two Latin American markets, Argentina and Mexico, and two Asian markets, South Korea and Thailand) as well as the MSCI US stock market index and the US Industrial Production Index: corrected from seasonal variations. The study period from December 1987 to January 2009 is chosen in order to investigate the effect of the current global financial crisis on emerging stock markets. Data about stock market indices are obtained from Datastream International (Thomson Financial) whereas the US Industrial Production Index is from the Federal Reserve Board database. All data are expressed in US dollars in order to provide homogeneous data and to avoid the effects of currency risk.

Figure 9.1 shows that stock market prices in Asian markets (respectively Latin American markets) evolve together, which may indicate some evidence of regional comovements. Emerging market price indices appear to relatively follow price trends in the US markets much more before the 1994s Tequila effect than after this crisis event. These low linkages can be explained either by the efforts of emerging markets to reduce their dependences on developed countries in general and on the US in particular or by the lack of interest from global investors following

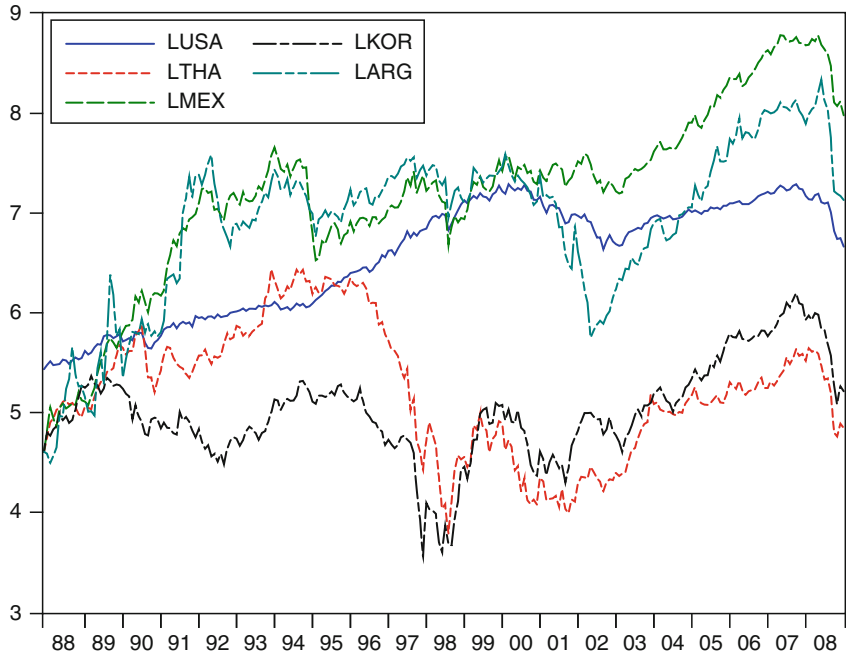

Fig. 9.1 Price movements in emerging and US stock markets
Notes: LUSA, LTHA, LMEX, LKOR and LARG represent the logarithm of price indices for the US, Thailand, Mexico, South Korea and Argentina respectively

Table 9.2 Correlation matrix: December 1987–June 2007

December 1987–June 2007	RUSA	RTHA	RMEX	RKOR	RARG
RUSA	1.00	0.43	0.50	0.36	0.27
RTHA		1.00	0.37	0.50	0.20
RMEX			1.00	0.29	0.43
RKOR				1.00	0.10
RARG					1.00
December 1987–January 2009	RUSA	RTHA	RMEX	RKOR	RARG
RUSA	1.00	0.46	0.54	0.41	0.32
RTHA		1.00	0.41	0.53	0.25
RMEX			1.00	0.33	0.46
RKOR				1.00	0.15
RARG					1.00

Notes: RUSA, RTHA, RMEX, RKOR and RARG denote the continuously compounded returns of the US, Thailand, Mexico, South Korea and Argentina respectively

the Mexican crisis. After the start of the current global financial crisis, all emerging markets have followed closely the US markets and they were plunged into economic recession.

All price series considered are integrated of order one, noted *I(1)*, according to the Augmented Dickey-Fuller (ADF) and Philips-Perron unit root tests[2]. It is then possible to compute the correlation matrix of stock returns for sample markets over two periods: December 1987–June 2007 and December 1987–January 2009. The results reported in Table 9.2 show significant linkages between emerging and the US markets. The interdependence with the US is however higher for emerging markets in Latin America than for those in Asia. More importantly, these linkages have become more apparent and increased when the effects of the current crisis is taken into account. Indeed, correlation coefficients between emerging and US markets range from 27% (Argentina–US) to 50% (Mexico–US) over the first period, while they comprise between 32 and 54% for the same couple of markets over the second period. This finding typically suggests that the current crisis has intensified the comovements of emerging markets with the US, and might lead to some contagion.

Distributional characteristics of the monthly returns are also calculated, but they are not reported here to conserve spaces. Apart the well-known features of emerging markets, the return properties suggest sharp decreases in market returns for all countries considered particularly over the second period.

9.4.2 Contagion Tests

The potential of contagion effects between emerging and US markets is now investigated using cointegration techniques.

[2]These results are available upon request addressed to the authors.

9.4.2.1 Cointegration Tests

Let X_t and Y_t be two variables that are integrated of order one, noted *I(1)*. X_t and Y_t are said to be cointegrated if it is possible to find a stationary linear combination z_t between these two variables so that the following cointegration relationship is satisfied:

$$z_t = X_t - a_0 - a_1 Y_t \tag{9.1}$$

where X_t and Y_t denote the US market index and an emerging stock market index respectively. z_t designates the error term of the cointegration relationship or also called "long-term equilibrium relationship".

In the first step, this long-term relationship is estimated for each couple of emerging-US markets (e.g., Argentina–US, Mexico–US, South Korea–US, and Thailand–US) and the linear cointegration hypothesis is tested in the second step. Tables 9.3 and 9.4 report the findings for both periods.

The null hypothesis relative to the presence of a unit root in the estimated residuals of the long-run relationship is not rejected for all emerging market indices over both periods. These findings reject, as a result, the linear cointegration hypothesis between emerging and US markets. To further check for the robustness of the obtained results, Johansen (1988)'s trace test which permits to simultaneously examine the cointegration relationship and the number of cointegrated relationships between studied markets is also carried out. The hypothesis of linear

Table 9.3 Linear cointegration test: period of December 1987–June 2007

Stock market price index series	ADF (p, model)	Critical value at 5% level
Mexico	−1.69 (1, a)	−3.34
Argentina	−2.39 (0, a)	−3.37
Thailand	−2.27 (0, a)	−3.37
South Korea	−1.21 (0, a)	−3.37

Note: (a) designates a model without constant and linear trend. The order p is the number of optimal lags retained while applying the cointegration test according to the usual information criteria (AIC and BIC) and the autocorrelation functions

Table 9.4 Linear cointegration test: period of December 1987–January 2009

Stock market price index series	ADF (p, model)	Critical value at 5% level
Mexico	−1.87 (0, a)	−3.37
Argentina	−2.53 (0, a)	−3.37
Thailand	−2.40 (0, a)	−3.37
South Korea	−1.79 (0, a)	−3.37

Note: (a) designates a model without constant and linear trend. The order p is the number of optimal lags retained while applying the cointegration test according to the usual information criteria (AIC and BIC)

cointegration is always rejected according to Johansen trace tests. Summarizing all the results provide evidence that emerging stock markets are not cointegrated with the US markets. This consequently implies the absence of contagion effects between the US and emerging countries in the long term.

In what follows, the short-term dynamics of cross-market linkages and contagion potential is analyzed through causality tests.

9.4.2.2 Granger Causality Test

Let X and Y be two random variables. According to Granger (1969), the variable X is said to cause the variable Y if X values provide statistically significant information about the future values of Y. Thus, the causality analysis permits to investigate the dynamic interaction between variables of interest, and causality test in the Granger sense consists of examining the null hypothesis of noncausality against its alternative of causality. This test is particularly useful in that it allows the reproduction of emerging market reactions to a shock affecting the US markets (e.g., the occurrence of the subprime mortgage and banking crisis in July 2007) as well as the empirical detection of any shift contagion (i.e., structural modifications of return comovements over the pre- and postcrisis period).

As before, Granger causality test is also performed over two periods using monthly stock market returns and the main findings, reported in Table 9.5, do not reject the null hypothesis of absence of causality over the period 1987–2007, indicating no significant dependence of selected emerging markets on the US market movements. The only exception is South Korea where the impact of US returns is significant at 10% level. Over the second period, the null hypothesis is clearly rejected for Asian emerging stock markets at 5% (South Korea) and 10% (Thailand) levels, which highlights significant causal effects from the US on emerging market returns. In cases of Argentina and Mexico, there is still no evidence of linkages with the US, albeit test results indicate an improvement in intermarket relationships. Overall, the results witness higher degree of market

Table 9.5 Granger causality test

Stock market return series	*P*-value
Period of December 1987–June 2007	
Mexico	0.64
Argentina	0.35
South Korea	0.10
Thailand	0.17
Period of December 1987–January 2009	
Mexico	0.15
Argentina	0.11
South Korea	0.04
Thailand	0.08

Notes: This table reports the results of the Granger causality test which examine whether stock returns in the US cause changes in emerging markets returns

interdependence over the whole period covering the current crisis. Therefore, a vector autoregressive model (VAR) can be set up to investigate the dynamic adjustments of stock market returns.

9.4.3 Contagion Modeling with VAR Model

The VAR model considered is a 5-variable system which is composed of five return series (four emerging markets and the US stock markets), and the US industrial production index. The latter is introduced to capture the effects of the US recession on emerging stock markets. The short-term market interactions are investigated as follows:

- In the first step, both the lead-lag effects and the causality effects between the US and emerging markets are apprehended through the estimation of the VAR model's parameters
- In the second step, the estimated residuals of the VAR model are employed to compute impulse response functions of a specific market to shocks caused by another market in the system while taking the US return innovations as original shocks

The main advantage of this modeling is to simultaneously reproduce the adjustment dynamics of a vector of return variables (Mexico, Argentina, South Korea, Thailand and the US), and to apprehend the behavior of desired variables as well as their responses to a particular shock which may affect any one of them.

The use of several specification tests to identify the best-fit model for the considered system leads to the selection of a VAR(2) over both sample periods. Estimation results are reported in Tables 9.6 and 9.7 in which only results regarding emerging market indices are presented.

Several interesting facts can be noted:

- First, the dependence toward the US markets is statistically significant but it seems to be notably stronger over the second period because of the financial crisis effects. In addition, the results indicate that changes in the US industrial production index affect negatively and significantly return variations in emerging stock markets, essentially after the crisis.
- Second, according to determination coefficients of the estimated models and information criteria, VAR models appear to be more relevant over the second period. This is indicative of higher causal linkages between markets in the system.
- Finally, the effects of the US stock markets on emerging markets are more important and significant than those from other emerging markets of the same region. This evidence sheds new light on the return spillovers as it suggests that international integration tends to be more apparent than regional integration. It also confirms globally the results of the Granger causality test in that each shock affecting the US stock markets is quickly transmitted to emerging markets at least in the short term.

Table 9.6 Estimation results of VAR(2): period of December 1987–June 2007

	RUSA	RTHA	RMEX	RKOR	RARG
RUSA(−1)	0.051943	−0.059032	0.062899	0.178162	0.473553
	[0.63113]	[−0.24836]	[0.33054]	[0.81021]	[1.51665]
RUSA(−2)	−0.024864	−0.283801	−0.085318	−0.526864	−0.104608
	[−0.30439]	[−1.20300]	[−0.45174]	[−2.41403]	[−0.33755]
RTHA(−1)	−0.046048	−0.022868	−0.037758	−0.000281	−0.029562
	[−1.64305]	[−0.28253]	[−0.58269]	[−0.00376]	[−0.27803]
RTHA(−2)	0.044540	0.241886	0.196970	0.259143	0.082437
	[1.57983]	[2.97075]	[3.02171]	[3.44023]	[0.77073]
RMEX(−1)	−0.006765	0.100328	0.084514	0.087409	−0.042147
	[−0.19360]	[0.99415]	[1.04606]	[0.93622]	[−0.31792]
RMEX(−2)	−0.028994	−0.010159	−0.006072	−0.020653	0.224675
	[−0.83047]	[−0.10075]	[−0.07522]	[−0.22141]	[1.69629]
RKOR(−1)	0.001573	0.063845	−0.017435	0.010814	0.022963
	[0.05488]	[0.77103]	[−0.26301]	[0.14116]	[0.21111]
RKOR(−2)	−0.027027	−0.084388	−0.080181	−0.036098	−0.063586
	[−0.95071]	[−1.02783]	[−1.21985]	[−0.47524]	[−0.58955]
RARG(−1)	−0.013212	−0.024390	−0.004045	−0.041114	0.001576
	[−0.67461]	[−0.43121]	[−0.08933]	[−0.78570]	[0.02121]
RARG(−2)	0.027104	−0.016957	0.012106	−0.020379	−0.091252
	[1.39348]	[−0.30186]	[0.26918]	[−0.39214]	[−1.23662]
C	0.009261	0.008495	0.021856	0.009757	0.017261
	[3.20263]	[1.01723]	[3.26909]	[1.26290]	[1.57345]
RPI	−0.579838	−2.105613	−2.943456	−1.083735	−2.740766
	[−1.27146]	[−1.59872]	[−2.79156]	[−0.88943]	[−1.58413]
R-squared	0.051815	0.063438	0.086485	0.083402	0.038420
Adj. R-squared	0.004405	0.016610	0.040810	0.037572	−0.009659
F-statistic	1.092921	1.354700	1.893463	1.819811	0.799105
Log likelihood	427.1088	181.0548	232.6566	199.1071	117.7658
AIC	−3.578524	−1.457369	−1.902212	−1.612992	−0.911775
BIC	−3.400245	−1.279089	−1.723933	−1.434712	−0.733495

Notes: RMEX, RARG, RUS, RTHA, and RKOR represent respectively stock return series for Mexico, Argentina, the US, Thailand, and South Korea. RPI refers to changes in the US industrial production and serves as exogenous variable. t-statistics are in brackets

Impulsion response functions over the two sample periods can be now estimated through the orthogonalization of the system shocks (standard deviations of a variable innovation) using Cholesky decomposition. A 10-month horizon period is retained to evaluate the responses of system markets to shock issued by a particular market[3]. The original shock to the system is the one issued by changes in the US return innovations.

Figure 9.2 shows that the effect of a US shock on Argentinean stock market is immediate, and its consequences subside after 3 months. For Mexico, the US effect is less important over the first month. However, the US shock has negative effects on Asian markets and is more remarkable for South Korea. It is amortizing and disappears after 4–5 months. In Fig. 9.3, nearly the same effects are observed, but

[3]See Hamilton (1994) for more details.

Table 9.7 Estimation results of VAR(2): period of December 1987–January 2009

	RUSA	RTHA	RMEX	RKOR	RARG
RUSA(−1)	0.139152	0.050019	0.181508	0.257015	0.618717
	[1.67630]	[0.22168]	[0.98941]	[1.22942]	[2.09551]
RUSA(−2)	−0.057996	−0.324333	−0.111079	−0.519498	−0.184990
	[−0.69088]	[−1.42140]	[−0.59876]	[−2.45734]	[−0.61956]
RTHA(−1)	−0.049975	−0.029376	−0.041097	0.007416	−0.050165
	[−1.69415]	[−0.36636]	[−0.63043]	[0.09982]	[−0.47812]
RTHA(−2)	0.048495	0.233738	0.189723	0.248442	0.096271
	[1.63946]	[2.90706]	[2.90229]	[3.33508]	[0.91502]
RMEX(−1)	−0.012409	0.103362	0.067053	0.092210	−0.050311
	[−0.33440]	[1.02474]	[0.81766]	[0.98671]	[−0.38118]
RMEX(−2)	−0.029324	−0.007736	−0.000571	−0.019780	0.222884
	[−0.79191]	[−0.07686]	[−0.00698]	[−0.21212]	[1.69229]
RKOR(−1)	0.003826	0.058323	−0.019507	−0.002750	0.035107
	[0.12664]	[0.71016]	[−0.29216]	[−0.03614]	[0.32668]
RKOR(−2)	−0.008326	−0.048851	−0.050327	−0.006720	−0.023597
	[−0.27786]	[−0.59977]	[−0.75998]	[−0.08905]	[−0.22140]
RARG(−1)	0.001864	−0.010837	0.019589	−0.012168	0.027639
	[0.09064]	[−0.19389]	[0.43107]	[−0.23498]	[0.37789]
RARG(−2)	0.037766	−0.011978	0.019550	−0.019588	−0.075811
	[1.85719]	[−0.21670]	[0.43503]	[−0.38249]	[−1.04815]
C	0.004074	0.002216	0.012574	0.002844	0.008230
	[1.46070]	[0.29232]	[2.04017]	[0.40494]	[0.82966]
RPI	0.164831	−1.281875	−1.472524	−0.257333	−1.109434
	[0.40892]	[−1.16996]	[−1.65304]	[−0.25350]	[−0.77382]
R-squared	0.045126	0.054270	0.060318	0.079221	0.041464
Adj. R-squared	0.001178	0.010743	0.017069	0.036842	−0.002653
F-statistic	1.026799	1.246805	1.394660	1.869348	0.939872
Log likelihood	443.7877	192.7986	244.7543	211.9612	125.3009
AIC	−3.440539	−1.440626	−1.854616	−1.593317	−0.902796
BIC	−3.271992	−1.272079	−1.686069	−1.424769	−0.734248

Note: RMEX, RARG, RUS, RTHA, and RKOR represent respectively stock return series for Mexico, Argentina, the US, Thailand, and South Korea. RPI refers to changes in the US industrial production and serves as exogenous variable. t-statistics are in brackets

several interesting findings need to be mentioned. First of all, the disappearance of a shock originated from the US is longer. This might be due to the current crisis effects. Next, the dependence of Mexico toward the US financial system is more significant after the financial crisis. Finally, the comparison of emerging markets' impulse responses to the US shocks before and after the crisis suggests further evidence of persistence in the disappearance of stock market reactions. It means that the effects of US shocks become more significant over the second period.

In summary, these results show significant short-term linkages between the US market and the emerging stock markets, suggesting that markets are rather linked and interdependent particularly over the period where the subprime mortgage crisis spreads from the US to Europe and emerging markets. The small increase in amount of return spillovers and linkages between the US and emerging markets leads to conclude in favor of only some higher interdependence due to crisis effects, but no contagion. Note also that a test of changes in unconditional correlation coefficients

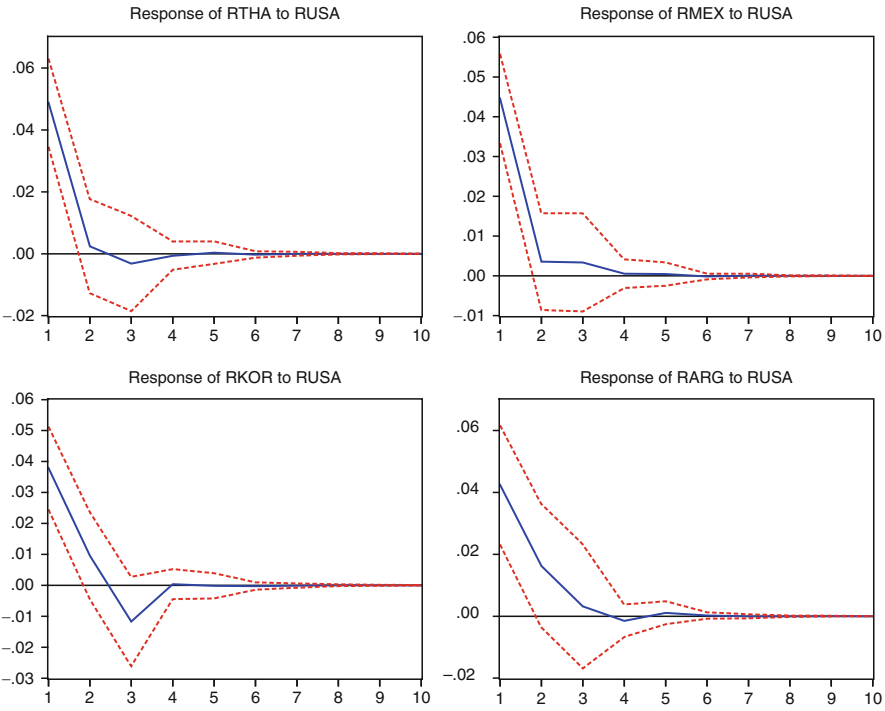

Fig. 9.2 Impulse response functions: period of December 1987–June 2007
Notes: This figure displays the impulse response functions of all considered emerging markets to a shock affecting the US stock markets and industrial production activities over a 10-month period as well as to shocks affecting remaining emerging markets

would provide similar results if the existing links among the US and emerging markets are effectively controlled for.

9.5 Summary

This chapter investigated the dynamics of emerging stock markets within financial crises. After discussing the channels by which previous financial crises affected the financial systems of emerging countries, the extent to which emerging markets are affected by the current global financial crisis originated from the US is examined. In practice, different econometric techniques were used to explore the short- and long-term linkages between emerging and US stock markets as well as the potential of financial contagion around the current crisis.

Using an up-to-date dataset, we globally provided evidence of short-term financial dependences of four emerging markets on the US markets, especially in the aftermath of the subprime crisis and economic recession symptoms. It appears also

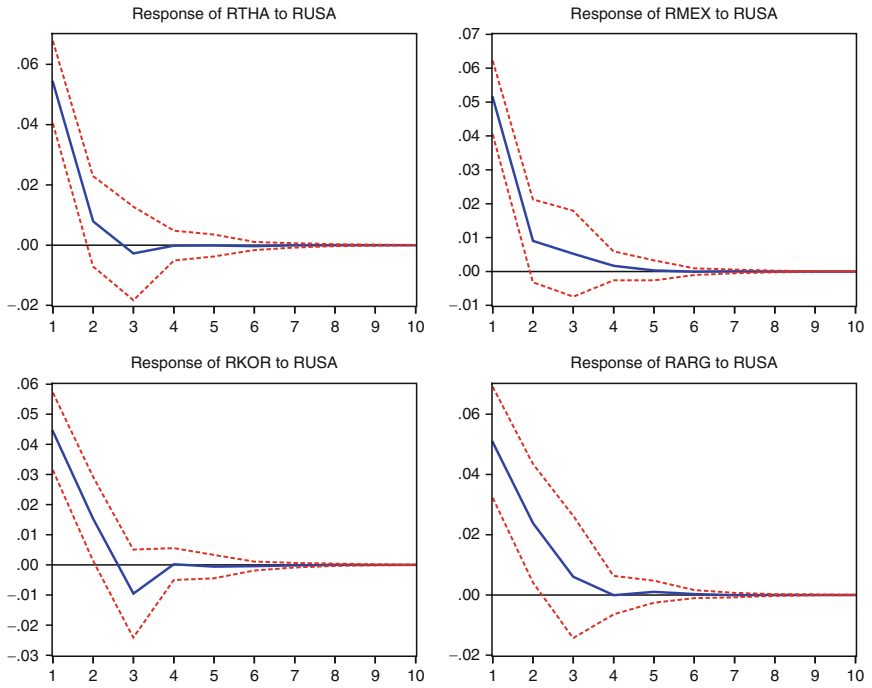

Fig. 9.3 Impulse response functions: period of December 1987–January 2009
Notes: This figure displays the impulse response functions of all considered emerging markets to a shock affecting the US stock markets and industrial production activities over a 10-month period as well as to shocks affecting remaining emerging markets

that the impulse responses of all emerging markets to the US shocks tend to persist more after the occurrence of crisis than before, but the results are rather consistent with the absence of contagion effects given the small magnitude of changes in cross-market linkages.

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