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Dedication

To my mother and father whose hardworking nature remained an inspiration for me!

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All the possible errors or omissions left in the project are my sole responsibility.

Muhammad Jamil

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Chapter 1

Introduction

In the present time, financial markets, whether in the form of stock markets, banks, or forex markets, can play an important role in a country's economic development. Initially, research topics were more concentrated on the comparisons of the various financial markets. Moreover, rather than the existence of the financial markets, current research is more focused on the stability of these financial markets. During the last few decades, researchers have tried to develop new theories, new methods, and new channels to highlight the importance of stability in financial markets. However, from the literature, clear evidence can be found for the existence of controversies about the role of financial markets. These controversies are often referred to unresolved puzzles in the theory of financial markets.

Schumpeter (1912) was one the early investigators who highlighted positive link between financial markets development and economic growth. This link of positive impacts of financial markets to economic growth is not unanimously accepted among the researchers. Various studies reported no link or negative effect of financial markets to economic growth. Apart from this link, another point of conflict among the analysts is about the direction of causality between financial markets and economic growth. Studies provide different bases for the link between financial markets and economic growth: supply leading role of financial markets; demand following role of financial markets; feedback hypothesis; and some of them are emphasizing that a non-existence of the relation between the financial markets and economic growth. Other than this, the development of various types of financial markets has provided base to researchers for comparison of the efficiency of each type of the financial market. With the development of the theories regard-

ing the role of financial markets, researchers also have paid attention to the variations in the returns of the financial markets. The detail about conflicts regarding the role of financial markets is provided in the second chapter which tries to re-evaluate the link by using comprehensive data.

Other than the stock markets and banks; forex market is also one of the financial market for which researchers and policy markets are more concerned about the stability. For this reason, researchers and policy makers have tried various channels. After an effort of more than fifty years, introduction of "Euro" as common currency in the last decade of the twentieth century is a great success in the monetary history. However, impacts of the introduction of the Euro for the European countries are still unclear. In chapter three, we will provide detailed comparison of impacts of the exchange rate volatility before and after the introduction of Euro. The distinction of the study is the cross comparison of countries that have joined European Monetary Union and have not joined European Monetary Union.

Highlighting impacts of the volatility in financial markets without identifying their sources is similar to identifying problem without solution. Discussing about the sources of financial market's volatility, participants in a symposium titled 'Financial Market Volatility' sponsored by Federal Reserve Bank of Kansas city, accepted that it is hard to identify sources of financial markets volatility and they know very little about the sources of financial markets volatility.[1] In the symposium, Robert Shiller and Frederic Mishkin have agreed that very little is known about the determinants of financial market volatility. So far, economists and other researchers simply do not have a proven theory of financial fluctuations. Researchers over the time identify number of fundamental variables as determinants of volatility in financial markets but they are unable to establish consensus for the impact of these fundamental variables. In the fourth chapter we try to highlight im-

[1] For detail see: Financial Market Volatility: A symposium sponsored by The Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, August 17-19, 1988.

pacts of the macroeconomic and financial variables on the volatility of financial markets in Europe.

The layout of following parts is that Chapter 2 highlights the relative importance of banking sector development and stock market development for higher economic growth. Chapter 2 also identifies effects of stock market volatility on economic growth. Chapter 3 deals with the analysis of the impacts of volatility in exchange rate on industrial production. Chapter 4 identifies macroeconomic determinants of exchange rate volatility and stock market volatility. At the end, Chapter 5 summarizes the results of preceding chapters to draw an integrated idea.

Chapter 2

Impact of Financial Markets Development and Stock Market Volatility on Economic Growth: A Dynamic Panel Data Analysis

2.1 Introduction

The increase in the academic literature on the role of financial institutions in economic development provides a clear indication for the importance of the issue.[2] The literature on positive role of financial market development can be traced back to early twentieth century by the writings of Schumpeter (1912). After that, a number of studies tried to analyze the relationship between financial markets development and economic growth. Each of the new studies in the field provide considerable evidence to support one of these arguments: financial institutions development affects economic growth; economic growth affects financial institutions development; whether a two-way relationship exists; whether no relationship exists; or financial markets are unable to contribute significantly to economic growth.[3]

Another critical question that studies have tried to answer is about the type of financial markets that can play more important role for economic development. Some of the authors argue that banks can play a more important role for economic growth, while other authors find support for stock markets contribution in economic growth. Yet, many au-

[2] Financial markets (institutions) refer to banks and stock markets in this chapter.
[3] Detailed review of studies regarding the issues is presented in next section.

thors are of the view that functions of banks and equity markets are different from each other. Therefore, it is safe to say that both play their role for economic growth.

Irrespective of size and liquidity, continued existence and development of stock markets could have important implications for economic activity. Pardy (1992) finds in his seminal work that even capital markets of less developed countries are able to mobilize domestic savings and allocate funds more efficiently. Similarly, Spears (1991) argues that early stages of financial markets have contributed positively to economic growth. On the other hand, Greenwood and Smith (1997) have documented that the stock markets can decrease the cost of mobilizing savings, thus, facilitating investment in most productive technologies. The general observation from the literature is that most of the studies of financial markets impact on economic growth focus only on developed countries. Few studies are based exclusively on developing and emerging countries. Some of them are based on time series data while others utilize small number of emerging economies. According to the reports of *Global Stock Markets Factbook*, equity markets have experienced their most explosive growth over the past few decades and emerging equity markets have experienced an even more rapid growth, taking on an increasing larger share of this global boom. The share of emerging markets increased from less than 9.5% to above 19%, while share of developed countries to world market capitalization decreased from above 90% to less than 81% during 1996 to 2006. So far, research is unable to highlight exact differences in the impacts of financial markets development on economic growth in developed and developing countries.

Despite all the controversies regarding role of financial markets, the literature is also unable to provide satisfactory evidence for the impact of stock price volatility on economic growth. Stock price volatility, in fact, reflects the arrival of new information; which is absorbed by the investors. According to the fundamental valuation models, stock prices respond to the changes in the expectations about the future economy. Therefore, expected changes in the real economy can be traced from changes in the values of stock prices. This instability in economy or frequent changes in policies can cause prices to be even

more volatile. High volatility in the prices can affect investor's decisions regarding savings and long term projects. The literature does not provide satisfactory answers regarding the impact of stock price volatility on economic growth.

The objective of this study is to investigate the impacts of banking sector development, stock markets development, and stock market volatility on the real economy. The paper contributes to the empirical literature in many ways: Firstly, it investigates the direction of causality between financial markets development and economic growth using panel causality tests; Secondly, it investigates the impact of banking sector development on the real economy; Thirdly, it investigates the impact of stock market development on the real economy; and lastly, it investigates impact of stock market volatility on the economic growth. The distinction of this study is the parallel comparison of the impact of banking sector development, stock market development, and stock market volatility on the real economy for high and low income countries.

The structure of the chapter is organized as follows: section 2 provides a brief summary of the theoretical and empirical literature regarding the inter-relationship between impact of the financial markets development, stock market volatility, and economic growth. Issues regarding methodology and data are discussed in the section 3 and section 4 respectively. Section 5, provides results and results discussion. Concluding remarks and some policy suggestions are presented in the last section.

2.2 Review of Literature

A vast literature exists linking financial markets with economic growth. However, a clear difference in opinions regarding importance of the financial markets development for economic growth can be observed. Economists in their theoretical and empirical literature try to cover sources, causes, directions, and strengths of the relationship. To put an emphasis on each part, the present section is divided into three subsections: subsection 2.1 compiles literature regarding direction of relationship between the financial markets de-

velopment and economic growth; subsection 2.2 deals with the argument that whether banking sector is more effective for higher economic growth or equity markets can provide sound base for higher growth; and in the last subsection, discussion regarding impacts of the stock market volatility and economic growth is provided.

2.2.1. Direction of relationship between financial markets development and economic growth

In the literature, the financial markets development is assumed to play a developmental role in the global economies. On the other hand, improvements in the economies are considered to play a crucial role for the financial markets development. Similarly, studies identify various channels through which the financial markets can play a leading role for the economic development, while other empirical studies are unable to find the significant link between financial markets development and real economy. Due to these differences within the existing literature, four main groups of opinions can be found.

First group of studies believe and provide evidence on the "supply leading" role of the financial markets development. That implies that the financial market development is a necessary condition for achieving high rate of economic growth.[4] In one of the initial works on the causal relationship between the financial markets development and the economic growth, Gurley and Shaw (1955) conclude that efficient financial markets can improve the efficiency of trade by enhancing borrower's capacity and hence affect the level of per capita income. The famous statement, "industrial revolution had to wait for the financial revolution" by Bencivenga et al. (1996) is based on the finding that financial markets development through increase in market liquidity play a crucial role for economic growth. Similarly, Schumpeter (1912) states that the well-functioning banks spur technological innovation by identifying and funding those entrepreneurs with the best chances of successfully implementing innovative products and production process. Hicks (1969)

[4] Patric (1966) was the first who used supply leading and demand following hypothesis to explain relationship between financial sector development and economic growth.

finds that the financial system has played a critical role in boosting industrialization in England by facilitating the mobilization of capital for the enormous workers.

Many channels through which financial development can affect economic growth are explored in various studies. Goldsmith (1969) reports positive correlation between growth and indicators of financial development by stating that financial superstructure of an economy accelerates economic growth and improves economic performance to the extent that facilitates the transfer of funds to the best users. Obstfeld (1994) emphasizes that the greater risk sharing through the global diversification make high risk, high return (in domestic and international) projects viable. This leads to the efficient allocation of savings between investment opportunities. According to North (1981), the creation of the stock exchange can increase economic growth by lowering the costs of exchanging ownership rights in the firms; an important part of some institutional stories of economic growth. Guiso et al. (2002) examine various regions of Italy. According to them, the stock markets can also increase incentives to get information about firms and improve corporate governance. They find that local financial development: (i) enhances the probability that an individual starts a business; (ii) increases industrial competition; and (iii) promotes the growth of the firms.

Similarly, Wurgler (2000) documents that countries with a higher level of financial development increase investment more in growing industries and decrease investment more in declining industries than financially underdeveloped economies. Beck (2002) argues that the financial development is much more effective in promoting economic growth in the industrialized economies than in the agricultural economies. Similarly, Levine (1997) and Mishkin (2001) find that a well developed financial system promotes investment by identifying and financing lucrative business opportunities, mobilizing savings, allocating resources efficiently, helping diversify risks, and facilitating the exchange of goods and services. Enisan and Olufisayo (2009), based on an extensive literature review, document various channels through which the financial markets development is seen to be contributing to the economic growth. These channels are: (i) efficient allocation of capital as

the proportion of financial saving in total wealth rises; (ii) mobilization of savings by providing attractive instruments and saving vehicles; (iii) provision of vehicles for trading, pooling and diversifying risk; (iv) lowering of cost of gathering and processing information and thereby improve the allocation of resources; and (v) increased specialization in production, development of entrepreneurship and adoption of new technology. In other studies, Abu-Sharia and Junankar (2003), King and Levine (1993), Holmstrom and Tirole (1993), Agarwal (2001), Rousseau and Sylla (2001), Chen and Wong (2004), Adjasi and Biekpe (2005a), and Deb et al. (2008) have shown empirically that the financial markets development has a significant role and provides an important contribution to economic growth in one way or the other.

The positive impact of the financial development to the economic growth is not common in all the studies. Studies have documented same channels (through which financial development can have positive impact on economic growth) along with various other channels of the financial development that can hurt the economic growth. The argument is that due to the liquidity, stock markets may hurt growth as saving rate may be reduced because of externalities in capital accumulation. Moreover, diffuse ownership may negatively affect corporate governance and invariably the performance of the listed firms thereby, impeding the growth of the stock markets. Demirguc-Kunt and Levine (1996) point out that the increased liquidity may deter growth via three channels: (i) it may decrease saving rates through the income and substitution effects; (ii) By reducing the uncertainty associated with the investments, greater stock market liquidity may decrease saving rates because of the ambiguous effects of uncertainty on savings; and (iii) Stock market liquidity encourages investor myopia, adversely affecting corporate governance (more liquid markets make it easy for dissatisfied investors to sell quickly. Liquid markets may weaken investors commitment and reduce investors' incentives to exert corporate control by overseeing managers, monitoring firm performance, and potential) and thereby reducing growth. Bhide (1993) argues that excessive liquidity may hinder the costly monitoring of managers since shareholders can readily sell their stakes in a firm. Roubini and Martin (1995) find that the growth is negatively correlated with the bank reserve ratio as

a proxy for financial repression that was not likely to be affected by the economic growth.

Second group of studies (relatively smaller than first group) are in favor of causality from economic growth to the financial markets development. Their view called "demand-following" indicates economic development creates demand for financial services and the financial system responds to provide these services. Robinson (1952) declares that "where enterprise leads finance follows." According to this view, economic development creates demands for particular types of financial arrangements, and the financial system responds automatically to these demands. Kar and Pentecost (2000) find that the direction of causality between the financial markets development and economic growth is sensitive to the choice of measurement of financial markets development in Turkey. However, results imply that the strength of causality from financial markets development to economic growth is much weaker than strength of causality from economic growth to financial markets development. Similarly, Stem (1989) and Romer (1990) find that economic growth causes the financial markets development.

Third group of studies view "feedback" hypothesis that favors the existence of two way causality between the financial markets development and the economic growth. The nature of the relationship depends on the stage of economic development. Jung (1986), using annual data of 56 countries and Vector Autoregressive (VAR) framework, reports that using currency ratio proxy suggests that economic growth leads to the financial development, while the monetization proxy suggested that the financial development leads to high economic growth. Demetriades and Hussein (1996) report the existence of bi-directional causality between financial markets development and economic growth for a set of 16 developing countries during different periods. They also conclude that causality patterns have a tendency to vary with countries. Luintel and Khan (1999) study 10 developing economies and find bi-directional causality between financial development and economic growth in all the sample countries. Similarly, Kul and Khan (1999) using Multivariate Vector Auto-Regression (MVAR) document the long run financial intermedia-

tion and economic growth ties featured by a bi-directional causality. Boyd and Smith (1996) using endogenous growth model argue that the financial initiative will affect and be affected from the development of real sector. Shahbaz et al. (2008) analyzing time series data from 1971 to 2006 for Pakistan with the help of Granger causality and Auto-regressive Distributed Lag tests report existence of bi-directional causality between the stock market development and economic growth. Shan and Morris (2002) analyze the relationship between the financial markets development and the economic growth for nine OECD countries and China by estimating a VAR model. The results of their study show that five out of ten countries have a bilateral Granger causality; three of them have reverse causality with economic growth leading to financial development, while two countries do not have a causal effect at all. Dritsaki and Dritsaki (2005) analyzing relationship between the financial markets development and economic growth for Greece using monthly data from 1988 to 2002 show that there is a bilateral causal relationship between the banking sector development and the economic growth. They also find unidirectional causality from economic growth and stock market development. By contrast, no causal relationship between the stock market development and banking sector development is found.

A fourth group of studies believe on "no relation" between the financial markets development and the economic growth. Lucas (1988) concludes that the financial systems do not matter for the economic growth and the financial development simply follows or reflects anticipation of the economic development. In addition, the role of finance is often simply ignored in development economics. Chandavarkar (1992) argues that the development economists frequently express their doubts about the role of the financial system by ignoring it. For example, Stem (1989) in a review of development economics does not discuss the financial system, even in a section that lists omitted topics. Similarly, Mayer (1988) argues that if not much corporate investment is financed through the issuance of equity; the stock markets do not play any part in the economic growth. Singh (1997) also documents no role of financial markets in the process of economic growth.

In light of these conflicting views, the present study tries to determine direction of relationship between the financial markets development and the economic growth using extensive panel data including developed and developing countries. Additionally, study also tries to explore the differences in the impacts due to the differences in the level of per capita income across different groups of the countries.

2.2.2. Banks, stock market and Economic Development

Banking sector based indicators of the financial markets development and equity market based indicators of the financial markets development are interchangeably used in economic literature. Few studies have tried to answer the questions based on these indicators of financial development; which system is better than the other? Are financial systems performing same functions or do they constitute different ways of doing the same thing? Again, the broad literature on the issue can be divided into two main groups.

The first group of studies argues same impact of both types of financial systems on economic growth. Allen and Gale (1999) analyzing five industrial countries (Germany, Japan, France, US, and UK) find that the marginal effects of different financial systems on growth is not strong. Arestis and Demetriades (1998) using division of financial systems into two categories (the bank-based and the equity-market based) find causality between financial intermediation and economic growth is likely to be bi-directional in case of the bank-based systems and bi-directional relationship also cannot be ruled out in the case of equity-market based systems. Similarly, Beck et al. (2001) also document that countries do not grow faster with either market-based or bank-based financial systems. They emphasize that what matters more is the overall level of financial development and the efficiency of the legal system in protecting outside investor's rights in terms of inducing a higher economic growth rate.

On the other hand, a second group of studies report that different types of financial markets provide different services and hence affect the economic growth differently. Theoret-

ical literature report number of benefits of using equity-market based financial system over banks-based financial system: (i) The primary benefit of the stock market is that it constitutes a liquid trading and price determining mechanism for a diverse range of financial instruments; (ii) Stock markets also allow risk spreading by capital raisers and investors and matching of the maturity preferences of capital raisers (generally long-term) and investors (short-term); (iii) While banks finance only well-established and safe borrowers, stock markets can finance risky, productive, and innovative investment projects. Other than these, from the monetary growth perspective a well-developed stock market also provides means for the exercise of the monetary policy through the issuance and repurchase of the government securities in a liquid market. Many studies, for example Levine and Zervos (1993), Atje and Jovanvic (1993), Levine and Zervos (1998), Rousseau and Wachtel (2000), and Beck and Levine (2004), find that both the stock market liquidity and the banking sector development predict future growth rate of the economy when they enter into the growth regression. They conclude that the stock markets provide different services from those provided by the banks.

Due to these conflicting results, present study also tries to evaluate impact of the bank-based financial development and the stock market based financial development on real economy. Study also analyzes relationship using extensive panel data making distinction with respect to income.

2.2.3. Stock market volatility and economic development

The stock market development is a multi-dimensional concept. It is usually measured by size, liquidity, volatility, concentration, integration with the world capital markets, and the legal rules (regulation and supervision) in the market. Along with the other indicators, concern about volatility in the stock market is increased for policy makers and investors during last few decades.

Various studies have tried to explore the relationship between the stock market development and the economic growth across space and time but too few studies have paid atten-

tion to link stock market volatility and economic growth. Studies that try to explore sources of stock market volatility like Aggarwal et al. (1999) document country specific factors like corporate earnings, political, and government decisions tend to be associated with high volatility. Beaulieu et al. (2005) report that political news play an important role in the volatility of stock returns. Mala and Reddy (2007) analyzing time series data for 2001-2005 for 16 firms of Fiji's stock market find that interest rates changes have a significant effect on stock market volatility. Kumar (2007) documents that both short-term and long term volatilities are declining in the Indian stock market and volatility is highest during the declining period. This study also reports that investors are largely responsive to economic fundamentals. Engle et al. (2008) report that, at a daily level, inflation and industrial production growth account for between 10% and 35% of the one-day ahead volatility prediction. Based on this extensive literature, a wide range of variables such as goods prices, money supply, real activity, exchange rate, political risks, oil prices, trade sector, and original stock market indexes may be relevant in explaining the stock market volatility.

In contrast to the considerable attention to the sources of stock market volatility, little attention is paid on the effects of stock market volatility on economic growth. Large fluctuations in the stock prices, which exhibit volatility, affect investor's decision about the choice of the portfolio and hence allocation of capital that will ultimately determine economic growth. The impact of stock market volatility on economic growth is not clear. Singh (1997) views the stock market as an agent that harms economic development due to its susceptibility to the market failure, which is often manifested in the volatile nature of the stock markets in many developing countries. A rise in stock market volatility can be interpreted as a rise in risk of the equity investment and thus a shift of funds to less risky assets. This move could lead to a rise in cost of funds to firms and thus new firms might bear this effect as investors will turn to purchase a stock in larger and well known firms. On the other hand, in a detailed study of 48 countries (1973-1993) Levine and Zervos (1998), report stock market size, volatility, and international integration are not robustly linked with economic growth along with positive impact of the market liquidity on

economic growth. However, Campbell et al. (2001) show that stock market volatility helps to predict GDP growth.

Again, due to conflicting and missing linkage between stock market volatility and economic growth, the current study tries to fill the gap using panel causality tests. Study also tries to examine impact of stock market volatility in the high and low income countries separately. In the next section, we will present methodological issues regarding the testing of the hypotheses mentioned in subsections 2.2.1, 2.2.2 and 2.2.3.

2.3 Methodology

2.3.1. Panel Causality Test

The study employs Fisher-type test for unit root proposed by Maddala and Wu (1999) and Choi (2005). Under the null hypothesis of unit root Fisher-type test combines the p-values from the unit root tests for each cross-section i. One of the main advantages of this test is that it can be applied for finite as well as for infinite cross-sectional dimensions along with the different time series dimensions. Another advantage of the test is that each group can have different types of non-stochastic and stochastic components.[5]

Furthermore, study employs causality test based on panel data developed by Hurlin and Venet (2001) and Hurlin (2007) to address the direction of causality between indicators of the financial markets development and the economic growth. Model is the extension of the null hypothesis of standard Granger model: knowing the previous values of the independent variable x provides no new information about the current value of the dependent variable y, which is not already contained in the previous values of y i.e., $\left[E\left(y \mid y_{t-k}\right) = E\left(y \mid y_{t-k}, x_{t-k}\right)\right]$. Simple form of the model for causality test based on panel data can be represented as follow:

[5] For detail comparisons of unit root tests see Baltagi (2008).

$$y_{it} = \alpha_i + \sum_{k=1}^{p} \gamma^{(k)} y_{i,t-k} + \sum_{k=1}^{p} \beta_i^{(k)} x_{i,t-k} + \nu_{i,t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.1)$$

Where y_{it} is the dependent variable, α_i represents fixed effects, $\gamma^{(k)}$ represents the auto-regressive coefficients, $\beta^{(k)}$ represents regression coefficients, and $\nu_{i,t}$ represents the error term that satisfy the conventional assumptions.[6] First lag ($k = 1$) of the dependent and explanatory variables is used to estimate the model and testing the hypothesis that x does not cause y for any cross-section $\left[E\left(y_{i,t} \mid y_{i,t-1}, \alpha_i\right) = E\left(y_{i,t} \mid y_{i,t-1}, x_{i,t-1}, \alpha_i\right)\right]$. A test statistic is constructed by comparing the sum of squared residuals from a restricted model (RSS_1) to the sum of squared residuals produced by a baseline unrestricted model (RSS_2). Similar to traditional Granger causality test, the unrestricted model includes lags of the dependent variable $y_{i,t-k}$, lags of the independent variables $x_{i,t-k}$ and the fixed effects themselves α_i to predict current values of $y_{i,t}$. On the other hand, in restricted model slope coefficients of the lags of independent variables are constrained to zero $\beta_{i,t-1} = 0$, leaving only the unit specific effects and lags of the dependent variable to predict current values of $y_{i,t}$. The test statistic to determine the presence of causality (F) is calculated as:

$$F = \frac{\left(RSS_1 - RSS_2\right)/Np}{RSS_2 / \left[NT - N(1+p) - p\right]} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.2)$$

Where, N is the number of cross-sections, p is the number of lags, and T is the number of time periods. An insignificant statistic for this test indicates that x does not cause y in any cross-section. In similar way to test, whether y causes x in any cross section, same procedure is repeated by taking x as the dependent variable and y as the independent variable.

[6] For detail background and extensions of the test Hood et al. (2008).

2.3.2. Arellano-Bond Model

Present literature in Economics identifies three major sources: labors, capital, and technological progress as determinants of the level of GDP per capita (GDPPC) in any economy. In order to establish link between the financial markets development and the real economy, let us assume the economies featured by an aggregate production function; where output $y_{i,t}$ is produced during period t by country i can be defined as:

$$y_{it} = f(k_{it}, X_{it}, FMD_{it}) \quad \text{..... (2.3)}$$

Where k_{it} is the capital per unit of labor of country i in period t; X_{it} represent control variables, and FMD_{it} is the level of financial market development of country i in period t. The FMD_{it} represents banking sector development indicators ($BSDI_{it}$) and stock market development indicators ($SMDI_{it}$). Because of the dependency of GDP per capita on its previous values, Dynamic Panel Data Model ($DMPD$) is used for the analysis.

$$Y_{i,t} = \alpha_i + \gamma Y_{i,t-1} + \beta X_{i,t} + \phi FMD_{i,t} + \varepsilon_{i,t} \quad \text{..... (2.4)}$$

Where α_i are fixed effects, $X_{i,t}$ is a vector of control variables, and $\varepsilon_{i,t}$ is the random disturbance. A problem with estimating equation (2.4) is that time-invariant country characteristics α_i may be correlated with the explanatory variables. Moreover, $FMD_{i,t}$ might also be endogenous because causality may run in both directions; from the financial markets development to economic growth and vice versa. Another problem of the autocorrelation can arise because of the presence of the lagged dependent variable $Y_{i,t}$.

Estimating a fixed effect model by Least Square Dummy Variable (LSDV) in the presence of lagged dependent variable generate biased estimate of the coefficients. Several estimators have been proposed to estimate equation (2.4) without bias. To cope with the

problems of endogenity between the financial markets development indicators and economic growth study employ Arellano and Bond (1991) difference GMM estimator first proposed by Holmstrom and Tirole (1993). Arellano-Bond model along with exogenous instruments, lagged levels of the endogenous regressors, and the first differenced lagged dependent variable are also added as instruments. Lagged levels of endogenous regressors make the endogenous variables pre-determined and therefore, not correlated with the error term. The first differenced lagged dependent variable as instrument help to remove the autocorrelation. Another incentive of using Arellano-Bond model is that estimator is designed for small-T large-N panels.

2.4 Data

The unbalanced panel data of seventy-six countries from 1980 to 2006 is used for analysis of the economic and financial variables.[7] The choice of countries is determined primarily with the availability of data using common data source. To assess causality between the indicators of financial markets development and economic growth and the impact of the indicators of financial markets development on the real economy using methodology mentioned in previous section, we need:

i. Empirical indicators of stock market development
ii. Empirical indicators of bank sector development
iii. Empirical indicators of stock market volatility
iv. Empirical indicators of economic growth and its components.

2.4.1. Empirical Indicators of Stock market Development

Out of many potential indicators of the stock market development (SMDI), one measure for representing stock market size and two measures for representing stock market liquid-

[7] List of countries along with income groups is presented in Appendix A-I.

ity are taken for analysis. Although each of these indicators has shortcomings, using a variety of the measures provides a richer picture of the ties between the stock market development and economic growth. Unbalanced annual data for seventy-six countries ranging from 1980-2006 of these measures of the stock market development indicators in US$ is taken from *Emerging Stock Markets Factbook* (various issues) and *Global Stock Markets Factbook* (various issues). Detail about these measures of stock market development is presented as below:

2.4.1.1. Market Capitalization Ratio

Size of the stock market compared to size of the economy is measured by market capitalization to GDP ratio (MCR), whereas, market capitalization is defined as the value of the listed domestic shares on the domestic exchanges. Although large markets do not necessarily function effectively and taxes may distort incentives to list on the stock exchange, many observers still use capitalization ratio as an indicator of market development. It is expected that market size is positively correlated with the ability to mobilize capital and diversify risk on an economy-wide basis, hence to real economy.

2.4.1.2. Trading Value Ratio

The Trading Value Ratio (TVR) is obtained by the division of total value of the domestic shares traded on the domestic exchange and GDP. The total value traded complements the market capitalization: although a market may be large, there may be little trading. The TVR represents organized trading of the firm equity as a share of the national output and therefore should positively reflect liquidity on an economy-wide basis.

2.4.1.3. Turnover Ratio

The Turnover Ratio (TOR) is used as second measure of liquidity of stock market in the study. It equals the total trading values of domestic shares on domestic exchanges divided by market capitalization. Though it is not a direct measure of theoretical definitions of liquidity, high turnover is often used as an indicator of low transaction costs. The turnover ratio complements the market capitalization ratio and trading value ratio. A large but

inactive market will have a large market capitalization ratio but a small turnover ratio. On the other hand, the trading value ratio captures trading relative to the size of the economy but turnover measures trading relative to the size of the stock market. A small liquid market will have a high turnover ratio but a small trading value ratio.

2.4.2. Empirical Indicators of Banking Sector Development

The banking sector development indicators (BSDI) incorporate size, domestic asset distribution and relative importance of banking sector. Beck et al. (2000) has constructed a large cross-country, time-series database on financial structure for up to 150 countries from 1960 to 95. Later on, Beck and Levine has updated data for these financial variables up to 2007. In the present study, all the variables representing bank-sector development are taken from Beck et al. (2008). Similar to the measures of stock market development, measures of the bank-sector development also have shortcomings. Detail about each measure of the bank-sector development is presented as under:

2.4.2.1. Financial Depth

The size of the financial intermediary relative to the economic activity is the representative of the measure of financial depth. A common measure have been used for the financial depth in literature is Liquid Liability Ratio (LLR). It equals the ratio of liquid liabilities of the deposit money banks (currency held outside the banking system plus the demand and interest-bearing liabilities of banks and nonbank financial intermediaries) to GDP. The users of LLR assume that the size of the financial intermediaries is positively related to the provision of the financial services.

2.4.2.2. Relative Importance of Banks

Similar to King and Levine (1993), we can breakdown financial institutions between the central bank and the deposit money banks. In this way the relative importance of the banking sector is measured by the ratio of domestic assets of deposit money banks to deposit money plus central bank domestic assets (DBACBA). Intuitively, banks seem more

likely to provide the type of risk sharing and information services. Problem with this indicator of the bank-sector development is that it does not measure to whom the financial system is allocating credit.

2.4.2.3. Measure of Domestic Asset Distribution

The financial system that simply funnels credit to the government or to the state-owned enterprises may not be evaluating managers, selecting investment projects, pooling risk and providing financial services to the same degree as financial systems that allocate credit to the private sector. Thus, we compute credit allocated to private enterprises by deposit banks relative to the size of the economy (PCRDBGDP). This measure may reflect the overall size of the public sector and the degree of public sector borrowing; therefore, it may not accurately indicate the level of financial services. Nevertheless, we include this broad array of financial indicators to maximize the information on bank-sector development in our study.

2.4.3. Empirical Indicators of Stock Market Volatility

The standard deviation of stock market returns (SDSMR) is considered to be an effective measure of stock market volatility. Researchers and financial analysts have widely used standard deviation or variance to measure volatility. An annual measure of stock market volatility σ_{it} is obtained from monthly returns of the stock market R_{itm} calculated from stock market total return index (SMTRI).

$$R_{itm} = \frac{SMTRI_{itm} - SMTRI_{i,tm-1}}{SMTRI_{i,tm-1}} \quad \text{..... (2.5)}$$

and

$$\sigma_{it} = \sqrt{\frac{1}{12}\sum_{m=jan}^{Dec}\left(R_{itm} - \overline{R}_{it}\right)^2} \quad \text{..... (2.6)}$$

Where $i = 1,2,3,\ldots,N$ represent countries; $t = 1,2,3,\ldots,T$ represent years; m represents months within period t; R_{imt} represents return of country i, in period t, and in month

m; $SMTRI_{itm}$ represents stock market total return index of country i in month m of period t; σ_{it} represents volatility (standard deviation) of stock market return of country i in period t; and $\bar{R}_{it}$ represents average of monthly returns over the year t for country i.

The measure of stock market volatility is expected to affect the economic growth negatively as volatility can hamper by affecting decisions of allocation of resources. Unbalanced monthly data of SMTRI for seventy-six countries ranging from 1993:1 to 2006:12 is taken from *Emerging Stock Markets Factbook* (various issues) and *Global Stock Markets Factbook* (various issues).

Risk in the stock market return will not be bad if it is generating sufficient higher returns for the compensation. Due to this, another measure that can be used as the indicator of stock market volatility is the coefficient of variation of stock market returns (CVSMR) calculated as the ratio of $\bar{R}_{it}$ and σ_{it}. The CVSMR can appear with the positive as well as with the negative sign depending upon the level of the compensation of return to risk.

2.4.4. Empirical Indicators of Real Economy and Its Components

The growth rate of GDP per capita (GGDPPC) is used as the indicator of the economic growth to check the direction of causality among financial development indicators, stock market volatility, and economic growth. A consistent annual data series of GGDPPC for seventy-six countries ranging from 1980-2006 is obtained from World Bank data base, *World Bank Development Indicators* (CD-ROM 2008).

Like many other studies, the present study used logarithmic value of GDP per capita (LGDPPC) at constant dollar price of 2000, as the representative of real economy. It is believed that variables other than stock market development and bank-sector development could have great impact on LGDPPC. The omission of these variables could create bias in results of impact of financial markets development on the level of GDPPC. In this view, we include three main variables in regression: logarithmic value of capital to labor

ratio (LKL); trade to GDP ratio (TRGDP); and foreign direct investment to GDP ratio (FDIGDP). Capital stock is calculated from investment (gross fixed capital formation) by perpetual inventory method. Data of economic variables; GDP, GDP Per Capita, exports, imports, and foreign direct investment in US$, for seventy-six countries ranging from 1980–2006, is obtained from World Bank data base *World Bank Development Indicators* (CD-ROM 2008).

2.5 Results and Results Discussion

Using methodology that is presented in section 2.3 and unbalanced panel data that is described in section 2.4, now we will present results in the current section. In section 2.5.1, we will present results regarding causality tests between the financial markets development indicators and the economic growth. In section 2.5.2 we will present results of impact of financial markets development indicators on level of economy, based on the Arellano-Bond model.

2.5.1. Causality tests between FMDI and economic growth

Tests of stationarity for the economic growth and financial variables with the help of EViews indicate that all the variables are integrated of order zero.[8] Thus, under the null hypothesis: FMDI does not cause economic growth for all the cross sections; and economic growth does not cause FMDI for all the cross sections; causality tests have been conducted. Furthermore, F-statistics along with P-values about the causality between the FMDI and economic growth for overall, developed, and developing countries is presented in Table 2.1.

Interesting findings are extracted when we decomposed data into the subcategories of high and low income countries. Admittedly, the MCR appears to be uni-directionally

[8] Results of stationarity tests are presented in Appendix A-II.

related with the economic growth in case of the high income countries, while bi-directionally related with the economic growth in case of the developing countries. In

Table 2.1: F statistics of Causality Test

Null Hypothesis	Overall		Developed Countries		Developing Countries	
GGDPPC Does not Cause MCR	0.79	[0.9060]	0.93	[0.5908]	1.65	[0.0327]
MCR Does not Cause GGDPPC	2.51	[0.0000]	2.11	[0.0002]	2.29	[0.0008]
GGDPPC Does not Cause TVR	1.34	[0.0302]	1.70	[0.0078]	1.80	[0.0149]
TVR Does not Cause GGDPPC	1.83	[0.0000]	0.72	[0.8840]	3.31	[0.0000]
GGDPPC Does not Cause TOR	1.64	[0.0005]	1.86	[0.0018]	1.74	[0.0210]
TOR Does not Cause GGDPPC	1.93	[0.0001]	2.24	[0.0000]	1.46	[0.0833]
GGDPPC Does not Cause LLR	1.39	[0.0187]	1.26	[0.1456]	2.00	[0.0066]
LLR Does not Cause GGDPPC	2.45	[0.0000]	2.16	[0.0001]	1.60	[0.0423]
GGDPPC Does not Cause DBACBA	2.35	[0.0000]	2.95	[0.0000]	2.33	[0.0006]
DBACBA Does not Cause GGDPPC	2.34	[0.0000]	1.30	[0.1190]	1.53	[0.0575]
GGDPPC Does not Cause BDGDP	1.34	[0.0321]	1.17	[0.2352]	1.49	[0.0798]
BDGDP Does not Cause GGDPPC	2.20	[0.0000]	2.11	[0.0002]	1.89	[0.0090]
GGDPPC Does not Cause PCRDBGDP	2.40	[0.0000]	1.77	[0.0048]	1.77	[0.0215]
PCRDBGDP Does not Cause GGDPPC	2.08	[0.0000]	1.92	[0.0012]	1.35	[0.1330]
GGDPPC Does not Cause CVSMR	0.86	[0.7863]	0.74	[0.8458]	0.79	[0.7383]
CVSMR Does not Cause GGDPPC	1.77	[0.0001]	2.43	[0.0000]	1.44	[0.0974]
GGDPPC Does not Cause SDSMR	0.78	[0.9405]	0.39	[0.9991]	1.21	[0.2432]
SDSMR Does not Cause GGDPPC	1.13	[0.2160]	1.45	[0.0510]	0.74	[0.7960]

a) Abbreviations used: GGDPPC = Growth rate of GDP per capita, , MCR = market capitalization ratio, TVR = trading value ratio, TOR = turnover ratio, LLR = Liquid liability ratio, DBACBA = domestic bank assets to central bank assets ratio, BDGDP = bank deposit to GDP ratio, PCRDBGDP = Private credit by domestic bank to GDP ratio, SDSMR = Standard deviation of Stock Market Return, CVSMR = Coefficient of Stock Market Returns.
b) Values in square-brackets are P-values.

addition, all the other SMDI show two-way causality. The indicators of bank-sector development showed mixed results for developed countries: uni-directional causality from BSDI to economic growth when BSDI are presented by LLR and BDGDP; uni-directional causality from economic growth to BSDI when BSDI is presented by DBACBA; and bi-directional when BSDI is presented by PCRDBGDP. On the other hand, causality appears to be bi-directional in case of developing countries for all the BSDI except for PCRDBGDP, where uni-directional causality from banking sector development to economic growth is observed. Moreover, volatility in stock market, measured by CVSMR, indicates volatility in markets cause economic growth in developed and devel-

oping countries. However, the volatility in market does not affect the economic growth in case of the developing countries when it is measured by SDSMR.

2.5.2. Impact of BSDI and SMDI on GDP per capita

Due to the endogenous relationship between FMD and economic growth, Arellano-Bond type GMM model is used for estimation purpose. The results based on this are presented in table 2.2. Combinations of three proxies of the banking sector development (DBACBA, LLR, and PCRDBGDP), three proxies of the stock market development (MCR, TVR, and TOR), and two proxies of the stock market volatility (SDSMR, CVSMR) help us to obtain results for fifteen different specifications. In each specification, three control variables (LKL, TRGDP, and FDIGDP) are used.

In each regression, some of the countries are dropped from the analysis because of unavailability of data for any of the variables. Overall significance of χ^2 indicates that the models are good fit. Clearly, logarithmic value of GDP per capita is significantly affected by its lag values in all the cases. The coefficients of control variables, LKL and TRGDP are positive and significant in all the cases, indicating increase in the capital labor ratio and openness of the economy contribute positively to economic growth. Coefficient of another variable, FDIGDP that is used as the control variable, is positive but insignificant in most of the cases. This indicates that the foreign direct investment does not significantly contribute to the level of per capita income.

The results of impacts of the banking sector development on GDP per capita, from the available indicators of banking sector development, are not providing unique conclusion. On the one hand, positive and significant coefficients of the DBACBA indicate that DBACBA contribute positively to economic growth. On the other hand, coefficients of LLR appear to be negative and significant indicating that LLR hampers the LGDPPC. However, the contradicting result of LLR might be due to inclusion of various categories of countries at the same time in regression. Similarly, coefficients of the PCRDBGDP are negative and significant in all the cases, indicating private credit allocated by domestic

Table 2.2: Impact of BSDI and SMDI on GDPPC in overall panel of all countries

Independent Variables	Regressions														
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
LGDPPC(-1)	0.8998	0.9027	0.9183	0.8153	0.8149	0.9263	0.9250	0.9311	0.9201	0.9398	0.9284	0.9285	0.9337	0.8762	0.8879
	(77.33)***	(73.64)***	(79.76)***	(27.55)***	(26.82)***	(71.9)***	(70.91)***	(71.37)***	(38.16)***	(37.55)***	(68.73)***	(68.57)***	(69.24)***	(25.83)***	(25.36)***
LKL	0.0134	0.0149	0.0109	0.0679	0.0705	0.0165	0.0161	0.0152	0.0300	0.0239	0.0150	0.0146	0.0140	0.0634	0.0643
	(2.65)***	(2.90)***	(2.15)**	(4.61)***	(4.66)***	(3.81)***	(3.74)***	(3.50)***	(3.10)***	(2.36)**	(3.47)***	(3.40)***	(3.22)***	(4.64)***	(4.55)***
TRGDP	0.0374	0.0432	0.0491	0.0641	0.0706	0.0411	0.0541	0.0613	0.0615	0.0692	0.0413	0.0545	0.0642	0.0613	0.0664
	(3.76)***	(4.39)***	(4.96)***	(4.45)***	(4.78)***	(4.45)***	(6.06)***	(6.80)***	(4.54)***	(4.93)***	(4.41)***	(6.05)***	(7.08)***	(3.96)***	(4.16)***
FDIGDP	0.0143	0.0205	0.0378	0.0212	0.0217	0.0420	0.0531	0.0756	0.0491	0.0421	0.0444	0.0555	0.0798	0.0378	0.0424
	(0.55)	(0.78)	(1.46)	(0.44)	(0.44)	(1.67)*	(2.12)*	(3.03)*	(1.06)	(0.88)	(1.76)*	(2.22)**	(3.20)***	(0.76)	(0.82)
DBACBA	0.0820	0.0920	0.0957	0.1067	0.1185										
	(5.88)***	(6.7)***	(6.84)***	(4.87)***	(5.27)***										
LLR						-0.0353	-0.0322	-0.0193	-0.0500	-0.0614					
						(-2.79)***	(-2.55)**	(-1.51)	(-2.30)**	(-2.72)***					
PCRDBGDP											-0.0259	-0.0269	-0.0176	-0.0525	-0.0639
											(-3.11)***	(-3.24)***	(-2.10)**	(-3.46)***	(-4.09)***
MCR	0.0282					0.0279					0.0287				
	(6.74)***					(8.39)***					(8.75)***				
TVR		0.0213					0.0237					0.0251			
		(4.84)***					(6.86)***					(7.35)***			
TOR			-0.0001					-0.0002					-0.0002		
			(-2.1)**					(-3.32)***					(-3.82)***		
SDSMR				-0.0018					-0.0021					-0.0019	
				(-7.08)***					(-8.89)***					(-7.65)***	
CVSMR					0.0094*					0.0103					0.0096
					(3.54)					(3.75)***					(3.50)***
Wald Chi^2	32946	31930	31362	7179	6781	31979	31065	30435	6586	6076	31926	31066	30431	5882	5483
Prob> Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. of Obs	1440	1428	1424	635	635	1405	1394	1390	616	616	1402	1391	1387	616	616
No. of Groups	74	74	74	73	73	71	71	71	71	71	71	71	71	71	71
Obs. Min	5	5	5	4	4	8	8	8	4	4	8	8	8	4	4
Obs. Max	25	25	25	13	13	25	25	25	13	13	25	25	25	13	13

a) Dependent variable: LGDPPC
b) Abbreviations used: LGDPPC = log of GDP per capita, LKL = log of capital labor ratio, TRGDP = trade to GDP ratio, FDIGDP = Foreign direct investment to GDP ratio, DBACBA = domestic bank assets to central bank assets ratio, LLR = Liquid liability ratio, PCRDBGDP = Private credit by domestic bank to GDP ratio, MCR = market capitalization ratio, TVR = trading value ratio, TOR = turnover ratio, SDSMR = Standard deviation of Stock Market Return, and CVSMR = Coefficient of Stock Market Returns.
c) Values in the parentheses are the Z-statistics except for Wald Statistics which are P-values: ***,**, * significant at 1%, 5%, and 10% respectively.

banks are not used properly in most of the cases. Findings based on PCRDBGDP supports the findings of Shen and Lee (2006), who has reported negative impact of banking sector development on economic growth. On the other hand, other indicators of banking sector development show results similar to the findings of Levine and Zervos (1993), Atje and Jovanvic (1993), Levine and Zervos (1998), Rousseau and Wachtel (2000), and Beck and Levine (2004) who has reported positive impact of the banking sector development on economic growth.

In each specification of the regression equation, along with BSDI one variable for SMDI and one variable of stock market volatility is also used. In the results, indicators of stock market development (MCR, TVR) are positive and significant in all the specifications. This indicates that depth of the equity market as well as liquidity of the equity market contributes positively to economic growth. Moreover, coefficient of TOR appears to be negative and significant in all the cases. The results match with the findings of Nowbutsing (2009), Abu-Sharia and Junankar (2003), and Levine (1997).

Along with these measures of banking sector development, this study also employ measures of stock market volatility. Naturally, negative and significant coefficients of the SDSMR indicate that the increase in the stock market volatility hampers the economic growth. On the other hand, positive and significant coefficients of the CVSMR indicate that the impact of stock market volatility will be positive when each extra unit of market volatility is compensated with higher returns in the markets. The negative impact of stock market volatility on economic growth is very much similar to the findings of Campbell et al. (2001), Levine and Zervos (1996a), Levine and Zervos (1996b), and Arestis et al. (2001).

2.5.3. Impact of BSDI and SMDI on GDP per capita in developed and developing countries

To check whether or not a country's level of development can change the impacts of banking sector development, stock market development, and stock market volatility on

the GDP per capita, we separately estimate effects for the group of higher income countries and for the group of the lower income countries.[9] The results are presented in tables 2.3 and 2.4.

Various differences in findings are observed while analyzing different income groups separately. Again, the coefficients of lag of the logarithmic value of GDP per capita are positive and significant in all the cases, indicating that last year value of the GDP per capita contribute positively to the current year value for low and high income countries. Similarly, coefficients of capital labor ratio appear to be positive and significant in all the cases except when regressions are regressed with volatility of stock market returns. A possible reason of contradictory result can be the less number of observations available in each regression when regressed with indicators of stock market volatility.

The magnitudes of the coefficients of LKL are bigger for the low income countries, indicating that capital is more productive in low income countries. However, in low income countries trade appeared to be insignificant in most of the cases while in some cases it shows negative impact on GDP per capita. On the other hand, trade appears to be beneficial for GDP per capita of high income countries. The coefficients of foreign direct investment for high income countries are positive indicating that high inflow of foreign investment is linked with high GDP per capita in most of the cases, while in some cases it remain insignificant. On the basis of results of all the regressions of low income countries, it can be stated that foreign direct investment is productive for the GDP per capita in low income countries.

Moreover, the coefficients of indicators of the banking sector development show mixed results for high and low income countries. The coefficients of DBACBA are positive and

[9] Ranking of countries is based on the World Bank ranking. However, group of upper middle income countries is merged in the group of high income countries, group of lower middle income countries is merged in the group of low income countries, and group of middle income countries is excluded from analysis.

Table 2.3: Impact of BSDI and SMDI on GDPPC in panel of high income countries

Independent Variables	Regressions														
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
LGDPPC(-1)	0.8956 (105.29)***	0.8995 (101.88)***	0.9207 (109.65)***	0.9926 (31.07)***	1.0067 (30.8)***	0.9163 (105.32)***	0.9109 (104.26)***	0.9139 (101.30)***	0.9962 (41.73)***	1.0053 (41.09)***	0.9214 (97.84)***	0.9193 (98.04)***	0.9221 (95.48)***	0.9859 (38.22)***	0.9951 (37.89)***
LKL	0.0152 (4.04)***	0.0194 (5.10)***	0.0150 (3.91)***	0.0100 (0.56)	0.0028 (0.15)	0.0152 (5.06)***	0.0158 (5.31)***	0.0165 (5.42)***	0.0196 (2.12)**	0.0130 (1.35)	0.0144 (4.78)***	0.0150 (5.04)***	0.0160 (5.23)***	0.0188 (2.01)**	0.0133 (1.36)
TRGDP	0.0308 (4.80)***	0.0319 (5.01)***	0.0399 (6.21)***	0.0023 (0.21)	0.0058 (0.52)	0.0382 (6.65)***	0.0453 (8.19)***	0.0521 (9.21)***	0.0198 (2.06)**	0.0238 (2.42)**	0.0364 (6.24)***	0.0428 (7.58)***	0.0503 (8.76)***	0.0203 (2.03)**	0.0247 (2.42)**
FDIGDP	0.0263 (1.68)*	0.0360 (2.33)**	0.0548 (3.56)***	0.0240 (0.63)	0.0033 (0.09)	0.0456 (2.97)***	0.0545 (3.60)***	0.0706 (4.64)***	0.0342 (0.94)	0.0087 (0.24)	0.0483 (3.14)***	0.0562 (3.72)***	0.0726 (4.76)***	0.0193 (0.53)	-0.0034 (-0.09)
DBACBA	0.0891 (4.42)***	0.0918 (4.60)***	0.0833 (4.01)***	0.0615 (1.84)*	0.0571 (1.67)*										
LLR						-0.0204 (-2.62)***	-0.0108 (-1.42)	-0.0033 (-0.43)	-0.0478 (-2.10)**	-0.0365 (-1.56)					
PCRDBGDP											-0.0128 (-2.92)***	-0.0121 (-2.75)***	-0.0087 (-1.94)*	-0.0010 (-0.10)	0.0006 (0.05)
MCR	0.0219 (7.92)***					0.0176 (8.35)***					0.0170 (8.32)***				
TVR		0.0148 (5.98)***					0.0133 (6.52)***					0.0138 (6.81)***			
TOR			-0.0001 (-1.15)					-0.0004 (-3.60)***					-0.0004 (-3.84)***		
SDSMR				-0.0024 (-4.5)***					-0.0024 (-4.57)***					-0.0022 (-4.31)***	
CVSMR					0.0061 (1.76)*					0.0053 (1.61)					0.0043 (1.33)
Wald Chi^2	60456	58807	56409	7179	4809	65445	64544	61625	5510	5260	65512	64608	61571	5429	5203
Prob>Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. of Obs.	659	651	651	199	199	686	678	678	204	204	686	678	678	204	204
No. of Groups	33	33	33	33	33	34	34	34	34	34	34	34	34	34	34
Obs. Min	6	6	6	4	4	8	8	8	4	4	8	8	8	4	4
Obs. Max	25	25	25	13	13	25	25	25	13	13	25	25	25	13	13

a) Dependent variable: LGDPPC
b) Abbreviations used: LGDPPC = log of GDP per capita, LKL = log of capital labor ratio, TRGDP = trade to GDP ratio, FDIGDP = Foreign direct investment to GDP ratio, DBACBA = domestic bank assets to central bank assets ratio, LLR = Liquid liability ratio, PCRDBGDP = Private credit by domestic bank to GDP ratio, MCR = market capitalization ratio, TVR = trading value ratio, TOR = turnover ratio, SDSMR = Standard deviation of Stock Market Return, and CVSMR = Coefficient of Stock Market Returns.
c) Figures in the parentheses are the Z-statistics except for Wald Statistics which are P-values: ***,**, * significant at 1%, 5% and 10% respectively.

Table 2.4: Impact of BSDI and SMDI on GDPPC in panel of low income countries

Independent Variables	Regressions														
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
LGDPPC(-1)	0.9275 (58.73)***	0.9300 (56.36)***	0.9364 (57.36)***	0.9285 (38.42)***	0.9362 (37.98)***	0.9176 (45.64)***	0.9146 (43.86)***	0.9226 (44.02)***	0.9112 (29.87)***	0.9327 (29.92)***	0.9386 (49.07)***	0.9343 (46.20)***	0.9409 (47.25)***	0.9386 (34.21)***	0.9301 (31.79)***
LKL	0.0256 (3.40)***	0.0269 (3.50)***	0.0254 (3.23)***	0.0061 (0.41)	0.0117 (0.77)	0.0264 (3.50)***	0.0291 (3.78)***	0.0274 (3.47)***	0.0156 (1.05)	0.0207 (1.34)	0.0254 (3.39)***	0.0285 (3.72)***	0.0275 (3.51)***	0.0160 (1.10)	0.0283 (1.86)*
TRGDP	-0.0501 (-3.54)***	-0.0357 (-2.50)**	-0.0308 (-2.16)**	0.0388 (1.56)	0.0357 (1.39)***	-0.0329 (-2.29)	-0.0180 (-1.25)	-0.0145 (-1.00)	0.0350 (1.32)	0.0386 (1.42)	-0.0413 (-3.00)***	-0.0235 (-1.70)*	-0.0187 (-1.35)	0.0133 (0.50)	0.0126 (0.47)
FDIGDP	0.2093 (2.35)**	0.3513 (3.79)***	0.4250 (5.05)***	0.2393 (2.69)***	0.2016 (2.23)**	0.2967 (3.19)***	0.4412 (4.59)***	0.5306 (6.00)***	0.2738 (2.85)***	0.2531 (2.56)**	0.3336 (3.58)***	0.5038 (5.17)***	0.5824 (6.59)***	0.3218 (3.41)***	0.3302 (3.40)***
DBACBA	0.0327 (1.98)**	0.0462 (2.78)***	0.0460 (2.70)***	0.0567 (2.84)***	0.0481 (2.33)**										
LLR						-0.0396 (-1.53)	-0.0349 (-1.32)	-0.0305 (-1.13)	-0.0098 (-0.28)	-0.0444 (-1.26)					
PCRDBGDP											-0.0957 (-4.94)***	-0.0862 (-4.35)***	-0.0884 (-4.40)***	-0.0894 (-3.72)***	-0.1041 (-4.22)***
MCR	0.0463 (5.98)***					0.0484 (6.33)***					0.0506 (6.61)***				
TVR		0.0212 (1.83)*					0.0236 (2.04)**					0.0193 (1.68)*			
TOR			-0.0001 (-1.02)					-0.0001 (-1.57)					-0.0001 (-1.48)		
SDSMR				-0.0016 (-5.60)***					-0.0017 (-5.87)***					-0.0016 (-5.42)***	
CVSMR					0.0144 (3.58)***					0.0158 (3.75)***					0.0123 (2.95)***
Wald Chi^2	11798	11116	10871	4899	4681	9011	8331	8036	4879	4580	9179	8426	8179	3048	2803
Prob>Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
No. of Obs	457	454	452	254	254	416	413	411	233	233	416	413	411	233	233
No. of Groups	22	22	22	22	22	20	20	20	20	20	20	20	20	20	20
Obs. Min	8	8	8	8	9	9	9	9	9	9	9	9	9	9	9
Obs. Max	25	25	25	13	13	25	25	25	13	13	25	25	25	13	13

a) Dependent variable: LGDPPC
b) Abbreviations used: LGDPPC = log of GDP per capita, LKL = log of capital labor ratio, TRGDP = trade to GDP ratio, FDIGDP = Foreign direct investment to GDP ratio, DBACBA = domestic bank assets to central bank assets ratio, LLR = Liquid liability ratio, PCRDBGDP = Private credit by domestic bank to GDP ratio, MCR = market capitalization ratio, TVR = trading value ratio, TOR = turnover ratio, SDSMR = Standard deviation of Stock Market Return, and CVSMR = Coefficient of Stock Market Returns.
c) Figures in the parentheses are the Z-statistics except for Wald Statistics which are P-values: ***,**, * significant at 1%, 5% and 10% respectively.

significant for both high and low income countries but magnitude of coefficients is bigger in case of the high income group. The coefficients of LLR appear to be insignificant for all the cases of low income countries and for most of the cases of the high income countries. The coefficients of PCRDBGDP appear to be negative and significant for both high and low income countries and high negative impact can be observed in case of low income countries. In short, it can be concluded on the basis of various indicators, banking sector development contribute positively as well as negatively to the level of GDP per capita in high and low income countries but each extra service of banking sector contribute more in high income countries as compared to each extra service of banking sector in low income countries.

Similarly, the proxies for the stock market development indicators (MCR, TVR) appear to be positive and significant in high and low income countries. These coefficients are bigger in magnitude for the low income countries in all the cases. However, TOR appears to be negative and significant in some regressions of high income countries and negative and insignificant for all the cases of low income countries. Here, we can conclude on the basis of various indicators of stock market development that increase in activities of stock market contributes more in low income countries as compared to high income countries.

Indicator of the stock market volatility SDSMR appears to be negative and significant in all the cases of regressions for low and high income countries. The absolute coefficients of SDSMR are bigger in magnitude for low income countries, indicating that volatility hampers more in low income countries. The coefficients of CVSMR are positive and significant in all the cases of low income countries while positive and insignificant for some cases of high income countries. This indicates that though impacts of stock market volatility are higher in low income countries but with high compensation of high returns, it contributes positively to the level of GDPPC.

Regressions based on low and high income countries provide interesting outcomes, indicating that the banking sector development and stock market development significantly

contribute to the level of GDP per capita. The improvements in the banking sector are more beneficial for high income countries and improvements in stock markets are more beneficial for low income countries. Stock market volatility hampers GDP per capita of low and high income countries but its negative impact is higher for low income countries. It is also observed that high volatility is compensated well in low income countries as compared to high income countries.

2.6 Conclusion

We study the causal relation of a range of indicators of the banking sector development, stock market development, and stock market volatility with economic growth. Moreover, the study also tries to evaluate impact of banking sector development, stock market development, and stock market volatility on the level of GDP per capita. We take advantage of long but unbalanced panel data of seventy-six countries from 1980-2006 for analysis. The study employs newly developed panel causality tests and the Arellano-Bond model for the analysis.

We find that: (1) in the overall analysis, indicators of stock market development (TVR, TOR) and banking sector development (DBACBA, LLR, PCRDBGDP) are bi-directionally related with economic growth. However, MCR is uni-directionally related with economic growth, from stock market to economic growth; (2) all the proxies of stock market development and banking sector development show bi-directional relationship in low income countries while mixed evidences appeared on the basis of different indicators, in case of high income countries; (3) the previous value of GDP per capita, capital labor ratio, and trade to GDP ratio contribute positively to GDP per capita while impacts of FDIGDP are insignificant in all the cases; (4) In most of the regressions, the coefficients of trade appear to be insignificant for the low income countries, while significant for the high income countries. On the other hand, the coefficients of the foreign direct investment are significant in most of the regressions of high income countries and in all the regressions of low income countries; (5) the indicators of the banking sector de-

velopment show mixed impacts on GDP per capita in overall, high income, and low income countries; (6) the indicators of the stock market development show positive impacts on GDP per capita for most of the cases of groups of countries (whole, high income and low income countries); (7) the results highlight that volatility of the stock market contribute negatively to economic growth but when each extra unit of volatility is compensated with higher returns then it contribute positively to economic growth; (8) Comparing the level of impacts of banking sector development and stock market development on GDP per capita for the high income countries and low income countries, we can conclude:

i. Improvements in the banking sector are more beneficial for the high income countries and improvements in the stock markets are more beneficial for the low income countries.
ii. Stock market volatility hampers GDP per capita for low and high income countries but its negative impact is higher for low income countries.
iii. It is also observed that high volatility of stock returns is compensated well in low income countries as compared to high income countries.

On the basis of empirical results, we can conclude that a bi-directional relationship between stock market development and economic growth, banking sector development and economic growth, cannot be neglected. This study also concludes that stock markets and banking sector play an important role in country's level of GDP per capita in both high and low income countries. However, study is also able to prove that the volatility in stock market returns is harmful for the level of GDP per capita unless that is supported by high returns.

There are also some policy implications associated with clarifying the relationship between banking sector development, stock market development, stock market volatility and economic growth. Results suggests that banking sector development and stock market development induces faster economic growth so higher priority support should be granted to factors that lead to the banking and stock market development. In similar way,

on the basis of negative impact of stock market volatility on economic growth, we support granting a higher priority to factors that lead to lower stock market volatility. However, the indicators that help to decrease the stock market volatility still need to be identified.

Chapter 3

Exchange Rate Volatility and its impact on Industrial Production, before and after the Introduction of Common currency in Europe

3.1. Introduction

The volatility is defined as "instability, fickleness, or uncertainty" whether appearing in asset pricing, option pricing, portfolio optimization, or risk management. This volatility provides huge base for economic decisions. The exchange rate (price of one currency in relation to another) is believed to be the fastest moving price in the economy, if it's allowed to move freely. The volatility of exchange rate describes uncertainty in international transactions both in goods and in financial assets. Exchange rates are modeled as forward-looking relative asset prices that reflect unanticipated changes in relative demand and supply of domestic and foreign currencies. Hence, exchange rate volatility reflects agent's expectations regarding changes in determinants of money supplies, interest rates and incomes. The impacts of volatility in exchange rate remained in discussion for a long time.

Over the last few decades, many developing countries/regions have or are considering implementing changes in their development strategies. After an effort of more than fifty years, introduction of "Euro" as the common currency on January 1, 1999, was a great success in monetary history. At that time, eleven countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherlands, Portugal, and Spain) replaced their own national currencies with Euro. Removal of the exchange rate volatility among

the European countries is supposed to be one of the major benefits out of many expected benefits of Euro as common currency. Now after more than a decade, it's an opportune time to investigate the issue whether alterations in exchange rate arrangements have an effect on the exchange rate volatility. The case of European countries provides a particularly rich testbed for the theoretical predictions. It also provides an opportunity to investigate, if changes in exchange rate volatility after the introduction of Euro have similar effects on real economy or not? The European countries also provide an opportunity to check if changes in exchange rate volatility have a similar impact on real economic variables of all the countries or if their responses differ. It also provides an opportunity to check how real economic variables have responded to variations in exchange rates for the countries that have not adopted the common currency. The present study tries to answer the above mentioned questions using data for 15 European countries from Jan. 1980 to Feb. 2009.

The rest of the chapter is arranged as follows: Section 3.2 provides discussion about the historical background of the Euro, theoretical channels through which exchange rate volatility can affect real economy, and the empirical studies regarding the issue. The construction and utilization of variables along with empirical methodology is presented in section 3.3. Results and their discussion are presented in section 3.4. The last section contains conclusions.

3.2. Review of Literature

For detail review of literature, the present section is further divided into four subsections: First, we will discuss historical background about the introduction of the Euro as common currency; second, we will highlight pros and Cons of adopting common currency; third, the literature regarding sources through which exchange rate volatility can affect real economic variables will be presented; In the last subsection, empirical studies regarding the issue will be presented.

3.2.1. Historical Background of Euro

Introduction of the Euro as the common currency is one of the steps for establishing European integration. This is the process of political, legal, economic, and in some cases social and cultural integration of states, wholly or partially in Europe. Recently, Jadresic (2002) analyzing common currency for the countries of Gulf Cooperation Council (GCC), states that a currency union should be seen as only one component of a much broader integration effort. This would have to include the removal of domestic and cross-border distortions that inhibit intra-regional trade and investment. For this reason, at various points in time numbers of institutions have been established among countries of Europe. The Council of Europe (founded in 1949) is one of the oldest international organizations working towards European integration. It has 47 member states with more than 800 million citizens. Other than this, European Union Customs Union (EUCU-1958), European Free Trade Association (EFTA-1960), European Monetary System (EMS-1979), Schengen Agreement (1985), European Union (EU-1993), European Economic Area (EEA-1994) etc., have been established to contribute in the efforts to achieve the goal of European integration.[10] Each institution has been contributing significantly to the integration process among the European countries after its establishment.

The European Monetary system (EMS) introduced in 1979, as the reaction to the large exchange rate variability of currencies during the 1970s.[11] The EMS ceased to exist on January 1, 1999. The Exchange Rate Mechanism (ERM) and the European currency Unit (ECU) were the two elements of EMS.

Exchange Rate Mechanism (ERM) is an 'adjustable peg' system. Countries that were participating in the ERM determined an official exchange rate for all their currencies, and a band around these central rates within which the exchange rates could fluctuate freely. The band was set at 2.25% and -2.25% around the central rates for most of the member

[10] For detail review of European history see; http://www.ena.lu/
[11] For details regarding the procedures of introduction of Euro see, Ludlow (1982), Emerson et al (11992), Grauwe (2007).

countries (Belgium, Denmark, France, Germany, Ireland, and the Netherlands). However, Italy was allowed to use a larger band of fluctuations (6% and -6%) until 1990. The three newcomers to the system, Spain (1989), the United-Kingdom (1990), and Portugal (1992) also used the wider bands of fluctuations. In September 1992, UK dropped out of the system.

The central banks of the countries were committed to intervene so as to maintain the exchange rate within the band. These interventions were very frequent during the first half of the 1980s. They became much less frequent after the mid of 1980s. During the years 1987-1992 no realignment took place. However, due to crises in 1992-93 much realignment took place. The nature of the ERM was changed drastically by the increase of the band of fluctuations to 15% and -15% in August 1993.

European Currency Unit (ECU) defined as the basket of currencies of the member countries, was the second feature of EMS.[12] It included all the EU countries except Austria, Finland and Sweden. On January 1, 1999, the ECU was transformed into the Euro at the rate 1 ECU equivalent to 1 Euro.

The Euro came into existence after coordinating economic policies and achieving economic convergence among the European countries. Economic and monetary union (EMU) of the European Union (EU) members was established to look after issues regarding adoption of single currency. According to 'Maastricht Treaty', signed in 1991, before joining the common currency countries have to fulfill the following convergence criteria:

i. Country's rate of inflation must not be more than 1.5 percent above the average of the three countries of European Union (EU) with the lowest inflation.

[12] The ECU rate of currency i was defined as: $ECU_i = \sum_j a_j S_{ji}$, Where a_j is the amount of currency j in the basket; S_{ji} is the bilateral exchange rate.

ii. Country's nominal interest rate on long run government bonds (usually 10-years maturity) must not be more than 2 percent above the average of the three countries of EU with the lowest inflation.
iii. Country's government budget deficits must not be more than 3 percent of their Gross Domestic Product (GDP)
iv. Country's total government debt must not be more than 60 percent of their GDP
v. Country's national currency has to join Exchange Rate Mechanism (ERM) for two years period and exchange rate has to fluctuate between (plus minus] 15 percent band and short term high changes of the exchange rate are not acceptable.
vi. Country's national government cannot influence central bank's decisions.

It was decided in May 1998 that 11 EU countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, the Netherlands, Portugal, and Spain) satisfied this convergence criteria. On the other hand, Greece did not satisfy these criteria at that time. However, it thought to satisfy the conditions afterwards and was ready to introduce the Euro on January 1, 2002. Technically, monetary union started on January 1, 1999; however, the Euro did not exist in physical form until December 31, 2001. The national currencies continued to circulate in each country, and the exchange rates between them were irrevocably fixed. Full monetary union came into existence on January 1, 2002, when the Euro was introduced in physical form (banknotes and coins) and the national currencies were taken out of circulation.

On January 1, 2007, Slovenia became the 13th member of the Eurozone. Moreover, Cyprus and Malta joined currency union on 1st January, 2008 and Slovakia adopted common currency on 1st January, 2008. Estonia became the member of EMU on 1st January, 2011. In total, currently Euro is used as national currency in seventeen countries. Lithuania and Latvia are expected to join the Eurozone in the next few years and thus become countries using the euro. Euro is the second largest reserve currency as well as the second

most traded currency in the world after the U.S. dollar.[13] According to IMF estimates, based on Gross Domestic Product (GDP) and purchasing power parity among the various currencies of 2008, the Eurozone is the second largest economy in the world.

3.2.2. Pros and Cons of Euro

Obviously, every project has its pros and cons; the Euro-project is no exception. There are number of pros and cons related to the introduction of Euro. The costs of common currency through common monetary union derive from the fact that when a country relinquishes its national currency, it also relinquishes an instrument of economic policy. In a monetary union, common central bank can perform well in the case of symmetric shocks while common central bank has no solution to the problem of asymmetric shocks. The reason behind this is that common central bank cannot stabilize output at the county level; it can only do this at the union level.

On the other hand, the single currency should end currency instability in the participating countries. Because Euro would have the enhanced credibility of being used in a large currency zone, it would be more stable against speculation than individual currencies has been. An end to internal currency instability and a reduction of external currency instability would enable exporters to project future markets with greater certainty. This would unleash a greater potential for growth. Similarly, consumers would not have to change money when travelling and would encounter less red tape when transferring large sums of money across borders. A single currency would help that transactions pass smoothly without transaction costs. Likewise, businesses would no longer have to pay hedging costs, which they did in order to insure themselves against the threat of currency fluctuations. Businesses, which are involved in commercial transactions in different member states, would no longer have to face administrative costs of accounting for the changes of currencies, plus the time involved. Other than the economic reasons to join common monetary union, countries might adopt a common currency for political reasons.

[13] For detail, see Bank for International Settlements (2007)

3.2.3. Theoretical links between exchange rate volatility and Real Economy

An introduction of the common currency in the European region imposes the question of its contributions to stabilize exchange rates and their impacts on real economy. The argument that the elimination of the exchange risk will lead to an increase in economic growth can be made using the neoclassical growth model, and its extension to situations of dynamic economies of scale. This analysis featured prominently in the European Commission report 'One Market, One Money' (1990). According to this model, elimination of exchange risk reduces the systemic risk. This would have the effect of lowering the real interest rate. The reason is that in a less risky environment, investors would require a lower risk premium to make the same investment. In addition, when agents discount the future they are willing to use a lower discount rate. Due to this, there will be an accumulation of capital and an increase in the growth rate of GDP. Some of the various channels through which exchange rate volatility transmit to more economic growth are described below.

3.2.3.1. Trade

The relationship between the exchange rate volatility and international trade is highly explored and well established. According to Brodsky (1984), due to risk averse (or even risk neutral) behavior of commodity traders, higher exchange rate uncertainty may lead to a reduction in the volume of trade. The main idea is the demand of higher price by economic agents to cover their exposure to current risk. In turn, it would decrease the volume of trade. Other than the direct effect of exchange rate volatility on trade, there may be a more or less important indirect effect of exchange rate volatility on trade and hence on economic growth.

3.2.3.2. Foreign Direct Investment

Exchange rate volatility may also affect level of development of the country through its effects on foreign direct investment inflows. The main idea is that the higher exchange

rate volatility increases uncertainty over the return of the investment. A potential investor will invest in foreign location only if the expected returns are high enough to cover for the currency risks. Thus, under high exchange rate volatility foreign direct investment will be lower. This can be counted as another channel through which negative impact of exchange rate volatility on economic growth can be traced out.

3.2.3.3. Currency Crises

It is argued that instability in big currencies can contribute to currency crises in small countries. The idea behind this is if big currency (dollar) had large and relatively rapid appreciation vis-à-vis other big currencies (i.e. Euro, Yen) then all the currencies that were pegged to the dollar also appreciated with respect to Euro and Yen. The result is the weakening of relative price competiveness of these currencies, thus contributing to a deterioration of their external accounts and may have eventually led to the currency crises. Thus exchange rate volatility is not the volatility itself, but a continuous change of one currency in certain direction adversely affecting the real economy.

3.2.3.4. Debt Servicing costs:

One of the main effects of exchange rate movements for developing countries refers to the external debt burden. As most of the developing countries are net debtors, hence changes in exchange rates may affect the real cost of servicing their debts. A strong appreciation of the dollar, for example, implies a higher cost of servicing an external debt. Thus high exchange rate fluctuations affect allocation of funds for development purpose. On the other hand, Frankel and Roubini (2001) find ambiguous impact of exchange rate variations because changes in all big currencies for developing countries are not in the same direction.

Summarizing, exchange rate changes may affect economic growth differently for different countries depending upon the channels through which the effects take place. Impact might also change when national currency is backed up with more than one country. Oth-

er than this, trade and foreign direct investment channels suggest that exchange rate volatility may decrease economic growth in the country. Moreover, the impact of exchange rate volatility through channels of currency crises and debt servicing costs is ambiguous depending upon the parity conditions. A detailed review of empirical studies regarding these relationships is presented in the next sub-section.

3.2.4. Empirical Studies regarding exchange rate volatility

A vast number of empirical studies are conducted to determine and evaluate the impacts of exchange rate volatility to various indicators of real economy. Empirical studies are concentrated most of the time on the selection of exchange rate systems i.e. fixed or flexible. Studies demonstrate a discrepancy in terms of their findings regarding the impacts of exchange rate volatility on indicators of real economy. Differences in studies take place because of differences in types of exchange rates, the time of analysis, the place of analysis, and the methodology used for analysis. The main intuition behind the difference in findings is that the increase in exchange rate volatility leads to uncertainty, which might have different impacts for different countries on both domestic and foreign investment decisions, trade, and other sources of economic growth. The studies have explored various channels through which exchange rate volatility linked (positively/negatively) with real economy.

Mainly, Kormendi and Meguire (1985), and Grier and Tullock (1989) are among the first who explore the relationship between volatility and growth empirically. Both report positive impact of standard deviation of GDP growth on its mean. Nevertheless, Ahmed (2009), being one of the last in literature so far investigates impact of exchange rate volatility on growth using quarterly data for Bangladesh trade with North America, Western Europe, Eastern Europe, SAARC, ASEAN, and Asia-Pecific regions. The study points out that the volatility of exchange rate has a negative and significant effect in the long run as well as in the short run. On the other hand, Ghosh et al. (2003) find weak evidence that exchange rate affects growth in a positive or negative way.

In the literature, Hooper and Kohlhagen (1978) are among the first ones who analyzed systematically the effects of exchange rate volatility on trade. In this study, exchange rate risk is measured by standard error of nominal exchange rate fluctuations. Any significant link could not be established by them, and inconsistent results regarding the impact of exchange rate volatility on international trade are being observed. Frankel and Rose (2002) using data for more than 200 countries suggest that belonging to a currency union triples trade with other currency union members. They also report that every one percent increase in a country's overall trade relative to GDP raises income per capita by at least one third of the percent. The hypothesis that the volatility of exchange rate decreases the volume of international trade is supported by Akhtar and Hilton (1984), Kenen and Rodrick (1986), Thursby and Thursby (1987), De Grauwe (1988), Pere and Steinherr (1989), Koray and Lastrapes (1989), and Arize (1995). No impact of the exchange rate volatility on trade is reported by Hooper and Kohlhagen (1978), Gotur (1985), Bailey et al.(1987), Asseery and Peel (1991), and Bacchetta and Wincoop (2000).

Another way to analyze the impact of real exchange rate volatility on the real economy is to check its impact on investment. The literature provides evidence that uncertainty decreases investment in the presence of adjustment costs. If the investment projects are irreversible then uncertain environment leads to delay in investment decisions by investors to obtain more information about the real exchange rates. This exerts negatively on economic performance. Campa and Goldberg (1993) report a negative impact of exchange rate volatility on investment. Similarly, Barlevy (2004) using AK models with concave investment function show that volatility of the exchange rate lowers growth through the volatility of investment.[14] On the other hand, using AK models Mendoza (1994), and Jones and Wilson (1989) show that high risk will increase growth for individuals having high degree of relative risk aversion. Aizenman (1992) also reports a positive relation-

[14] AK models are special form of the Solow growth model (α = 1), first time discussed by King and Rebelo (1990).

ship, whereas Campa and Goldberg (1995) find almost no impact between these variables.

Despite the existence of huge literature regarding exchange rate volatility few studies have investigated impact of exchange rate volatility on the real economy after the introduction of Euro in Eurozone. De Grauwe and Schnabl (2004) using a panel estimation for the period 1994-2002 find a significant impact of the exchange rate stability on low inflation as well as a highly significant impact of the exchange rate stability on real growth. Micco et al. (2003) reports that in its early years, the European Monetary Union has increased intra-EMU trade by up to 16%. Schnabl (2007) analyzes the impact of exchange rate stability at the periphery of the euro area. It identifies international trade, international capital flows, and macroeconomic stability as important transmission channels from exchange rate stability to more growth. By panel estimation, Schnabl (2007) establishes a negative relationship between the exchange rate volatility and economic growth for the countries in the economic catch-up process with open capital accounts. A clear gap between the impacts of exchange rate volatility on economic growth within new system can be observed in literature.

Other than these, there are various other channels that have been explored theoretically and empirically as the possible sources of building relationship between exchange rate volatility and economic growth. Keeping such relationships in mind a hypothesis is developed relating to the link between exchange rate volatility and economic growth after the introduction of common currency Euro. It is considered to be an appropriate time for such analysis because more and more countries are joining the group. In such state of affairs, the aim of the study is to find out:

(a) Has the introduction of the common currency Euro decreased volatility in exchange rate for each European country as compared to the volatility they were facing before the introduction of Euro?
(b) Has introduction of the Euro any effect on the relationship between exchange rate volatility and the real economic variables?

(c) How does exchange rate volatility affect the real economy of the countries that are part of European Union but not the part of Eurozone?

3.3. Methodology and Data Description

This section provides detailed description of the methodology, which is employed to measure volatility in the exchange rates. Techniques to capture the effects of volatility on economic performance are presented in later subsections.

3.3.1. Methodology

3.3.1.1. Unit Root Tests

One of the initial steps of the empirical analysis is to test for unit roots. For this reason, we employ Augmented Dickey Fuller (ADF) test, presented by Dickey and Fuller (1979), to check the stationarity of the growth rate of exchange rate. The current study also employs methods that are developed by Maddala and Wu (1999), and Choi (2005) to determine the level of integration of the macroeconomic variables of each group. Along with this Fisher-type test, we also use the IPS test developed by Im, Pesaran, and Shin (1997). However, both of these tests are based on the null hypothesis of unit root. The IPS test, the Fisher-ADF, and PP tests allow for individual unit root processes. These tests combine individual unit root tests to derive a panel-specific result.

3.3.1.2. Measurement of Volatility

In past, studies have used naive measures of volatility i.e. rolling variance of the series for the analysis of volatility structure of financial variables. However, Campbell et al. (1997, p.481) have argued that:

> "*it is both logically inconsistent and statistically inefficient to use volatility measures that are based on the assumption of constant volatility over some period when the resulting series moves through time*."

During the last more than two decades, another class of model, *Autoregressive Conditional Heteroscedasticity* (ARCH) and *Generalized Autoregressive Conditional Heteroscedasticy* (GARCH), has proved to be very successful in predicting the volatility changes. These kinds of the volatility models are more acceptable because of their capability to capture most stylized facts of volatility, i.e. leptokurtosis (fat tails) and volatility clustering (the tendency of large observations to be followed by other large observations and of small observations to be followed by other small observations).

In ARCH model, the conditional variance changes over time as a function of past squared deviations from the mean. As the extension of ARCH model, GARCH processes take changes in variance over time as a function of past squared deviations from the mean and past variances. Generalized Autoregressive Conditional Heteroscedasticity (GARCH) is another most popular class of models for volatility that was first time suggested by Engle (1982) and Bollerslev (1986).

In detail, standard GARCH models assume that positive and negative error terms have a systematic effect on the volatility. In other words, good and bad news have the same effect on the volatility of the model. In practice this assumption is frequently violated and it is observed that volatility increases more after bad news than after good news. This so called leverage effect is first time introduced by Black (1976). Precisely, *Exponential GARCH* (EGARCH) model that is proposed by Nelson (1991) incorporates the leverage effects while calculating volatility. Berument et al. (2001) and Kontonikas (2004) indicated that the EGARCH method is more powerful and more advantageous than other models for quantifying volatility. The EGARCH is preferred over other models because of the following reasons: First, as discussed above the EGARCH models capture asymmetry in the responsiveness of uncertainty to good and bad news; second, unlike GARCH, an EGARCH does not impose the non-negativity constraints on the parameters; Third, modeling uncertainty in logarithms form, reduces the effects of outliers on the estimation results.

Let, RER_{it} with $t = 1,2,3,\ldots,T$, $i = 1,2,3,\ldots,N$ denote the real bilateral exchange rate of country "i" in period "t".[15] This is the relative inflation adjusted exchange rate and is constructed by multiplying the nominal exchange rate with the ratio of consumer price indexes, e.g. real exchange rate of Germany can be calculated as:

$$RER_t^{GER} = \left[\frac{DM_t}{USD_t}\right] * \left[\frac{CPI_t^{US}}{CPI_t^{GER}}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

Where, DM_t / USD_t represents Deutsche-Mark per unit of US-Dollar, CPI_t^{US} / CPI_t^{GER} represents relative CPI in period "t". Moreover, monthly exchange rate returns R_{it}, for country i in period t, is calculated by the log-differences of the real exchange rates.

$$R_{it} = \ln\left(\frac{ER_{it}}{ER_{it-1}}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

Formally, *AR(k)-EGARCH(p,q)* model for returns of exchange rate can be expressed, like expressed by Wang (2010), as follows:

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

$$\varepsilon_t / \psi_{t-1} \sim N(0, h_t)$$

$$h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left|\frac{u_{t-j}}{\sqrt{h_{t-j}}}\right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}}\right]$$

OR

$$\log(h_t) = \omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left|\frac{u_{t-j}}{\sqrt{h_{t-j}}}\right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \quad \ldots\ldots\ldots\ldots \quad (3.4)$$

[15] We used same methodology for the calculation of volatility in the nominal exchange rate. From onward in methodology section, exchange rate is used for both real exchange rate and nominal exchange rate unless it is mentioned.

Where R_t is the exchange rate return, α_o is the mean exchange rate return conditional on information set at time $t-1$ (ψ_{t-1}). Similar to original Nelson model, we assume that the ε_t follows a Generalized Error Distribution (GED). Logarithm of the conditional variance (h_t) on the right hand side imply that the leverage effect is exponential, rather than quadratic, and that forecasts of the conditional variance are guaranteed to be nonnegative without imposing any restriction on the coefficients. The presence of leverage effects can be tested by the hypothesis $\theta_m < 0$. The impact is asymmetric if $\theta_m \neq 0$.

Modeling volatility of financial time series has been enriched by various types of ARCH-GARCH models. We employ *AR(k)-EGARCH(p,q)* model to describe the dynamics of the exchange rate volatility of each European country in the analysis separately. With the availability of more sophisticated measures of volatility, choice of order of autoregression in mean and variance equation becomes a more complicated part. In this paper we employ Schwarz Bayesian Information Criteria (SBIC) for the selection of the orders k, p, and q.

3.3.1.3. Real Exchange Rate volatility and Industrial Production

At the first step, a detailed graphical analysis of the real exchange rate volatility has been conducted to compare its movements across countries. Later to analyze the impact of real exchange rate volatility on the indicators of real economy of Eurozone before and after the introduction of Euro, present study takes the help from two-stage least squares (instrumental variable) regression using pooled data (Pooled IV/TSLS).

$$Y_{it} = \sum_{j=1}^{n} \beta_j X_{j,it} + \lambda_i VOLER_{it} + \nu_{it} \quad \ldots\ldots \quad (3.5)$$

Where Y_{it} represents growth rate of real economy, $X_{j,it}$ represents the list of "n" control variables, and $VOLER_{it}$ is the indicator of exchange rate volatility obtained from conditional variance by using *AR(k)-EGARCH(p,q)* models for each country. Here, λ_i indicates separate coefficients of the impact of exchange rate volatility on real economy for each

country. Separate pooled regressions for two groups of countries before and after the introduction of Euro have been regressed.

3.3.2. Data Sources and Construction of Variables

Mainly, we have divided the analysis with respect to region and time. Countries are divided into two groups: Group A consists of countries that have adopted Euro as common currency on January 1999, while Group B consists of countries that have not adopted Euro as common currency on January 1999. In our sample, Group-A consist of Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherland, Portugal and Spain. On the other hand, Group-B consists of Denmark, Norway, Sweden and the United Kingdom. The impact of exchange rate volatility on the real economy is analyzed across two groups before and after the introduction of Euro.

To analyze the impact of exchange rate volatility on the real economy, before and after the introduction of Euro, study employs logarithm of industrial production index (LIPI) as an indicator of economic growth. Data of exchange rates of the European national currencies with US dollar before 1998 and exchange rate of the Euro with US dollar after 1998 is calculated using *AR(k)-EGARCH(p,q)* models separately. Both real and nominal exchange rates are used for the calculation of exchange rate volatility. Values of real and nominal exchange rate volatility for the countries that did not adopt common currency are also calculated using *AR(k)-EGARCH(p,q)* models in the similar way. Other explanatory variables (control variables), include indicator of inflation (consumer price index-CPI), indicator of government interest rates (government bond yield-LGBY), and an indicator of openness of the economy (logarithm of trade in US$-LTRA). Using the benefits of the same data source for all variables, monthly data for all the variables have been obtained from *International Financial Statistics* (IFS) from January 1980 to April 2009.

3.3.2.1. Descriptive statistics:

Before going into the detailed analysis of the impacts of exchange rate volatility on real macroeconomic variables, before and after the introduction of Euro, a short summary of

descriptive statistics regarding the variables of the real economy is presented in Table 3.1. First part of the columns shows descriptive statistics for the two groups of European countries for the period up to December 1998, while second part of columns shows descriptive statistics for the two groups of European countries for the period January 1999 to April 2009.

The table shows that the mean of the industrial production increased in all European countries which either adopted Euro or not after the introduction of Euro. Moreover, standard deviation of the growth rate of industrial production also increased in the second part except for Germany, Ireland, Denmark and Norway where it slightly decreased. One thing to note is that growth rate of industrial production for Germany and Denmark is remarkably high before January 1999 as compared to other countries, while the differences become low after the introduction of Euro. Similarly, growth rate of trade follow similar trends after the introduction of Euro for almost all the countries. The average growth of trade is doubled for almost all countries except for Ireland, Denmark and the United Kingdom. In case of Denmark, it decreased during the second sub-period of analysis. The values of standard deviations indicate increase in the variation of growth rate of trade for all European countries after the introduction of common currency. The gap between the maximum and minimum values almost doubled in the second sub-period for all the countries.

Additionally, the arithmetic means of logarithmic values of government bond yield in two time periods indicate that government bond yield increased in the second sub-period for all countries except for Denmark. Before the introduction of Euro, the Denmark has enjoyed higher level of government bond yield. The standard deviation is higher in second sub-period for both types of the countries which either have adopted common currency or not. The countries that have adopted common currency faced same or lower level of deviations in government bond yield after the introduction of Euro as compared to the countries that have not adopted Euro as national currency. The United Kingdom is also an

Table 3.1: Descriptive Statistics

		Jan. 1980 to Dec. 1998					Jan. 1999 April 2009				
Country		**Obs.**	**Mean**	**STD**	**Max.**	**Min.**	**Obs.**	**Mean**	**STD**	**Max.**	**Min.**
						Industrial Production					
Group A	AUS	228	1.74	0.07	1.91	1.59	122	4.56	0.14	4.55	4.84
	BEL	228	1.89	0.06	1.99	1.69	122	4.59	0.08	4.60	4.77
	FIN	228	1.72	0.09	1.94	1.44	122	4.58	0.13	4.59	4.86
	FRA	228	1.92	0.06	2.02	1.70	122	4.60	0.10	4.61	4.75
	GER	228	4.35	0.11	4.57	4.08	122	4.59	0.10	4.58	4.82
	IRE	228	1.37	0.19	1.82	1.05	122	4.54	0.17	4.57	4.85
	ITA	228	1.93	0.10	2.04	1.52	122	4.61	0.18	4.66	4.76
	LUX	228	1.77	0.08	1.90	1.53	122	4.52	0.12	4.53	4.70
	NET	228	1.88	0.06	1.98	1.72	122	4.59	0.10	4.58	4.80
	POR	228	1.86	0.09	2.02	1.55	123	4.62	0.09	4.65	4.75
	SPA	228	1.87	0.08	2.00	1.57	123	4.59	0.12	4.62	4.77
Group B	DEN	228	4.26	0.19	4.68	3.66	122	4.60	0.11	4.62	4.78
	NOR	228	1.84	0.12	2.05	1.44	122	4.61	0.06	4.61	4.74
	SWE	228	1.85	0.10	1.98	1.39	122	4.57	0.14	4.58	4.78
	UK	228	1.94	0.05	2.05	1.81	122	4.61	0.05	4.61	4.76
						Growth rate of Trade					
Group A	AUS	227	0.23	5.12	13.84	-11.35	121	0.57	11.14	27.50	-26.85
	BEL	71	0.29	5.16	12.54	-11.74	121	0.57	10.47	29.53	-21.83
	FIN	227	0.18	5.58	21.64	-40.54	122	0.47	8.75	20.44	-23.59
	FRA	227	0.18	5.76	15.80	-16.05	120	0.42	12.10	33.59	-34.24
	GER	227	0.19	4.28	9.66	-12.25	122	0.63	6.88	16.02	-18.17
	IRE	227	0.34	4.52	12.57	-10.90	121	0.35	9.67	23.76	-23.50
	ITA	227	0.19	9.08	24.60	-26.43	120	0.45	18.28	47.01	-55.42
	LUX	46	0.27	5.23	13.23	-12.08	120	0.45	10.57	24.01	-31.92
	NET	227	0.15	3.92	10.69	-8.54	122	0.60	7.86	19.04	-17.48
	POR	227	0.29	7.51	20.07	-23.74	121	0.45	13.79	32.97	-40.51
	SPA	227	0.33	8.03	20.31	-25.91	121	0.65	12.74	34.32	-33.83
Group B	DEN	227	0.47	11.37	25.29	-31.12	122	0.43	9.29	21.87	-22.40
	NOR	227	0.14	4.77	13.07	-22.61	122	0.73	8.34	21.16	-18.55
	SWE	227	0.16	5.58	18.91	-16.09	121	0.35	10.43	23.03	-24.17
	UK	227	0.18	1.46	4.96	-4.52	122	0.23	4.05	10.53	-14.16
						Government Bond Yield					
Group A	AUS	228	0.88	0.08	1.06	0.61	124	1.47	0.15	1.75	1.13
	BEL	228	0.95	0.12	1.14	0.61	124	1.49	0.15	1.76	1.14
	FIN	228	0.96	0.14	1.14	0.61	124	1.47	0.15	1.75	1.12
	FRA	134	0.96	0.15	1.23	0.59	124	1.46	0.14	1.73	1.14
	GER	228	0.85	0.08	1.02	0.59	124	1.43	0.15	1.71	1.11
	IRE	228	1.00	0.15	1.28	0.60	124	1.49	0.16	1.76	1.11
	ITA	228	1.08	0.15	1.33	0.60	124	1.51	0.14	1.75	1.19
	LUX	228	0.89	0.09	1.04	0.61	123	1.48	0.15	1.74	1.12
	NET	228	0.87	0.10	1.09	0.60	124	1.46	0.15	1.74	1.14
	POR	228	1.12	0.17	1.36	0.61	124	1.50	0.15	1.76	1.16
	SPA	228	1.07	0.14	1.26	0.61	124	1.48	0.15	1.75	1.13
Group B	DEN	228	2.33	0.38	3.08	1.45	124	1.49	0.16	1.77	1.12
	NOR	228	0.98	0.15	1.14	0.67	122	1.55	0.25	1.94	1.06
	SWE	228	1.01	0.11	1.14	0.63	124	1.48	0.18	1.78	0.98
	UK	228	0.99	0.11	1.20	0.66	124	1.56	0.12	1.76	1.10

Industrial Production is presented as the logarithmic values of the Industrial Production Index, Growth rate of Trade is taken as the logarithmic difference of the Trade taken in US$ multiplied by 100, Government Bond Yield is presented as the logarithmic value of the Government Bond Yield.

exception because it faced low level of variations in government bond yield in the second sub period.

Concluding this section, we can say that common currency has not helped to stabilize indicators of real economy. However, how variations in the real exchange rate responded to the introduction of Euro and how the real economy corresponded to changes in the variations of the real exchange rate still need to be explored with some detail.

3.4. Results and Results Discussion

In the present section, we will discuss results based on methodology presented in section 3.3 and using data of real macroeconomic variables from International Financial Statistics. Before going into the regression analysis, detailed graphical analysis of exchange rate volatility of each country is presented in the following sub-section.

3.4.1. Exchange Rate Volatility

The volatility of exchange rate is calculated on the basis of growth rate of the nominal as well as the real exchange rates. We employ *AR(k)-EGARCH(p,q)* models for two sub-periods before and after the introduction of the common currency for each country.[16] The volatility of exchange rate before January 1999 is calculated on the basis of exchange rate of national currencies with US-Dollar ($) while after January 1999 it is calculated on the basis of exchange rate of Euro with US$. Hence, any difference in volatility of nominal exchange rate is due to variation in nominal exchange rates, while any difference in volatility of real exchange rate across countries after January 1999 is due to the differences in nominal exchange rate and relative CPI. Both types of exchange rate volatility, for 11 European countries that switched to Euro as their common currency (Group-A) and 4

[16] Specification of AR(k)-EGARCH(p,q) models along with coefficients and significance is presented in Appendix B.

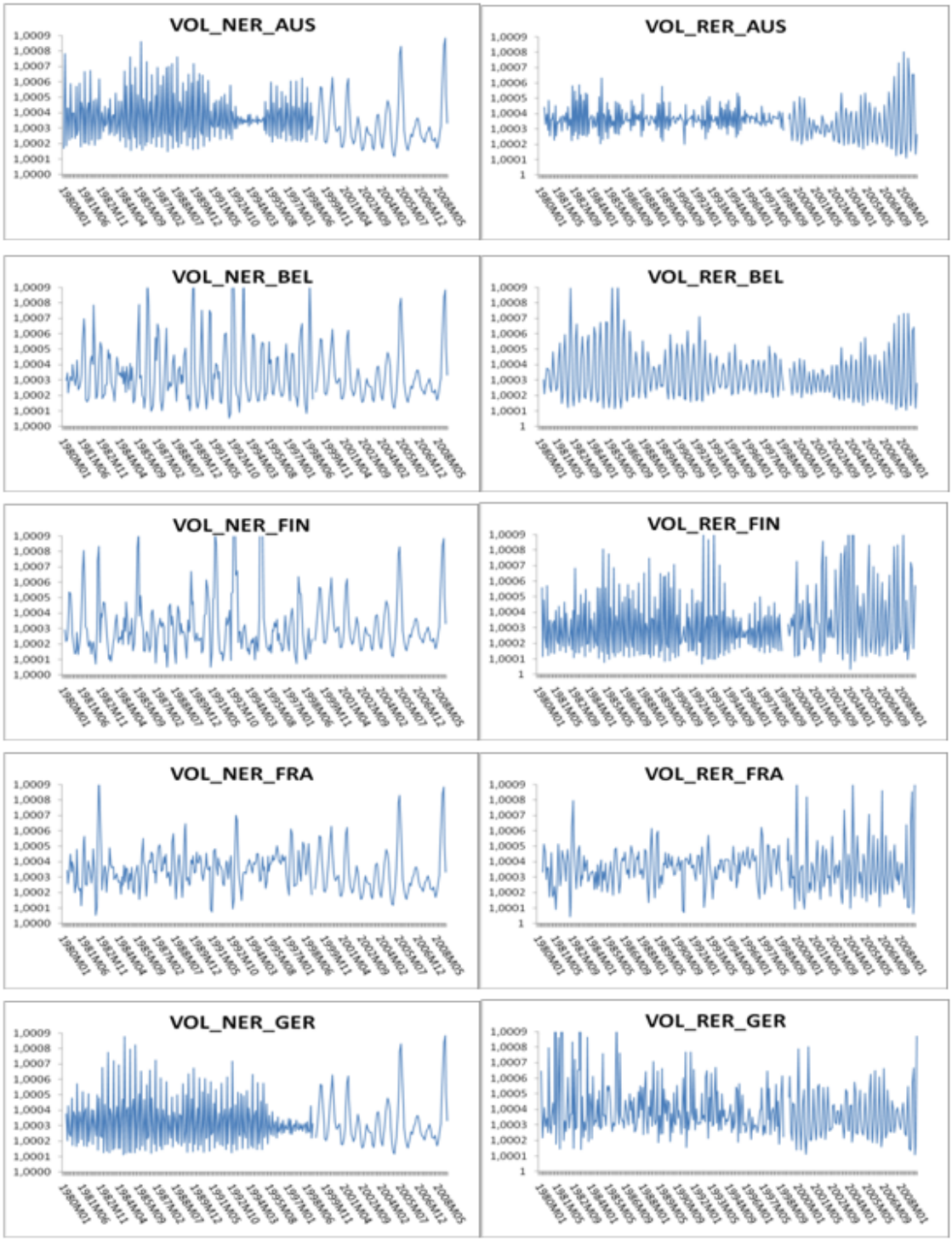
European countries that did not adopt Euro as their national currency (Group-B), are presented graphically in Figure 3.1.

Both, volatility in real exchange rate and volatility in nominal exchange rate show similar trends in all the countries before and after the introduction of Euro. The countries that have adopted common currency faced high level of volatility at the time of joining common currency but it stabilized in later periods. The countries that have not adopted common currency also faced high level of volatility in the beginning of 1999 but their intensity of shocks was less. Moreover, these countries faced higher number of peaks in exchange rate volatility after the introduction of Euro. This indicates exchange rate volatility of the countries that have not adopted common currency is more unstable after the introduction of Euro.

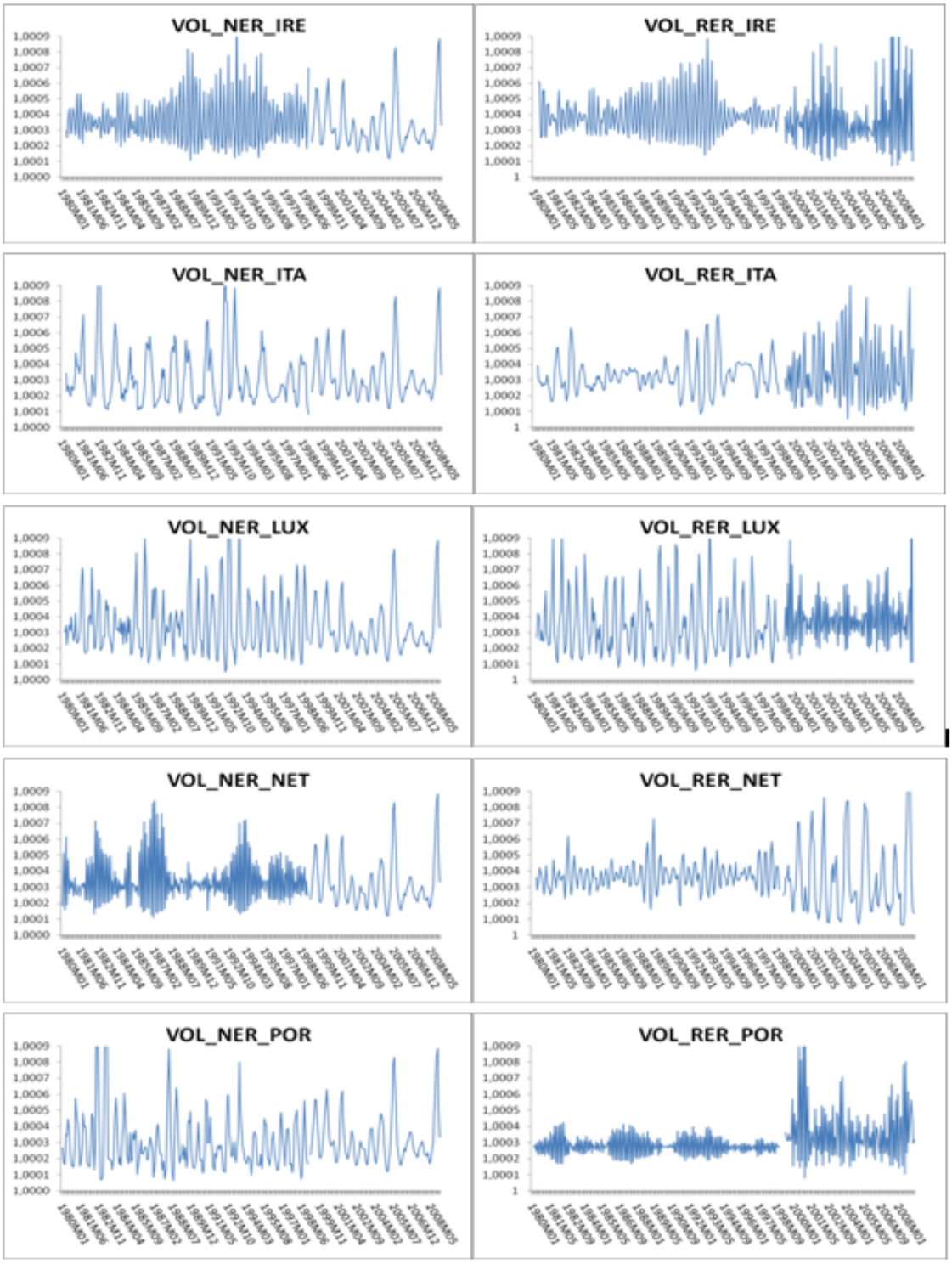
An overview of the exchange rate volatility of countries that have adopted common currency and countries that have not adopted common currency provide fruitful information. Countries that have adopted Euro as national currency faced same level of nominal exchange rate volatility after 1999. However, real exchange volatility differs across countries because of the variations in the inflation. Countries that have adopted common currency faced smaller and long lasting peaks in exchange rate volatility before the introduction of Euro. High peaks in exchange rate volatility for short periods can be observed for the countries that have adopted common currency. Absence of long lasting peaks in volatility of exchange rate after the introduction of common currency indicates that Euro helped these countries to stabilize shocks more quickly. Countries also faced high level of exchange rate volatility in the end of 2008 and in the beginning of 2009.

On the other hand, countries that have not adopted common currency, responded differently in their exchange rate volatility behaviours after the introduction of Euro. Countries that have not adopted common currency showed more stable exchange rate volatility before the introduction of common currency. High and frequent peaks in exchange rate volatility after the introduction of Euro indicate that exchange rate become more volatile

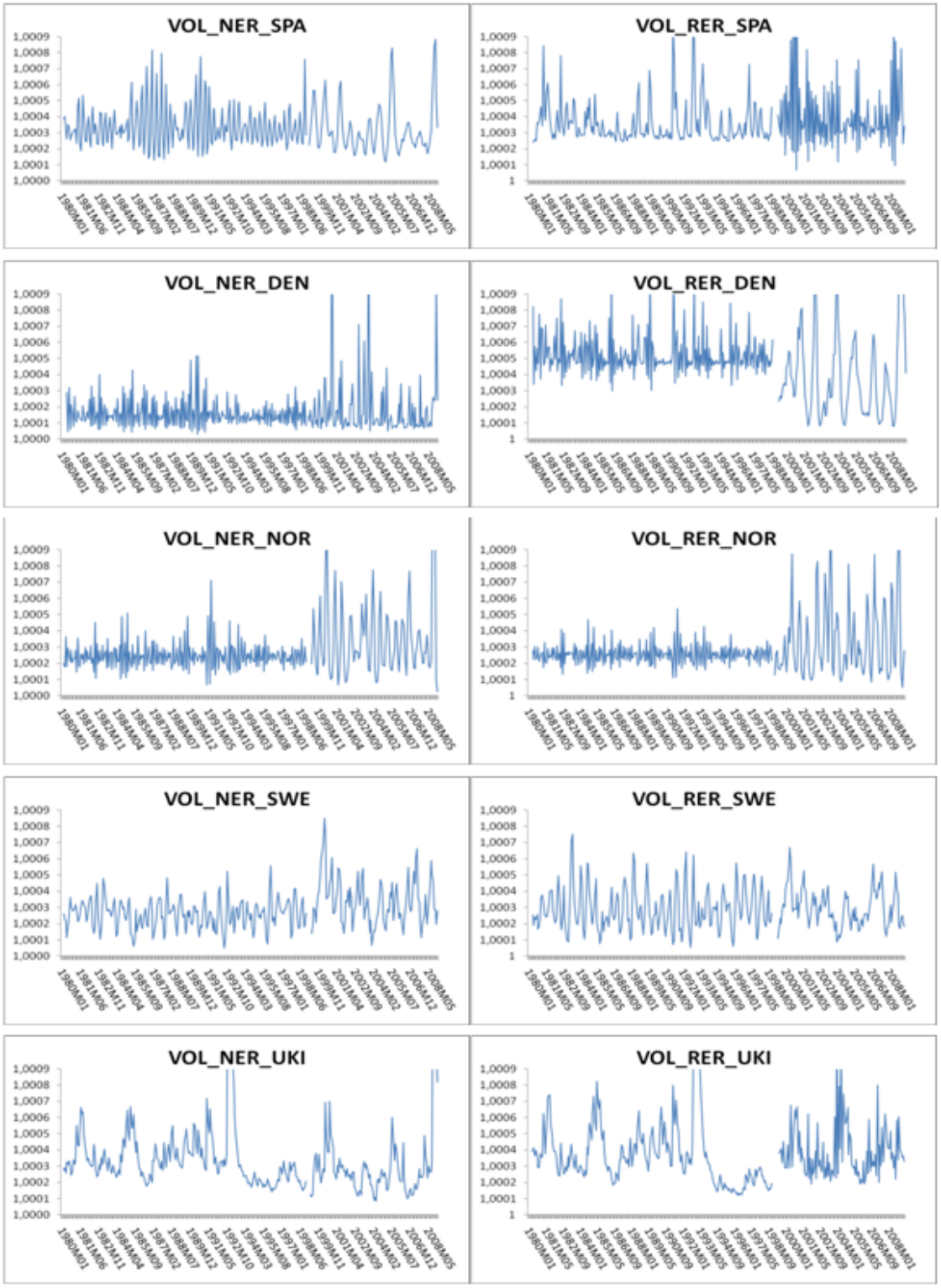
Figure 3.1: Exchange rate volatility based on NER and RER



Continued Figure 3.1:



Continued Figure 3.1:

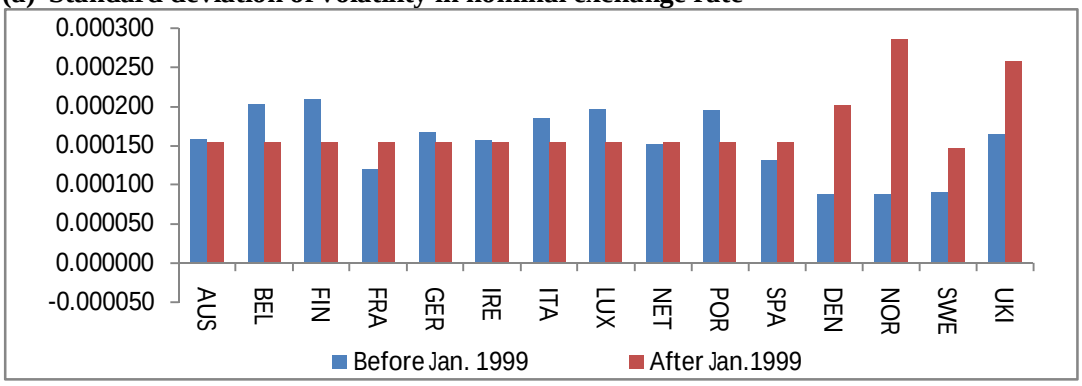


in these countries. Norway shows more peaks in exchange rate volatility than other countries.

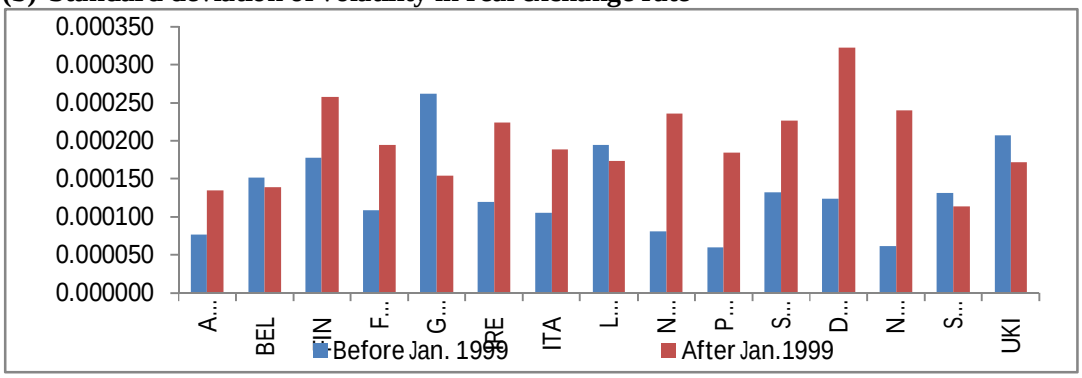
A similar pattern can be observed analysing standard deviations of exchange rate volatility before and after the introduction of common currency for these countries. Figure 3.2 (a, b) presents standard deviation of nominal and real exchange rate volatility of these countries. The standard deviation of nominal exchange rate volatility of Denmark, Norway and Sweden are lower as compared to other countries before the introduction of common currency. The standard deviation of volatility of nominal exchange rate increased for three countries (France, Netherlands and Spain) out of eleven. Clear and high increase in variations of nominal exchange rate volatility for all the countries that have not adopted the Euro can be observed after the introduction of common currency.

Figure 3.2: Variation in Volatility of exchange rate

(a) Standard deviation of volatility in nominal exchange rate



(b) Standard deviation of volatility in real exchange rate



The standard deviation of real exchange rate volatility shows a little bit different picture as compared to standard deviation of nominal exchange rate volatility. This is because of the differences in the inflation that countries faced before and after the introduction of common currency. Out of 11 countries that adopted common currency, 8 countries show increase in standard deviation of real exchange rate volatility after adopting common currency. Out of 4 countries that did not adopt common currency, 2 are able to reduce variations in real exchange rate volatility. On the basis of real exchange rate volatility, it can be seen that Germany is able to reduce more standard deviation of real exchange rate volatility as compared to other countries.

Summarizing the behaviour of nominal and real exchange rate volatilities, we can say: First, countries that have adopted common currency appeared with the same level of nominal exchange rate while different level of the real exchange rate volatility, after the introduction of common currency indicating the existence of the differences in relative inflation across countries; Second, exchange rate volatility appears to be more volatile at the time of introduction of Euro for most of the countries; Third, overall nominal exchange rate volatility show more volatile behaviour after the introduction of Euro for the countries that have not adopted common currency, while countries that have adopted common currency are able to decrease it; and last, only Belgium, Germany, Luxemburg, Sweden, and the United Kingdom are able to reduce standard deviation of the real exchange rate volatility after the introduction of the common currency. Despite all these, we are unable to identify sources and channels through which differences in volatility patrons across countries can be explained. Further research in the area is required.

3.4.2. Unit Root tests

As the common way of analyzing, the first step is to check for the unit roots in the series. For this reason, we have employed Augmented Dickey Fuller (ADF) tests to check the stationarity of the growth rate of exchange rate. Growth rate of exchange rate is integrated of order zero in case of all subsamples. Stationary time series data of growth rate of real exchange rate is used for the estimation of conditional variances in EGARCH

Table 3.2: Results from Unit root tests

Country	Individual Unit Root Test (ADF-Test)			
	NER		RER	
	1980 to 1998	1999 to 2009	1980 to 1998	1999 to 2009
AUS	-10.82***	-8.74***	-9.87***	-9.63***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
BEL	-10.57***	-8.74***	-3.44***	-8.09***
	[0.0000]	[0.0000]	[0.0107]	[0.0000]
FIN	-10.35***	-8.74***	-8.40***	-9.25***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
FRA	-10.95***	-8.74***	-5.92***	-7.18***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
GER	-10.86***	-8.74***	-9.80***	-10.35***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
IRE	-11.81***	-8.74***	-2.94*	-7.27***
	[0.0000]	[0.0000]	[0.0566]	[0.0000]
ITA	-10.57***	-8.74***	-10.71***	-7.16***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
NET	-10.62***	-8.74***	-3.59***	-10.26***
	[0.0000]	[0.0000]	[0.0067]	[0.0000]
POR	-10.21***	-8.74***	-11.89***	-8.25***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
SPA	-10.31***	-8.74***	-11.87***	-7.21***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
DEN	-14.36***	-10.78***	-14.41***	-10.99***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
NOR	-10.05***	-7.90***	-5.10***	-8.94***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
SWE	-9.47***	-7.49***	-12.04***	-14.02***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
UKI	-10.91***	-8.98***	-11.69***	-11.11***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]

Panel Unit Root Test for LIPI				
		Im, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square
Group A	1980 to 1999	-3.29***	77.93***	523.65***
		[0.0000]	[0.0000]	[0.0000]
	1999 to 2009	-7.12***	116.01***	453.89***
		[0.0000]	[0.0000]	[0.0000]
Group B	1980 to 1999	-13.18***	177.25***	183.49***
		[0.0000]	[0.0000]	[0.0000]
	1999 to 2009	-4.51***	38.22***	193.09***
		[0.0000]	[0.0000]	[0.0000]

(a) Values in parentheses are P-values.
(b) LIPI-Logarithm of Industrial Production Index
(c) Group-A consist of 11 countries that adopted Euro while Group-B consist of 4 countries that did not adopted Euro.
(d) ***,**,* significant at: 1%, 5%, 10% respectively

models. Given the stationarity of the EGARCH model, constructed conditional variance obtained from the model will also be stationary.[17] Other than this, panel unit root tests are employed to check the stationarity of the industrial production. Results of the ADF tests and panel unit root tests are presented in Table 3.1. Growth rate of industrial production also appears to be integrated of order zero. On the basis of this, variables are used in levels for the regression analysis.

3.4.3. Impact of Exchange Rate Volatility on Industrial Production

In this section, we have used methodology regarding two-stage least square with pooled data to check the impact of exchange rate volatility on industrial production. Differences in the direction and level of impacts are analyzed across countries. Differences in the impacts of the exchange rate volatility before and after the introduction of common currency for the countries that have adopted Euro (Group-A) and for the countries that have not adopted Euro (Group-B) are also analyzed. Analysis is performed both on the basis of real and nominal exchange rates volatilities.

The results based on the regressions using two-stage least square with pooled data are presented in Table 3.2. The volatility in the nominal exchange rate, trade, and government bond yield are used as explanatory variables in the regressions while growth rate of industrial production index is kept on the left hand side. Separate coefficients of volatility in nominal exchange rate of each country are estimated. All the variables report signs according to the theory.

Countries that have adopted common currency show results similar to the theory. The coefficient of logarithmic value of trade indicates that trade is beneficial for growth rate of industrial production for both groups of countries. Similarly, coefficients of government bond yield show positive effect on the industrial production growth indicating that

[17] As volatility of nominal (real) exchange rate is also integrated of order zero, hence it indicates no co-integration among industrial production and nominal (real) exchange rate volatility.

Table 3.3: Impact of exchange rate volatility (Nominal) on industrial production

$$Y_{it} = cLTRA_{it} + cLGBY_{it} + c_i VOLner_{it} + \varepsilon_{it}$$

Variables	Before 1998		After 1998	
	Group A	Group B	Group A	Group B
LTRA	1.273 (10.86)***	0.831 (9.72)***	0.064 (4.81)***	0.098 (3.42)***
LGBY	0.059 (10.43)***	0.052 (9.39)***	0.082 (3.22)***	0.020 (2.30)***
VOL_NER_AUS	-5.225 (-10.85)***		-0.743 (-4.74)***	
VOL_NER_BEL	-5.998 (-10.85)***		-0.810 (-4.76)***	
VOL_NER_FIN	-5.203 (-10.85)***		-0.704 (-4.73)***	
VOL_NER_FRA	-6.246 (-10.85)***		-0.835 (-4.76)***	
VOL_NER_GER	-6.576 (-10.85)***		-0.872 (-4.77)***	
VOL_NER_IRE	-5.311 (-10.81)***		-0.727 (-4.72)***	
VOL_NER_ITA	-6.292 (-10.85)***		-0.826 (-4.73)***	
VOL_NER_NET	-5.903 (-10.85)***		-0.811 (-4.76)***	
VOL_NER_POR	-5.119 (-10.84)***		-0.694 (-4.74)***	
VOL_NER_SPA	-5.741 (-10.85)***		-0.790 (-4.75)***	
VOL_NER_DEN		-9.215 (-9.73)***		-1.183 (-3.41)***
VOL_NER_NOR		-3.526 (-9.70)***		-1.006 (-3.40)***
VOL_NER_SWE		-3.768 (-9.70)***		-1.044 (-3.41)***
VOL_NER_UKI		-4.192 (-9.71)***		-1.181 (-3.41)***
Cross sections	10	4	10	4
Number of Observations	2005	901	1199	475

a) Group A consists of countries that have adopted common currency on January 1999 while Group-B consists of countries that did not adopted common currency on January 1999.
b) Luxembourg is dropped from the analysis because of unavailability of data for Industrial Production.
c) LTRA: Logarithmic value of the trade, LGBY: Logarithmic value of Government Bond yield, VOL_NER: Volatility of Nominal Exchange Rate.
d) ***,**,* significant at: 1%, 5%, 10% respectively.

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rise in bond yield precede an economic upturn. In the light of the regression results, we find negative and significant coefficients of volatility in nominal exchange rate for each country. This indicates that an increase in the nominal exchange rate volatility will generate an extra risk that will hamper industrial production. Furthermore, per unit negative effect of the nominal exchange rate volatility is higher in case of Germany. On the other hand, Portugal's industrial production is least negatively affected by an increase in volatility of nominal exchange rate.

The signs and significance of explanatory variables are not changed across two groups of countries (Group A and Group-B). Similar to Group-A, trade and government bond yield are positively related with industrial production in regressions of Group-B. The level of impacts of trade and government bond yield of Group-A are lower than that of Group-B. Similarly, all the countries of Group-B find negative impact of volatility in nominal exchange rate on industrial production. Moreover, in case of Denmark, industrial production is most negatively affected by changes in volatility of nominal exchange rate as compared to other countries of Group-B. On the other hand, Norway's industrial production is negatively less affected by volatility in exchange rate as compared to other countries of Group-B. The negative impact of volatility in exchange rate on industrial production is higher for all countries of Group-A as compared to the negative impact of volatility in nominal exchange rate of Group-B, except for Denmark where it is higher than the countries of Group-A.

Results of the regression analysis for both the groups, using data after the introduction of Euro, provide interesting findings. Again, trade and government bond yield are positively related with industrial production for both groups of the countries. Similar to before the introduction of common currency, in the second sub-sample, volatility in nominal exchange rate is negatively related with industrial production for both groups of the countries. However, intensity of the negative impact of the exchange rate volatility on industrial production decreased numerously after the introduction of Euro for both groups of countries. Among the countries of Group-A, still Germany has higher negative impact

Table 3.4: Impact of exchange rate volatility (real) on industrial production

$$Y_{it} = cLTRA_{it} + cLGBY_{it} + c_i VOLrer_{it} + \varepsilon_{it}$$

Variables	Before 1998		After 1998	
	Group A	Group B	Group A	Group B
LTRA	1.298 (10.79)***	0.840 (9.71)***	0.073 (5.19)***	0.098 (3.37)***
LGBY	0.060 (10.37)***	0.053 (9.42)***	0.095 (3.60)***	0.020 (2.26)***
VOL_RER_AUS	-5.327 (-10.78)***		-0.844 (-5.13)***	
VOL_RER_BEL	-6.111 (-10.78)***		-0.920 (-5.15)***	
VOL_RER_FIN	-5.300 (-10.78)***		-0.801 (-5.13)***	
VOL_RER_FRA	-6.363 (-10.78)***		-0.947 (-5.15)***	
VOL_RER_GER	-6.700 (-10.78)***		-0.989 (-5.16)***	
VOL_RER_IRE	-5.412 (-10.75)***		-0.826 (-5.11)***	
VOL_RER_ITA	-6.410 (-10.78)***		-0.938 (-5.11)***	
VOL_RER_NET	-6.013 (-10.79)***		-0.920 (-5.15)***	
VOL_RER_POR	-5.215 (-10.77)***		-0.787 (-5.13)***	
VOL_RER_SPA	-5.849 (-10.78)***		-0.898 (-5.14)***	
VOL_RER_DEN		-9.317 (-9.72)***		-1.186 (-3.36)***
VOL_RER_NOR		-3.570 (-9.69)***		-1.007 (-3.35)***
VOL_RER_SWE		-3.815 (-9.69)***		-1.046 (-3.35)***
VOL_RER_UKI		-4.242 (-9.70)***		-1.183 (3.36)***
Cross sections	10	4	10	4
Number of Observations	1997	897	1174	470

a) Group A consists of countries that have adopted common currency on January 1999 while Group-B consists of countries that did not adopted common currency on January 1999.
b) Luxembourg is dropped from the analysis because of unavailability of data for Industrial Production.
c) LTRA: Logarithmic value of the trade, LGBY: Logarithmic value of Government Bond yield, VOL_NER: Volatility of Nominal Exchange Rate.
d) ***,**,* significant at: 1%, 5%, 10% respectively.

and Portugal has lowest negative impact of the volatility in exchange rate. On the other hand, among the countries of Group-B, Denmark has highest negative impact and Norway has lowest negative impact of exchange rate volatility on industrial production.

Comparing results of each country across two sub-samples with respect to time (before and after the introduction of common currency), provides interesting feedback for the benefits of common currency. In short, per unit positive impact of trade has decreased after the introduction of Euro for both groups of countries. The positive impact of GBY increased for Group-A while it decreased for Group-B. Moreover, the negative impact of the volatility in nominal exchange rate decreased after the introduction of Euro for each country. Interestingly, intensity of the negative impact was higher for Denmark before the introduction of Euro, while it become higher for all the countries of Group-B as compared to countries of Group-A in the second sub-sample. This indicates that the common currency helps each country of the European Union, whether if adopted common currency or not, to decrease the negative impact of the volatility in nominal exchange rates on industrial production but its reduction in impact is higher for the countries that adopted common currency.

Furthermore, results based on the real exchange rate volatility for both groups of countries are presented in Table 4.3. Again, results show similar trends for all the variables of both groups of countries. A positive impact of trade and government bond yield on industrial production is observed for all the countries. The volatility in real exchange rate is negatively related to the industrial production before and after the existence of Euro. The negative impact of the real exchange rate volatility on industrial production remained higher for the countries that have not adopted common currency after its introduction.

Summarizing current section, on the basis of coefficients of regression, trade contributes less for the countries that have adopted the common currency as well as for the countries that have not adopted the common currency. Moreover, Level of positive impact of government bond yield increased for Group-A while its intensity decreased for Group-B.

Coefficients of the critical variable (volatility of nominal exchange rate and volatility of real exchange rate) show negative effect on the industrial production for both groups of countries. The coefficients of the exchange rate volatility are lower after the introduction of common currency indicating common currency has helped to decrease negative impact of the exchange rate volatility. Furthermore, Norway, Sweden, and United Kingdom are facing lower level of negative impact as compare to the countries of Group-A before the introduction of common currency. However, they have started facing higher level of negative impact as compared to countries of Group-A after the introduction of Euro.

3.5. Conclusion

The impact of exchange rate volatility on real economy appears to be more important because of changing policies and world scenario. The introduction of Euro provides new base for research and new questions need to be answered: Did introduction of Euro help to decrease volatility of the exchange rate for the European countries; Did the exchange rate volatility faced by different countries have similar impacts on the industrial production; Did exchange rate volatility have similar impacts for the countries which are part of Europe but have not adopted the common currency. This study employs monthly data from January 1980 to February 2009 for the analysis. Furthermore, we split the period of analysis to before and after the introduction of Euro.

Initial graphical and descriptive analysis indicates that members of European Union that have adopted the common currency face mixed evidence of volatility in exchange rate. Most of the countries that have adopted common currency are able to decrease variations in the volatility of the nominal exchange rate after the introduction of Euro. An increase in the standard deviation of the volatility of nominal exchange rate after the introduction of Euro is found for all countries that have not adopted common currency. On the basis of the real exchange rate, ratio of the countries that faced an increase in the standard deviation of volatility in the real exchange rate indicates the existence of huge variation in the inflation across two groups of countries. Moreover, we can conclude that due to un-

availability of strong support for currency, countries that did not adopt common currency face more variations in the volatility of exchange rate in the second sub-period.

Pooled data regressions show that trade started contributing less effectively to the industrial production for the countries that have adopted common currency as well as for the countries that have not adopted it. On the other hand, intensity of per unit positive impact of government bond yield is increased for the countries that have adopted common currency while it is decreased for the countries that have not adopted the common currency. The negative impact of the nominal exchange rate volatility is decreased for both types of the countries after the introduction of common currency. All countries of the analysis are also facing reduction in the impact of real exchange rate volatility on the industrial production. Moreover, Denmark, Norway, Sweden and United Kingdom face higher negative coefficients of exchange rate volatility as compared to the countries of Group-A after the introduction of Euro. Among these countries that have adopted common currency, Germany faces higher level of negative impact of the exchange rate volatility before and after the introduction of Euro. On the other hand, among the countries that have not adopted Euro as common currency, Denmark faces higher negative impact of the exchange rate volatility before and after the introduction of common currency.

We can conclude on the basis of available findings that overall countries enjoy more benefits after adopting the common currency even if they also find an increase in the real exchange rate volatility. It can also be concluded that the basket of fruit is not same for every country that have adopted common currency.

Chapter 4

Macroeconomic Determinants and Spillover Effects of Financial Markets

4.1. Introduction

One of the central unsolved problems in research on financial markets remains the disagreements regarding the sources of the financial markets volatility. The number of models based on univariate time series information have been developed to predict volatility and repeatedly used to predict volatility. However, models that identify macroeconomic variables as prime source of volatility in financial markets are hard to find. The macroeconomic sources identified by various methodologies appear to be much weaker than seems reasonable.

In this study, we provide an empirical investigation of the links between stock market volatility and exchange rate volatility. Other than this, study also tries to highlight and evaluate various economic variables as the contributors to the volatility in these markets using sophisticated econometric techniques. Our exploration is motivated by the existence of differences in empirical studies regarding the sources of financial markets volatility.[18] Moreover, this study aims to provide a strong literature background along with empirical findings regarding these issues. In addition, and crucially, our empirical approach exploits the group differences along with cross-country variations to uncover links that would likely be lost in simple time series analysis.

[18] Detail about the differences is provided in the next Section.

In a hypothetical way, main questions that the present study tries to answer are:

1. Does volatility in one type of the financial market returns (stock market/exchange rate market) cause changes in volatility of other type of the financial market returns (exchange rate market/stock market)?
2. Which macroeconomic variables contribute to the volatility of financial market returns (stock market returns/exchange rate market returns)?
3. Do size and liquidity of the financial markets play any role in determining level of volatility in the financial markets?

The remainder of the paper is organized as follows: A detailed review of the studies regarding the link between the financial markets volatility and the economic variables is presented in Section II. Later in Section III, methodological issues and construction of the necessary variables are described. Section IV explains the variables used for analysis. The results are presented in Section V, while a conclusion with brief summary and remarks is presented in Section VI.

4.2. Literature Review

There are a number of factors contributing to the fluctuations of the exchange rate returns and the stock market returns. In one way or the other, a number of studies try to evaluate research questions highlighted in previous section. However, there is no theoretical consensus on the interaction and sources of the volatility of stock market returns and the volatility of exchange rate returns. In the present section, first we will present theoretical and empirical links between the volatility of exchange rate returns and the volatility of the stock market returns. Later on, sources of the stock market volatility and exchange rate volatility are presented in detail.

4.2.1. Spillover effects of financial markets

In the literature, flow and stock-oriented types of models are proposed to explain the interaction between stock market volatility and exchange rate volatility. According to Choi et

al. (2008), flow models explain the effects of exchange rate movements on the international competitiveness of the firms as well as the balance of the trade position. Similarly, changes in the share prices on the stock market affect aggregate demand through wealth and liquidity effects. A reduction in the stock prices decreases wealth of local investors and further also decreases liquidity in the economy. The interest rate decrease due to reduction in the liquidity which in turn induce capital outflows and in turn currency depreciation. Choi et al. (2008) using EGARCH model on daily data from January 1990 to December 2004, report unidirectional volatility spillover from New Zealand stock market returns to exchange rate changes.

Another type of model is the stock-oriented model in which relationship between stock market and exchange rate is explained through a country's capital accounts. Adjasi et al. (2008) report a negative relationship between the exchange rate volatility and the stock market returns. They also find a positive relationship between inflation and stock market returns, i.e. increase in consumer prices will lead to a rise in stock market volatility. Adjasi and Biekpe (2005b) checked the relationship between stock market returns and exchange rate movements for seven African countries. Co-integration tests show a decrease in the stock market return due to an increase in the exchange rate depreciation in the long run for some of the countries, while increase in the stock market return in the short run is due to an increase in exchange rate depreciation.

On the other hand, Mishra (2004) reported that there is no Granger causality between the exchange rate and stock market returns. Furthermore, Pan et al. (2007) using data for Malaysia highlighted no co-integration between the exchange rate and the Malaysian stock market returns in the long run, while their pair wise causality tests indicate unconditional causality exists from the exchange rate to the stock market in the short run.

Irrespective of the existence of huge literature on the linkages and interactions between the exchange rates and stock prices, only a limited body of research has attempted to analyze the possible linkage and interaction between volatility in exchange rate return and

volatility in stock market return. Much of the available empirical evidence on the linkages between stock markets and exchange rates is concentrated on the first moments. Kanas (2000) was one of the first studies who have analyzed volatility spillovers from stock market returns to exchange rate change in USA, UK, Japan, Germany, France, and Canada. The author finds that volatility spillovers from stock market returns to exchange rate changes for all countries except for Germany, while volatility spillovers from exchange rate changes to stock returns were insignificant for all countries. Later, Kanas (2002) also finds evidence that volatility in stock market return is a significant determinant of the exchange rate volatility for the United States, the United Kingdom, and Japan. Using multivariate EGARCH model for the G-7 countries Yang and Doong (2004) find that information flows between two markets. They also find that two markets are integrated. Movement of stock prices will affect future exchange rate movements, while changes in exchange rates have less direct impact on future changes of stock prices. Study concludes that stock markets play a relatively more important role than foreign exchange markets in the first and second moment interactions and spillovers. Wu (2005) examines volatility spillovers between stock prices and exchange rates for Indonesia, Japan, Philippines, Singapore, South Korea, Taiwan, and Thailand for the period 1997-2000. The author divides the sample into crises and recovery periods. A bi-directional relationship between the volatility of stock returns and exchange rate changes is reported during the recovery period for all the countries except for South Korea. The author also finds that volatility spillovers increase in the recovery period. Qayyum and Kemal (2006) using bi-variate EGARCH model showed a strong relationship between volatility of foreign exchange market and the volatility of stock market returns. They finds that returns of the stock market are sensitive to the returns of exchange rate as well as volatility of exchange market while returns in foreign exchange market are mean reverting and they are affected by the volatility of stock market returns.

Morales (2008a) investigates the nature of volatility spillovers between stock returns and a number of exchange rates in six Latin American countries and one European economy using data from 1998 to 2006. Results show that the volatility of stock returns affect the

volatility of exchange rates but no evidence of volatility transmission in the opposite direction is found. Later on, Morales (2008b) analyzes the issue for three different regions of Europe. The author reports no evidence of co-movement between these two variables in long run or in short run.

Despite all these studies that try to put clear evidence on interlinks between stock market volatility and volatility in exchange rates, still the relation is not clear. Other than this, none of these studies try to explore the link for European countries. Present study tries to put some more evidence on the link between stock market volatility and exchange rate volatility by using data of European countries.

4.2.2. Economic sources of stock market return volatility

Theoretical models indicate that the volatility in stock returns depend not only on the asset-specific fundamentals but also on non-diversifiable risk factors driven by macroeconomic aggregates. The list of possible macroeconomic variables that can affect stock market volatility is very large. The general failure to link macroeconomic real variables to financial markets volatility holds true for the case of stock returns. There are a number of studies describing the relationship between stock market returns and macroeconomic variables but few studies have tried to link real economic variables as main contributors to stock market volatility in the late 1990's. Empirical evidence of the information contained in macroeconomic variables to predict the stock market volatility has been growing. Officer (1973) shows that volatility of money, aggregate stock volatility, and industrial production increased during the period of depression. The study also finds that stock volatility was at similar levels before and after the depression. Schwert (1989) in a classic paper under the title 'Why does stock market volatility change over time?' based on monthly data from 1857-1987 tries to link macroeconomic volatility with stock market volatility. He did not find much in the analysis and concludes that stock market volatility is not closely related to the volatility of other economic variables. Davis and Kutan (2003) also report that the variability of inflation and output growth rate has weak predic-

tive power for conditional stock market volatility. Morelli (2002) and Calvet et al. (2006) also approved the hypothesis that the volatility in macroeconomic variables does not explain or explain little about the volatility of stock market returns.

On the other hand, a number of studies report various macroeconomic variables as the important and main contributors to the stock market volatility. Liljeblom and Stenius (1997) find using Finnish data that conditional stock market volatility changes between one-sixth and more than two-thirds because of conditional macroeconomic volatility, namely inflation, industrial production, and money supply. Errunza and Hogan (1998) find a significant influence of monetary and real macroeconomic volatility on stock market volatility for the seven largest European countries. Beltratti and Morana (2006) find causality in both directions but direction of causality is stronger from macroeconomic to stock market volatility. Engle and Rangel (2008) used Spline-GARCH model for equity markets of 50 countries for up to 50 years of daily data to determine macroeconomic determinants of volatility. Authors find that the volatility in macroeconomic factors such as GDP growth, inflation, and short term interest rate are important explanatory variables that increase volatility. They also find consistent evidence that growth rate of output and high inflation are positive determinants of financial markets volatility. Similarly, Engle et al. (2008) also used Spline-GARCH and GARCH-MIDAS models to analyze the impacts of inflation and growth rate of industrial production on stock market volatility. They find significant impact of these variables on volatility in short as well as in long run. They also find for the full sample that the long run components typically accounts for roughly half of predicted volatility. On the other hand, at a daily level, inflation and industrial production growth account for between 10% and 35% of one day ahead volatility prediction.

Saryal (2007) using GARCH models on monthly data of Turkey and Canada checked the contribution of inflation to stock market volatility. The author finds that the inflation has high predictive power for stock market volatility in the case of Turkey, whereas it is weaker but significant in the case of Canada. Among the recent papers, Diebold and Yilmaz (2010), using data for forty countries with 20 years and seventy countries with 10

years find a clear link between macroeconomic fundamentals and stock market volatility. Rahman et al. (2009) analyzing macroeconomic determinants of Malaysian stock market, indicates that Malaysian stock market is sensitive to changes in macroeconomic variables. Furthermore, based on the variance decomposition analysis, authors claim that stock market has stronger dynamic interaction with reserves and industrial production index.

One of the main findings among researchers is that the stage of business cycle affects stock market volatility. Going more into detail, stock market volatility is higher in recessions. Hypothesis is supported by Hamilton and Lin (1996). Later, Gerlach et al. (2006) using long data series investigates the behavior of the volatility of returns in bond and stock markets for a sample of eight countries. They show that the volatility is high in periods of economic and political turbulence.

Researchers have sought to analyze the relative importance of economy-wide factors, industry-specific factors, and firm specific factors on a stock return's volatility. Number of studies have tried to provide sources (inflation, GDP, industrial production, interest rate, political instability, inter war periods, regulations of stock markets, and liberalization) of the stock market's volatility based on various indicators. In European region researchers have tried to explore the link for individual country but none of the studies have tried to explore contributions of macroeconomic fundamentals to the volatility of stock market returns for the panel of European countries. Presently, we are interested to identify macroeconomic variables that contribute significantly to variations in the stock market returns of 27 European countries.

4.2.3. Sources of Exchange rate's returns volatility

Linking variations of exchange rate to real macroeconomic variables is not a new idea. The literature on the determinants of the volatility of the exchange rate identifies a number of variables as prime contributors to exchange rate volatility. According to Edwards

and Savastano (1999) the equilibrium real exchange rate in long run is determined by a set of foreign and domestic real variables called fundamentals. Usually, these include: government spending, terms of trade, a country's openness to international trade, foreign capital inflows, net foreign assets, and sectoral productivity differentials (the Balassa-Samuelson effect).[19]

Interestingly, empirical literature provides evidences on both directions. Flood and Rose (1999) show that there are no macro-fundamentals that can explain the dramatic volatility of the exchange rate. On the other hand, Devereux and Lane (2003), identify variables: bilateral trade as a share of GDP, the standard deviation of the bilateral growth rate differentials, log of the products of two countries GDP, size of the domestic financial sector, and bilateral external debt play a significant role in determining the bilateral volatility of the exchange rate. Canales-Kriljenko and Habermeier (1999) using data of 85 developing and transition economies find inflation, real GDP growth, trade openness, and fiscal deficit in percent of GDP as the most important macroeconomic determinants of nominal exchange rate volatility.

In the European region, Stancik (2007), analyze the key factors contributing to the volatility of exchange rate using daily data from January 1, 1999 to December 31, 2004 for Czech Republic, Hungary, Latvia, Poland, Slovakia, and Slovenia. Author concludes that openness has a negative effect on exchange rate volatility, and the extent of this effect varies substantially across countries. Hau (2000, 2002) and Obstfeld and Rogoff (2000) also linked exchange rate volatility with trade openness negatively indicating that more-open economies exhibit less volatile real exchange rates. Because of existing gap and controversies in literature about the contributions of fundamental macroeconomic variables, we try to highlight some of the prime contributors to exchange rate volatility.

[19] A differential in productivity growth between the countries leads to differentials in inflation rates is called Balassa-Samuelson effect after Balassa (1964).

Hence, compared to previous studies based on determinants of financial markets volatility, our approach has the following advantages: (1) We analyze determinants of stock market volatility as well as exchange rate volatility in European countries; (2) Rather than using simple standard deviation as the measure of volatility, we use extensive *AR(k)-EGARCH(p,q)* model to capture volatility of stock market returns and volatility of exchange rates returns; (3) we try to determine economic sources of stock market volatility and exchange rate volatility in Europe using techniques of panel data; (4) we focus on the three economic variables (i) inflation, (ii) industrial production growth, and (iii) growth rate of trade.

4.3. Methodology

Following the methodology of Kanas (2000), we use stock market returns and exchange rate returns calculated at the first differences of the natural logarithms. i.e.

$$R_{it}^{s} = \log(SMI_{it}) - \log(SMI_{it-1}) \quad \ldots\ldots (4.1)$$

and

$$R_{it}^{E} = \log(ER_{it}) - \log(ER_{it-1}) \quad \ldots\ldots (4.2)$$

Where R_{it}^{S} and R_{it}^{E} are the stock market return and exchange rate return of country 'i' in period 't', SMI_{it} and ER_{it} are the stock market index and exchange rates of country 'i' in period 't'.

Many extensions to the model have been introduced since the introduction of ARCH-GARCH models by Engle (1982) and Bollerslev (1986) for the measurement of volatility. We employ *AR(k)-EGARCH(p,q)* for the measurement of volatility in stock market returns and exchange rate returns for each of the European country in analysis separately. Significant evidence by various researchers, summarized by Hamilton (1994, p. 672), supports the use of EGARCH models. The log form of the conditional variance is one of

the nice features of the EGARCH models, thereby guaranteeing that the variance is positive without any parametric restriction. Formally, similar to Wang (2010), *AR(k)-EGARCH(p,q)* model for measuring volatility in stock market return of country '*i*' can be expressed as follows:

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + u_t \qquad \text{.....} \quad (4.3)$$

$$u_t = \varepsilon_t h_t^{1/2} \qquad \varepsilon_t / \psi_{t-1} \sim N(0, h_t)$$

$$h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

OR

$$\log(h_t) = \omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \qquad \text{.....} \quad (4.4)$$

Where R_t is the stock market return, α_o is the mean exchange rate return, conditional on information set at time $t-1(\psi_{t-1})$. Logarithm of the conditional variance (h_t) on right hand side imply that the leverage effect is exponential, rather than quadratic, and that forecasts of the conditional variance are guaranteed to be nonnegative without imposing any restriction on the coefficients. The presence of leverage effects can be tested by the hypothesis $\theta_m < 0$. On the other hand, the impact is asymmetric if $\theta_m \neq 0$.

Furthermore, sources of financial markets are explored in three dimensions: Firstly, how much volatility in one financial market affects volatility of other financial market; secondly, how macroeconomic variables affect volatility of financial markets?; and thirdly, how much variations are explained by the size of the financial markets? In short, based on the methodology of Stancik (2007), following equation is estimated using various models of panel data to determine variables that can affect volatility in financial markets.

$$VR_{it}^{S} = \alpha + \delta_0 VR_{i,t}^{E} + \beta X_{it} + \varepsilon_{it} \qquad \text{.....} \quad (4.5)$$

Where VR_{it}^{S} is the volatility of stock market returns of country 'i' in period 't', α is the constant, X_{it} represents macroeconomic and financial variables and ε_{it} is a random disturbance term. Similar regression by taking volatility of exchange rate returns as dependent variable (VR_{it}^{E}) and VR_{it}^{S}, macroeconomic variables, and financial variables as the explanatory variables.

The estimation techniques for panel data include constant coefficient model, fixed effect model, and random effect model. In the constant coefficient model α is considered to be constant across countries, and β coefficients of the vector of explanatory variables as fixed. In the second model, fixed effect model, in which intercept terms vary across countries, however, slope coefficients are same for all countries. In the third model, random effect model take differences across countries as random. The selection of appropriate model is done with the help of tests like F(Chow-test) which compares efficiency of Pooled-OLS to the fixed effect models, Breusch-Pagan LM test to check if firm-specific intercepts are different from each other (comparing random effect model with Pooled-OLS), and Hausman specification test is applied to compare the fixed effect models with random effect models.

4.4. Data

The analysis is conducted for the panel of 27 European countries (Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom). The analysis will be conducted for the period from January 2002 to December 2008.

As described in the section of methodology, we use volatility of stock market returns and volatility of exchange rate returns as the dependent variable. These volatility variables are calculated using *AR(k)-EGARCH(p,q)* model specified in previous section. Data of stock

market indices is taken from various issues of *Global Stock Markets Factbook*, published by Standard's and Poor's. Moreover, data for real effective exchange rate is taken from *International Financial Statistics* (data CD-2009). We used growth rate of industrial production index (GIP), growth rate of trade (GTRA), logarithmic value of consumer price index (LCPI), and growth rate of total reserves (GTR) as possible macroeconomic determinants of volatility in financial markets. Data for these variables are also taken from *International Financial Statistics* (data CD-2009). To check the impact of size of the financial markets on its volatility, we employ the logarithmic value of market capitalization (LMC) and the logarithmic value of trading value (LTV) as possible explanatory variables. Data for these variables is taken from *Global Stock Markets Factbook*.

4.5. Results and Results Discussion:

Using the methodology presented in section 4.3 and panel data of 27 European countries, we present results in the current section. In section 4.5.1 we present results regarding inter-relationship among volatility of stock market returns and exchange rate returns, in section 4.5.2 we present results regarding the determinants of financial markets volatility using Arellano-Bond model.

4.5.1. Volatility in Financial markets

The *AR(k)-EGARCH(p,q)* models are employed to evaluate volatility in stock market returns and exchange rate returns for 27 countries.[20] Descriptive statistics for the panel of the macroeconomic variables, financial markets variables, and the volatility of financial markets returns are presented in Table 4.1.

It can be observed that on average volatility in real effective exchange rate is higher than the volatility in stock market returns. Similarly, variations in volatility of real effective

[20] Detailed specification of *AR(k)-EGARCH(p,q)* model for each country is presented in APPENDIX C.

Table 4.1: Descriptive Statistics

Variable	Obs.	Mean	STD	Max.	Min.
GIP	2158	0.0016	0.1116	0.6847	-0.7307
GTRA	2217	0.0103	0.1098	0.4701	-0.5542
LCPI	2268	4.6101	0.0783	4.9374	4.1986
GTR	2241	0.0015	0.1104	0.7791	-2.0673
LMC	2016	4.8835	0.9657	6.6327	2.6911
LTV	2016	3.4408	1.4356	5.8800	0.0000
SMV	2112	1.0033	0.0070	1.2307	1.0000
REERV	2207	1.0047	0.0258	1.2553	1.0000

Abbreviations used: Obs.-Observations; STD-Standard deviation; Max.-Maximum Value; Min.-Minimum Value; GIP- Growth rate of industrial production index; GTRA - Growth rate of trade; LCPI – Logarithm of consumer price index; GTR - Growth rate of total reserves; LMC- Logarithm of market capitalization; LTV- Logarithm of trading value; SMV-Stock market volatility; and REERV-Real effective exchange rate volatility.

exchange rates are also observed to be higher than the variation of volatility in stock market returns. For initial inter-relationship between the financial and macroeconomic variables is checked by correlation coefficients. Correlation coefficients between the volatility of financial variables and potential explanatory variables are presented in Table 4.2.

Table 4.2: Correlation Coefficients between Financial and Macroeconomic variables

	GIP	GTRA	LCPI	GTR	LMC	LTV	SMV	REERV
GIP	1.0000							
GTRA	0.7098	1.0000						
LCPI	-0.0317	-0.0889	1.0000					
GTR	-0.0001	0.0471	-0.0319	1.0000				
LMC	-0.0150	-0.0249	0.1118	-0.0758	1.0000			
LTV	0.0022	-0.0073	0.0463	-0.0656	0.9663	1.0000		
SMV	-0.0238	-0.1058	0.1916	-0.0043	-0.1678	-0.1677	1.0000	
REERV	0.0008	-0.0011	-0.0449	-0.0675	-0.1927	-0.2060	-0.0315	1.0000

Abbreviations used: GTRA - Growth rate of trade; LCPI – Logarithm of consumer price index; GTR - Growth rate of total reserves; LMC- Logarithm of market capitalization; LTV- Logarithm of trading value; SMV-Stock market volatility; and REERV-Real effective exchange rate volatility.

Coefficients of correlations indicate that trade is positively linked with the growth of industrial production while inflation, total reserves and market capitalization are negatively linked. Correlation between the volatility of stock market returns and growth rate of in-

dustrial production is negative while the correlation between volatility of real effective exchange rate and growth rate of industrial production is positive. Other than growth rate of industrial production all other macroeconomic and financial variables are negatively linked with volatility of real effective exchange rate. Detailed analysis with the help of panel regressions is presented in the next section.

4.5.2. Sources of volatility in financial markets

The estimation techniques of panel data; described in section of methodology, using monthly data for macroeconomic variables, volatility of real effective exchange rate return, and volatility of stock market return for 27 European countries has been employed. At overall level, three countries (Cyprus, Luxembourg, and Malta) are dropped from the analysis because of unavailability of data of financial indicators. The results of the regression analysis are presented in Table 4.3.

Significance of F-statistics-(a) indicates the overall goodness of the models. To choose among the different estimation models; namely, pooled-ordinary least square models, fixed effect models, and random effect models we used different models. In brief, Breusch and Pagan test that is employed to compare the random effect models against the Pooled-OLS indicate random effect models are preferred over the Pooled-OLS. Similarly, Chow-test that is used to compare the fixed effect models against Pooled-OLS models indicate fixed effect models are preferred over Pooled-OLS. Furthermore, the Hausman-test that is employed to test significance of fixed effects against random effects give mixed results. Regressions in which volatility of the stock market returns is used as dependent variable, fixed effect models are preferred over random effects. On the contrary, regressions where volatility of real effective exchange rates is used as dependent variable, random effect models are preferred over fixed effect models.

The volatility of real effective exchange rates is used as an explanatory variable in the regression of determinants of volatility of stock market returns. In random effect models, an increase in the exchange rate volatility causes reduction in the volatility of stock

Table 4.3: Macroeconomic sources of financial markets volatility

Independent Variable	Dependent Variable							
	SMV				REERV			
	FE	RE	FE	RE	FE	RE	FE	RE
REERV	-0.0158	-0.0168	-0.0055	-0.0153				
	(-1.24)	(-2.20)**	(-0.42)	(-1.94)*				
SMV					-0.0508	-0.0540	-0.0169	-0.0198
					(-1.24)	(-1.32)	(-0.42)	(-0.49)
GIP	0.0052	0.0060	0.0062	0.0062	0.0020	0.0020	0.0023	0.0023
	(2.65)***	(3.03)***	(3.10)***	(3.12)***	(0.58)	(0.56)	(0.66)	(0.65)
GTRA	-0.0087	-0.0104	-0.0097	-0.0103	-0.0024	-0.0024	-0.0035	-0.0033
	(-4.37)***	(-5.16)***	(-4.81)***	(-5.12)***	(-0.68)	(-0.66)	(-0.97)	(-0.92)
LCPI	0.0384	0.0198	0.0218	0.0178	-0.0115	-0.0101	-0.0251	-0.0237
	(13.27)***	(9.77)***	(9.42)***	(8.86)***	(-2.12)**	(-1.92)*	(-6.10)***	(-5.79)***
GTR	0.0002	0.0006	0.0001	0.0005	0.0067	0.0066	0.0069	0.0066
	(0.61)	(3.18)***	(0.21)	(2.30)**	(11.39)***	(11.22)***	(11.55)***	(11.24)***
LMC	-0.0098	-0.0022			-0.0047	-0.0052		
	(-10.71)***	(-8.22)***			(-2.79)***	(-3.24)***		
LTV			-0.0027	-0.0012			0.0012	0.0007
			(-5.36)***	(-6.75)***			(0.17)	(0.43)
C	0.8884	0.9336	0.9169	0.9366	1.0703	1.0709	1.0704	1.0708
	(53.38)***	(76.45)***	(54.79)***	(75.16)***	(26.58)***	(26.38)***	(26.55)***	(26.31)***
Obs.	1942	1942	1942	1942	1942	1942	1942	1942
Countries	24	24	24	24	24	24	24	24
F-test(a)	38.51	177.17	23.36	154.44	25.56	150.67	24.5	139.89
P-Value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Model Specification Test								
Random Effect Vs OLS								
Breusch and Pagan test	25.02		20.98		47958.02		47399.21	
P-Value	0.0000		0.0000		0.0000		0.0000	
Fixed Effect vs OLS								
F (Chow test)	6.02		2.93		344.71		340.73	
P-Value	0.0000		0.0000		0.0000		0.0000	
Fixed Effect vs. Random Effect								
Hausman Test	72.65		21.42		4.31		9.63	
P-Value	0.0000		0.0015		0.6349		0.1411	

a) Fixed Effect model is used for the estimations of the model.
b) SMV-Stock market volatility, REERV-Real effective exchange rate volatility, GIP- Growth rate of industrial production index, GTRA - Growth rate of trade, LCPI – Logarithm of consumer price index, GTR - Growth rate of total reserves, LMC- Logarithm of market capitalization, LTV- Logarithm of trading value, C-Constant
c) ***,**,* significant at: 1%, 5%, 10% respectively

market returns. Same signs but insignificant coefficients can be observed in fixed effect models. According to Hausman test, FE models are preferred over RE models. Furthermore, while determining sources of exchange rate volatility, coefficients of stock market volatility are insignificant. It can be concluded that neither volatility of stock market returns contribute to the volatility of exchange rates nor volatility of exchange rates contribute to the volatility of stock market returns.

In the light of results presented in table 4.1, it can be stated that macroeconomic variables contribute significantly to stock market volatility while not much evidence is found in the case of exchange rate volatility. Precisely, increase in the growth rate of the industrial production, and inflation leads to the higher volatility of stock market returns. On the other hand, increase in the inflation decrease volatility in the stock market returns. In addition, weak evidence of increase in variation of stock market returns through increase in total reserves is also found. Furthermore, increase in market capitalization and trading value help to reduce volatility in stock market returns.

Furthermore, while highlighting macroeconomic determinants of the volatility of real effective exchange rates; interesting results are observed. The coefficients of all the macroeconomic variables, i.e. growth rate of industrial production and growth rate of trade are insignificant. Other than this, the coefficients of inflation are negative indicating inflation help real exchange rates to adjust quickly and decrease volatility. Unlikely, the increase in total reserves is linked with higher real effective exchange rates volatility. Similar to the volatility of the stock market returns, an increase in the market capitalization is positively linked with higher exchange rate volatility. The effect of an increase in total trading value on volatility of real effective exchange rate is insignificant.

4.6. Conclusion

In this study we have analyzed the impact of different macroeconomic variables, size of financial markets on the volatility of financial markets (stock market, exchange rate). The

study has also analyzed the impacts of exchange rate volatility and stock market volatility on each other. Estimates are based on panel data of 24 European countries using monthly data for the period 2002-2008. Study employ *AR(k)-EGARCH(p,q)* models for the estimation of volatility and advanced techniques of panel data for the analysis.

The main finding of this study is that the volatility of one financial market does not contribute to the volatility of other financial market for the panel of European countries. The study also finds that some of the macroeconomic variables contribute positively and other contributes negatively to the volatility of the stock market, while the variations in exchange rate are not affected by the changes in macroeconomic variables. In particular, the growth rate of industrial production index increases volatility in stock market returns and growth rate of the trade help to decrease volatility. Weak evidence of increase in the stock market volatility due to an increase in growth rate of total reserves and strong evidence of increase in the exchange rate volatility are also found. Increase in inflation contributes positively to the stock market volatility, while it decreases exchange rate volatility. Similarly, increase in the size of stock market helped to reduce its volatility. On the other hand, size of the financial markets contributes positively to exchange rate volatility.

Chapter 5

Summary and Conclusion

This thesis is an empirical investigation of the estimations, sources, and impacts of the financial markets volatility. It also highlights the relative importance of two types of the financial markets: banking sector development and stock market development. On a larger canvas, this research tries to link volatilities of financial markets, i.e., stock markets, banks, and forex market to real macroeconomic variables. In this purpose, direction of the relationship remained in focus throughout the analysis. With regard to volatility structure of the financial markets, simple i.e., standard deviation and extensive models i.e., *AR(k)-EGARCH* has been employed. At different parts of the thesis, data from different countries (regions) is used for empirical investigation.

Initially in the second chapter of the thesis, we find a bi-directional relationship between the financial markets development (banking sector development or stock market developments) and economic growth. Moreover, we also find that stock market development contributes to economic growth on one hand while volatility in stock market returns hampers it. In addition, the study sheds some light that if volatility of stock market returns is compensated with high returns then it will help to boost economic growth. Results also show that effects of compensation for high volatility are more benefitial for low income countries as compared to the high income countries.

This study analyzes the impacts of exchange rate volatility before and after the introduction of Euro, and it finds that the nominal exchange rate volatility decreased for the countries that adopted the common currency “Euro” while for other countries it increased. In

terms of real exchange rate, no clear conclusion can be extracted for both groups of countries. However, negative impacts of fluctuations of real exchange rate decreased after the introduction of Euro for both groups of counties, i.e., for countries that adopted Euro as well as for countries that did not adopted Euro as common currency. Among the countries that have adopted Euro, decreased in effects of exchange rate volatility are not same.

On macroeconomic determinants of variations in stock market returns and exchange rate returns, study finds that volatility in these markets does not affect each other. Other than this, study finds that high economic growth contribute positively while high trade contribute negatively to stock market volatility. Variations in exchange rate are unaffected by the changes in these variables. High inflation leads to more volatile stock market returns and less volatile exchange rate returns. From the panel analysis, study also finds that bigger size of the stock market decrease stock market volatility as well as exchange rate volatility.

The overall perspective of this thesis is that developments of the financial markets contribute to higher economic growth on the one hand while higher economic growth leads to development of the financial markets on the other hand. The volatility is harmful whether appeared in stock market or whether appeared in exchange rate markets. Though, all the countries that have adopted Euro have not enjoyed same benefits but still benefits of adopting common currency are greater than the benefits of not adopting common currency. The results of this study are based on data of different blocks of countries. Furthermore, research may focus on expanding the scope of research to other regions or to other block of counties. This study used the *AR(k)-EGARCH(p,q)* model for estimation of volatility. Other models and techniques of checking the impact of financial markets volatility can be used for further research. At the end, the study identified few determinants of financial markets volatility; other potential variables can be employed for further research.

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Appendix

Appendix A.1: Country names and there classifications

Country Name	Country Code		WB Income Group	Country Name	Country Code		WB Income Group
Argentina	ARG	1	UMIE	Latvia	LVA	39	UMIE
Australia	AUS	2	HIEO	Lebanon	LBN	40	UMIE
Austria	AUT	3	HIEO	Lithuania	LTU	41	UMIE
Bahrain	BHR	4	HIEN	Malaysia	MYS	42	UMIE
Bangladesh	BGD	5	LIE	Mauritius	MUS	43	UMIE
Belgium/Luxembourg	BEL	6	HIEO	Mexico	MEX	44	UMIE
Botswana	BWA	7	UMIE	Morocco	MAR	45	UMIE
Brazil	BRA	8	UMIE	Namibia	NAM	46	UMIE
Bulgaria	BGR	9	UMIE	Netherlands	NLD	47	HIEO
Canada	CAN	10	HIEO	New Zealand	NZL	48	HIEO
Chile	CHL	11	UMIE	Nigeria	NGA	49	LIE
China	CHN	12	LMIE	Norway	NOR	50	HIEO
Colombia	COL	13	LMIE	Oman	OMN	51	HIEN
Cote d Lvoire	CIV	14	LIE	Pakistan	PAK	52	LIE
Croatia	HRV	15	UMIE	Peru	PER	53	LMIE
Czech Republic	CZE	16	HIEO	Philippines	PHL	54	LMIE
Denmark	DNK	17	HIEO	Poland	POL	55	LMIE
Ecuador	ECU	18	LMIE	Portugal	PRT	56	HIEO
Egypt	EGY	19	LMIE	Romania	ROM	57	UMIE
Estonia	EST	20	HIEN	Russia	RUS	58	UMIE
Finland	FIN	21	HIEO	Saudi Arabia	SAU	59	HIEN
France	FRA	22	HIEO	Singapore	SGP	60	HIEN
Germany	DEU	23	HIEO	Slovakia	SVK	61	HIEO
Ghana	GHA	24	LIE	Slovenia	SVN	62	HIEN
Greece	GRC	25	HIEO	South Africa	ZAF	63	UMIE
Hong Kong	HKG	26	HIEN	Spain	ESP	64	HIEO
Hungary	HUN	27	HIEO	Sri lanka	LKA	65	LMIE
Iceland	ISL	28	HIEO	Sweden	SWE	66	HIEO
India	IND	29	LMIE	Switzerland	CHE	67	HIEO
Indonesia	IDN	30	LMIE	Taiwan	TWN	68	HIEN
Ireland	IRL	31	HIEO	Thailand	THA	69	LMIE
Israel	ISR	32	HIEN	Trinidad & Tobago	TTO	70	HIEN
Italy	ITA	33	HIEO	Tunisia	TUN	71	LMIE
Jamaica	JAM	34	UMIE	Turkey	TUR	72	LMIE
Japan	JPN	35	HIEO	Ukraine	UKR	73	LMIE
Jordan	JOR	36	LMIE	United Kingdom	GBR	74	HIEO
Kenya	KEN	37	LIE	United States	USA	75	HIEO
Korea	KOR	38	HIEO	Venezuela	VEN	76	UMIE
				Zimbabwe	ZWE	77	LIE

NOTES: UMIE: Upper-Middle Income Economy, HIEO: High Income Economy (OECD), HIEN: High Income Economy (Non-OECD), LIE: Lower Income Economy, LMIE: Lower Middle Income Economy
Taiwan (TWN-66) is not used for analysis because of unavailability of data of real macroeconomic variables.

Appendix A.2: Results of Stationarity tests

Variables	ADF - Fisher Chi-square	P-value
GGDPPC	648.598	[0.0000]
DBACBA	252.88	[0.0000]
BDGDP	179.703	[0.0233]
PCRDBGDP	200.752	[0.0009]
LLGDP	223.109	[0.0000]
MCGDP	191.382	[0.0167]
TVGDP	202.35	[0.0039]
TOR	517.113	[0.0000]
SDFCGTRI	318.4	[0.0000]
CVFCGTRI	313.649	[0.0000]

a) Null: Unit root (assumes individual unit root process).
b) Abbreviations used: GGDPPC = Growth rate of GDP per capita, , MCR = market capitalization ratio, TVR = trading value ratio, TOR = turnover ratio, LLR = Liquid liability ratio, DBACBA = domestic bank assets to central bank assets ratio, BDGDP = bank deposit to GDP ratio, PCRDBGDP = Private credit by domestic bank to GDP ratio, SDSMR = Standard deviation of Stock Market Return, CVSMR = Coefficient of Stock Market Returns.
c) Values in square-brackets are P-values.

Appendix B-I: Specification of *AR(k)-EGARCH(p,q)* models using Nominal Exchange Rate data before 1998

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \ , \ \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \ , \ h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

Coefficients	AUS	BEL	FIN	FRA	GER	IRE	ITA	LUX	NET	POR	SPA	DEN	NOR	SWE	UKI
							Mean Equation								
α_o	0.001	0.002***	0.001	0.002	-0.001	0.001	0.002***	0.002***	-0.001	0.002	0.003***	0.002	0.003***	0.002	0.001
α_1	0.349***	0.331***	0.388***	0.314***	0.326***	0.257***	0.398***	0.331***	0.281***	0.299***	0.474***		0.423***	0.427***	0.302***
α_2		-0.166***	-0.166***		-0.140***		-0.163***	-0.166***			-0.128**	0.144***	-0.190***	-0.122**	-0.154**
α_3		0.109***		0.118**	0.061		0.166***	0.109***				0.124**			
α_4				0.060		-0.082	0.155***					0.111***			
							Variance Equation								
ω	-25.18***	-4.02***	-2.05***	-5.98***	-26.69***	-16.32***	-1.07***	-4.02***	-18.28***	-3.78***	-12.41***	-29.34***	-20.16***	-5.23***	-1.09
ρ_1	-0.094	-0.444***	-0.480***	-0.433**	0.090	-0.028	-0.353***	-0.444***	-0.104	-0.417***	0.007	0.366***	-0.279**	-0.330**	0.283***
ρ_2		0.504***	0.698***		0.142**		0.392***	0.504***	-0.185	0.483***	0.277**	0.353***			
θ_1	-0.017	0.051**	0.019	-0.121	-0.031	0.111**	0.061***	0.051**	-0.070***	0.114***	-0.086**	0.057**	-0.099	0.192***	0.057
γ_1	-1.527***	1.310***	1.324***	0.602**	-1.576***	-0.271***	1.733***	1.310***	-1.250***	1.324***	0.287***	-1.669***	-1.060***	0.834***	0.881***
γ_2	-0.949***	-0.848***	-0.575***	-0.467***	-0.985***	-0.963***	-0.872***	-0.848***	-0.261	-0.815***	-0.944***	-0.844***	-0.597**	-0.553**	
GED PARAMETER	1.952***	2.901***	1.526***	1.631***	2.487***	1.631***	2.098***	2.901***	2.106***	2.212***	1.985***	2.124***	1.853***	1.454***	1.470***
AR(k)-EGARCH(p,q)	AR(1)-EGARCH (2,1)	AR(3)-EGARCH (2,2)	AR(2)-EGARCH (2,2)	AR(4)-EGARCH (2,1)	AR(3)-EGARCH (2,2)	AR(4)-EGARCH (2,1)	AR(4)-EGARCH (2,2)	AR(3)-EGARCH (2,2)	AR(1)-EGARCH (2,2)	AR(1)-EGARCH (2,2)	AR(2)-EGARCH (2,2)	AR(4)-EGARCH (2,2)	AR(2)-EGARCH (2,1)	AR(2)-EGARCH (2,1)	AR(2)-EGARCH (1,1)

d) AUS-Austria, BEL-Belgium, FIN-Finland, FRA-France, GER-Germany, IRE-Ireland, ITA-Italy, LUX-Luxembourg, NET-Netherlands, POR-Portugal, SPA-Spain, DEN-Denmark, NOR-Norway, SWE-Sweden, UKI-United Kingdom.

e) ***,**,* significant at: 1%, 5%, 10% respectively.

Appendix B-II: Specification of *AR(k)-EGARCH(p,q)* models using Nominal Exchange Rate data after 1998

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \ , \ \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \ , \ h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

Coefficients	DEN	NOR	SWE	UKI	Europe
			Mean Equation		
α_o	-0.001	0.000	0.001	0.001	-0.001
α_1		0.336***	0.339***	0.302***	0.214**
α_2	-0.131			-0.154**	
α_3	0.077				
α_4		-0.137**	0.201***		
			Variance Equation		
ω	-1.084	-5.163***	-1.094***	-1.092	-1.926***
ρ_1	0.365	0.439***	-0.486***	0.283*	-0.030
ρ_2	-0.357				
θ_1	0.148	0.125**	0.204**	0.057	0.115*
γ_1	1.380**	1.242***	0.799***	0.881***	1.632***
γ_2	-0.523	-0.885***			-0.894***
GED PARAMETER	1.425***	3.721**	2.498***	1.470***	2.022***
AR(k)-EGARCH(p,q)	AR(3)-EGARCH (2,2)	AR(4)-EGARCH (2,1)	AR(4)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(1)-EGARCH (2,1)

a) DEN-Denmark, NOR-Norway, SWE-Sweden, UKI-United Kingdom
b) ***,**,* significant at: 1%, 5%, 10% respectively.

Appendix B-III: Specification of *AR(k)-EGARCH(p,q)* models using Real Exchange Rate data before 1998

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \ , \ \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \ , \ h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

Coefficients	AUS	BEL	FIN	FRA	GER	IRE	ITA	LUX	NET	POR	SPA	DEN	NOR	SWE	UKI
							Mean Equation								
α_o	0.0007	-0.0002	0.0025**	0.0015	0.0009	-0.0005	0.0004	0.0024**	0.0010	-0.0012	-0.0014	0.0003	0.0011	0.0020	0.0005
α_1	0.298***	0.319***	0.316***	0.322***	0.346***	0.192***	0.408***	0.346***	0.320***	0.356***			0.375***	0.406***	0.292***
α_2	-0.131*	-0.128**		-0.085				-0.155***					-0.122*	-0.153***	-0.139**
α_3	0.163**	0.134***	0.042			0.214***	0.147***	0.176***	0.047		0.119*	0.048	0.017	0.081*	
α_4	-0.050			0.059		-0.236***		-0.086***							
							Variance Equation								
ω	-13.04***	-8.60***	-25.87***	-6.67***	-12.32***	-14.14***	-2.82***	-4.02***	-7.06***	-15.08***	-4.55**	-11.09***	-20.00***	-4.43***	-1.66
ρ_1	-0.199	-0.149**	-0.136***	-0.425**	0.291*	-0.137*	-0.154*	-0.489***	-0.174	0.092*	0.270*	0.137	-0.212	-0.395***	0.469**
ρ_2		0.166***			0.566***			0.517***							
θ_1	-0.037	-0.002	-0.078	-0.174	-0.181**	0.052	-0.072	0.076***	-0.070	-0.018	0.186*	0.152	-0.067	0.159*	0.103
γ_1	-0.823***	0.808***	-1.507***	0.499*	-0.625***	-0.037	1.428***	1.297***	0.776***	-0.994***	0.406	-0.593*	-1.062***	1.030***	0.107
γ_2		-0.973***	-0.925***	-0.458*		-0.941***	-0.826***	-0.835***	-0.771***				-0.590*	-0.656***	0.716***
GED PARAMETER	1.871***	1.955***	1.658***	1.515***	1.555***	1.806***	1.655***	2.927***	2.139***	1.800***	2.097***	1.616***	2.046***	1.421***	1.490***
AR(k)-EGARCH(p,q)	AR(4)-EGARCH (1,1)	AR(3)-EGARCH (2,2)	AR(3)-EGARCH (2,1)	AR(4)-EGARCH (2,1)	AR(1)-EGARCH (1,2)	AR(4)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(4)-EGARCH (2,2)	AR(3)-EGARCH (2,1)	AR(1)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(3)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(2)-EGARCH (2,1)

a) AUS-Austria, BEL-Belgium, FIN-Finland, FRA-France, GER-Germany, IRE-Ireland, ITA-Italy, LUX-Luxembourg, NET-Netherlands, POR-Portugal, SPA-Spain, DEN-Denmark, NOR-Norway, SWE-Sweden, UKI-United Kingdom.

b) ***,**,* significant at: 1%, 5%, 10% respectively.

Appendix B-IV: Specification of *AR(k)-EGARCH(p,q)* models using Real Exchange Rate data After 1998

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \ , \ \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \ , \ h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

Coefficients	AUS	BEL	FIN	FRA	GER	IRE	ITA	LUX	NET	POR	SPA	DEN	NOR	SWE	UKI
							Mean Equation								
α_o	-0.0016	-0.0023	-0.0033*	0.0008	0.0008	-0.0011	-0.0018	-0.0005	-0.0024**	-0.0014	-0.0025*	0.0000	-0.0006	0.0012	0.0000
α_1	0.256**	0.259***	0.313***	0.429***	0.382***	0.272***	0.381***	0.266***		0.159*	0.218*	0.000	0.280***	0.400***	0.225***
α_2	-0.021	0.016			-0.050	-0.025	-0.046	0.021	-0.038		-0.161*			-0.163**	
α_3	-0.073	-0.082		0.096	0.020						0.071				0.189***
α_4			0.112**			0.029	0.076	0.074		-0.121**	-0.099			0.136*	
							Variance Equation								
ω	-12.84***	-12.94***	-12.28***	-12.11***	-12.21***	-27.70***	-12.03***	-22.11***	-2.00***	-14.01***	-13.90***	-18.39***	-5.21***	-0.98***	-24.01***
ρ_1	0.176	0.113	-0.386**	-0.351*	-0.169	0.355	-0.266*	0.010	-0.525***	0.519**	0.630***	0.144	0.678***	-0.388***	0.250
ρ_2			0.613***			0.393*	0.394*		0.519***						0.578***
θ_1	0.080	0.060	-0.378***	-0.343***	-0.205**	-0.048*	-0.398***	-0.161	0.067**	0.053	0.059	-0.400***	-0.017	0.053	-0.047
γ_1	0.335***	0.328***	0.017	0.048	0.196*	-1.733***	0.070	-1.411***	1.601***	-0.848***	-0.852***	-0.928***	1.012***	0.826***	-1.147***
γ_2	-1.050***	-1.045***	-0.654***	-0.722***	-0.879***	-0.944***	-0.677***	-0.638*	-0.868***			-0.630***	-0.633***		-0.889***
GED PARAMETER	2.045***	2.087***	2.089***	1.715***	1.655***	2.266***	1.861***	1.512***	3.114***	2.599***	2.268***	1.670***	2.176***	2.080***	2.503***
AR(k)-EGARCH(p,q)	AR(3)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(4)-EGARCH (2,2)	AR(3)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(3)-EGARCH (1,1)	AR(4)-EGARCH (2,2)	AR(4)-EGARCH (2,1)	AR(2)-EGARCH (2,2)	AR(4)-EGARCH (1,1)	AR(4)-EGARCH (1,1)	AR(2)-EGARCH (2,1)	AR(1)-EGARCH (2,1)	AR(4)-EGARCH (1,1)	AR(3)-EGARCH (2,2)

a) AUS-Austria, BEL-Belgium, FIN-Finland, FRA-France, GER-Germany, IRE-Ireland, ITA-Italy, LUX-Luxembourg, NET-Netherlands, POR-Portugal, SPA-Spain, DEN-Denmark, NOR-Norway, SWE-Sweden, UKI-United Kingdom.

b) ***,**,* significant at: 1%, 5%, 10% respectively.

Appendix C-I: Specification of *AR(k)-EGARCH(p,q)* of Exchange rate returns of European Countries

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \ , \ \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \ , \ h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

Coefficients	AUS	BEL	BUL	CYP	CZE	DEN	EST	FIN	FRA	GER	GRE	HUN	IRE	ITA
						Mean Equation								
α_o	0.0010**	0.0009***	0.0030***	0.0025***	0.0029***	0.0015***	-0.0043*	0.0022***	0.0019***	0.0018*	0.0008***	0.0054***	0.0039***	0.0016**
α_1			0.215**		-0.270***	0.250***	0.385***	0.544***			0.266***	0.367***		
α_2		-0.117					-0.357***		0.079		-0.166***	-0.219***		0.164***
α_3	-0.256*		-0.101*							-0.106			-0.048***	
α_4					-0.047**									
						Variance Equation								
ω	-18.138***	-19.579***	-15.252***	-21.473***	-11.326***	-0.859*	-24.143***	-1.074**	-17.357***	-4.067**	-17.784***	-12.902***	-18.950***	-19.484***
ρ_1	0.454*	0.713***	1.051***	0.723***	1.623***	0.653**	-0.380	0.252	0.455**	0.282*	1.361***	0.686**	0.355***	0.693**
ρ_2						-0.650**								
θ_1	-0.320*	-0.379***	-0.057	-0.504**	-0.418***	0.679***	0.155	1.040***	-0.558***	-0.327**	-0.572**	0.451***	-0.325**	-0.339
γ_1	-0.718***	-0.808***	0.207***	-0.544**	0.723***	0.914***	-1.409***	0.896***	-0.663***	0.602***	-0.623***	-0.539***	-0.960***	-0.900***
γ_2			-0.816***	-0.645***	-0.965***		-0.770***							
AR-EGARCH(p,q)	AR(3)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,2)	AR(0)-EGARCH (1,2)	AR(4)-EGARCH (1,2)	AR(1)-EGARCH (2,1)	AR(2)-EGARCH (1,2)	AR(1)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(2)-EGARCH (1,1)

a) AUS-Austria, BEL-Belgium, BUL-Bulgaria, CYP-Cyprus, Czech-Republic-CZE, Denmark-DEN, Estonia-EST, FIN-Finland, FRA-France, GER-Germany, Greece-GRE, Hungary-HUN, IRE-Ireland, ITA-Italy, LAT-Latvia, LIT-Lithuania, LUX-Luxembourg, MAL-Malta, NET-Netherlands, POL-Poland, POR-Portugal, ROM-Romania, SLK-Slovak-Republic, SLO-Slovenia, SPA-Spain, SWE-Sweden, UKI-United Kingdom.

b) ***,**,* significant at: 1%, 5%, 10% respectively.

Continued Appendix C-I:

Coefficients	LAT	LIT	LUX	MAL	NET	POL	POR	ROM	SLK	SLO	SPA	SWE	UKI
						Mean Equation							
α_o	-0.0054**	-0.0015	0.0014**	-0.0030***	0.0017***	-0.0002	0.0015***	-0.0097***	0.0045***	-0.0378***	0.0020***	0.0005	-0.0016*
α_1		0.460***		-0.015***		0.230***		0.130**	0.034	-0.114*	0.121*		0.257**
α_2					-0.022		-0.279**	-0.094		0.007***			
α_3		-0.011		0.026***		0.169*					-0.264***		
α_4	0.321***		-0.064			-0.190***							
						Variance Equation							
ω	-4.358**	-21.711***	-5.976***	-3.628***	-19.670***	-7.128***	-11.046***	-17.085***	-29.151***	-0.979***	-20.392***	-3.790	-0.629***
ρ_1	0.686*	-0.467	0.423	-2.624***	0.577***	-1.305***	0.801***	1.533***	0.388***	-2.083***	0.733**	0.125	-0.318***
ρ_2								1.617***		-0.609***			
θ_1	0.329*	0.169	-0.337*	0.870***	-0.439**	-0.649***	-0.285	-0.331***	0.007	-2.107***	-0.310**	-0.439**	-0.356***
γ_1	0.504*	-1.063***	0.480***	-0.056***	-0.884***	0.266	0.025	-0.936***	-1.462***	0.021***	-0.817***	0.577**	0.897***
γ_2		-0.799***		0.260***		-0.328*			-0.817***				
AR-EGARCH(p,q)	AR(4)-EGARCH (1,1)	AR(3)-EGARCH (1,2)	AR(4)-EGARCH (1,1)	AR(3)-EGARCH (1,2)	AR(2)-EGARCH (1,1)	AR(4)-EGARCH (1,2)	AR(2)-EGARCH (1,1)	AR(2)-EGARCH (2,1)	AR(1)-EGARCH (1,2)	AR(2)-EGARCH (2,1)	AR(3)-EGARCH (1,1)	AR(0)-EGARCH (1,1)	AR(1)-EGARCH (1,1)

a) AUS-Austria, BEL-Belgium, BUL-Bulgaria, CYP-Cyprus, Czech-Republic-CZE, Denmark-DEN, Estonia-EST, FIN-Finland, FRA-France, GER-Germany, Greece-GRE, Hungary-HUN, IRE-Ireland, ITA-Italy, LAT-Latvia, LIT-Lithuania, LUX-Luxembourg, MAL-Malta, NET-Netherlands, POL-Poland, POR-Portugal, ROM-Romania, SLK-Slovak-Republic, SLO-Slovenia, SPA-Spain, SWE-Sweden, UKI-United Kingdom.

b) ***,**,* significant at: 1%, 5%, 10% respectively.

Appendix C-II: Specification of *AR(k)-EGARCH(p,q)* of Stock Market returns of European Countries

$$R_t = \alpha_o + \sum_{i=1}^{k} \alpha_i R_{t-i} + \varepsilon_t h_t^{1/2} \ , \ \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \ , \ h_t = \exp\left[\omega + \sum_{i=1}^{p} \gamma_j \log h_{t-j} + \sum_{j=1}^{q} \rho_j \left| \frac{u_{t-j}}{\sqrt{h_{t-j}}} \right| + \sum_{m=1}^{r} \theta_m \frac{u_{t-m}}{\sqrt{h_{t-m}}} \right]$$

Coefficients	AUS	BEL	BUL	CYP	CZE	DEN	EST	FIN	FRA	GER	GRE	HUN	IRE	ITA
							Mean Equation							
α_o	0.0215***	-0.0001	0.0259**	0.0195*	0.0222**	0.0159**	0.0164*	-0.0070***	0.0027	0.0177***	0.0112	0.0423***	0.0271***	0.0014
α_1	0.351***		0.259**		0.181			0.539***	0.223***	0.178***	0.332**		0.519***	0.192*
α_2		0.357***		0.214**		-0.036	0.044	-0.420***				-0.198**	0.204***	
α_3			0.296**					0.114*			-0.255***	-0.223***		
α_4	-0.351***													
							Variance Equation							
ω	-1.062***	-0.320***	-2.792*	-4.598***	-8.876***	-0.616	-2.329*	-0.637***	-0.696***	-2.399***	-0.501	-1.840***	-6.895***	-0.326***
ρ_1	0.091	-0.189***	0.348	0.478***	0.470***	0.059	0.760***	-0.530***	-0.559***	-0.682***	0.412**	-0.237	0.570**	-0.186***
ρ_2			0.817*							0.927***	-0.615***	1.543***	2.254***	
θ_1	-0.295***	-0.440***	0.100	-0.470***	-0.401**	-0.315***	-0.063	-0.519***	-0.583***	-0.675***	-0.256***	0.630***	0.978***	-0.317***
γ_1	1.693***	0.911***	0.623**	0.145	-0.518**	0.901***	0.641***	0.790***	0.405***	0.633***	0.879***	0.829***	0.116	0.916***
γ_2	-0.852***								0.406***					
AR-EGARCH(p,q)	AR(4)-EGARCH (1,2)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (2,1)	AR(2)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(2)-EGARCH (1,1)	AR(3)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(1)-EGARCH (1,2)	AR(1)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(3)-EGARCH (2,1)	AR(2)-EGARCH (2,1)	AR(1)-EGARCH (1,1)

a) AUS-Austria, BEL-Belgium, BUL-Bulgaria, CYP-Cyprus, Czech-Republic-CZE, Denmark-DEN, Estonia-EST, FIN-Finland, FRA-France, GER-Germany, Greece-GRE, Hungary-HUN, IRE-Ireland, ITA-Italy, LAT-Latvia, LIT-Lithuania, LUX-Luxembourg, MAL-Malta, NET-Netherlands, POL-Poland, POR-Portugal, ROM-Romania, SLK-Slovak-Republic, SLO-Slovenia, SPA-Spain, SWE-Sweden, UKI-United Kingdom.

b) ***,**,* significant at: 1%, 5%, 10% respectively.

Continued Appendix C-II:

Coefficients	LAT	LIT	LUX	MAL	NET	POL	POR	ROM	SLK	SLO	SPA	SWE	UKI
						Mean Equation							
α_o	0.0096**	0.0223**	0.0195*		0.0049***	0.0230**	0.0100	0.0147	0.0222**	0.0045	0.0036***	0.0026	-0.0046***
α_1						-0.170	0.359***	0.284**	0.019	0.264***		0.064	0.326***
α_2		0.205	0.214**		0.011		-0.063			0.238**	0.140**		
α_3	0.179***												
α_4													
						Variance Equation							
ω	-10.842***	-0.014	-4.598***		-0.699***	-6.252***	-5.400***	0.016***	-1.313	-3.197**	-0.417*	-0.563**	-1.411***
ρ_1	0.700***	0.153**	0.478***		-0.555***	0.328	0.603**	-0.183**	0.505*	0.179	-0.419**	-0.456*	-0.110
ρ_2	1.001***									0.553*			-0.736***
θ_1	-0.349***	-0.085**	-0.470***		-0.527***	-0.413**	-0.677***	0.482*	-0.038	-0.507***	-0.385***	-0.386***	-0.454***
γ_1	-0.091	1.013***	0.145		0.809***	0.486**	0.478***	-0.132	0.800***	0.545***	0.867***	0.827***	0.668***
γ_2	-0.631***					-0.671***	-0.313*						
AR-EGARCH(p,q)	AR(1)-EGARCH (1,1)	AR(3)-EGARCH (2,2)	AR(2)-EGARCH (1,1)		AR(2)-EGARCH (1,1)	AR(1)-EGARCH (1,2)	AR(2)-EGARCH (1,2)	AR(1)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(2)-EGARCH (2,1)	AR(2)-EGARCH (1,1)	AR(1)-EGARCH (1,1)	AR(1)-EGARCH (2,1)

a) AUS-Austria, BEL-Belgium, BUL-Bulgaria, CYP-Cyprus, Czech-Republic-CZE, Denmark-DEN, Estonia-EST, FIN-Finland, FRA-France, GER-Germany, Greece-GRE, Hungary-HUN, IRE-Ireland, ITA-Italy, LAT-Latvia, LIT-Lithuania, LUX-Luxembourg, MAL-Malta, NET-Netherlands, POL-Poland, POR-Portugal, ROM-Romania, SLK-Slovak-Republic, SLO-Slovenia, SPA-Spain, SWE-Sweden, UKI-United Kingdom.

b) ***,**,* significant at: 1%, 5%, 10% respectively.

Appendix D-I: Abstract-I

Essay-I: Impact of Financial Markets Development and Stock Market Volatility on Economic Growth: A Dynamic Panel Data Analysis

Abstract

The role of banking sector and stock markets is emphasized as financial intermediaries in economic literature. Due to increasing importance of stock markets much of the emphasis is also placed on its volatility along with its size and pattern of returns on equities. Applying panel causality tests and Arellano-Bond model on unbalanced panel data of 76 countries ranging from 1980 to 2006 study explores: firstly, the direction of causality between financial markets and economic growth; secondly, the impact of various indicators of banking sector and stock markets development on real economy; and thirdly, the impact of increase in stock market volatility on real economy. The distinction of this paper is parallel comparison of the impact of banking sector development, stock markets development and stock market volatility on real economy for high versus low income countries. Study finds bi-variate relationship between stock market development and economic growth as well as between banking sector development and economic growth. Study finds that banking sector development and stock market development contribute towards economic growth whereas stock market volatility hampers it. Study also finds that high volatility is compensated well with high returns in low income countries as compared to high income countries.

Zusammenfassung

Die Rolle des Bankensektors und Börsen als Finanzintermediäre in der ökonomischen Literatur betont. Aufgrund der zunehmenden Bedeutung der Aktienmärkte einen Großteil der Schwerpunkt liegt auch auf seine Volatilität zusammen mit seiner Größe und Entwicklung der Renditen auf Aktien platziert. Anwenden Panel Kausalität Tests und Arellano-Bond-Modell auf unsymmetrisch Paneldaten von 76 Ländern im Bereich von 1980 bis 2006 Studie untersucht: erstens die Richtung der Kausalität zwischen Finanzmärkten und Wirtschaftswachstum, zweitens die Auswirkungen der verschiedenen Indikatoren des Bankensektors und Aktienmärkte Entwicklung auf die Realwirtschaft, und drittens die Auswirkungen der Zunahme der Volatilität an den Aktienmärkten auf die Realwirtschaft. Die Unterscheidung dieser Arbeit ist parallel Vergleich der Auswirkungen der Entwicklung des Bankensektors, die Aktienmärkte Entwicklung und Volatilität des Aktienmarktes auf die Realwirtschaft für hohe versus Ländern mit niedrigen Einkommen. Studie: BI-variate Beziehung zwischen Börse Entwicklung und wirtschaftliches Wachstum sowie zwischen Bankensektor Entwicklung und wirtschaftliches Wachstum. Studie stellt fest, dass Entwicklung des Bankensektors und Börsenentwicklung zum Wirtschaftswachstum beitragen, während Aktienkursvolatilität behindert es. Studie auch fest, dass eine hohe Volatilität und ist mit hohen Renditen in Ländern mit niedrigem Einkommen zu Ländern mit hohem Einkommen im Vergleich kompensiert.

Appendix D-II: Abstract-IIJ

Essay-II: Exchange Rate Volatility and its impact on Industrial Production, before and after the Introduction of Common currency in Europe

Abstract

The introduction of the common currency 'Euro' in Europe after an effort of more than fifty years was a great success in monetary history. In the literature the cost and benefits of stable exchange rate by using the common currency has been repeatedly observed. This paper explores the impacts of exchange rate volatility on industrial production before and after the introduction of the common currency for eleven European countries included in the European Monetary Union and for four European countries that did not adopt the 'Euro' as a common currency. The analysis of study is based on monthly data of exchange rate and macroeconomic variables from January 1980 to April 2009. We employ *AR(k)-EGARCH(p,q)* models to calculate volatility in exchange rates for all countries before and after the introduction of common currency separately. In this paper, we used Pooled-IV/TSLS. Descriptive statistics indicates that the introduction of the common currency increase variations of nominal exchange rates for all the countries that did not adopt 'Euro' as well as for a few countries that have adopted 'Euro' as common currency. However, variations of real exchange rate volatility for Sweden and the United Kingdom are decreased after 1999 while most of the other countries that adopt 'Euro' faced an increase in variation of the real exchange rate volatility. Moreover, trade and government bond yield is beneficial for growth rate of industrial production index. Negative impacts of volatility of nominal and real exchange rates decrease after the introduction of common currency for both groups of countries. Reduction in level of negative impacts is higher for the countries that adopt the common currency. We can conclude that all the countries enjoy benefits after the introduction of common currency by decrease in negative impacts of real exchange rate volatility, though; they also faced increase in real exchange rate volatility. It can also be concluded that basket of fruits is not same for every country that has adopted the common currency.

Zusammenfassung

Einführung der gemeinsamen Währung "Euro" in Europa nach einem Aufwand von mehr als fünfzig Jahren war ein großer Erfolg in der Geschichte des Geldwesens. Literatur berichteten wiederholt Kosten und Nutzen der Verwendung stabiler Wechselkurs mit Hilfe von gemeinsamen Währung. Wir untersuchten den Einfluss von Ex-Änderungen der Volatilität auf die industrielle Produktion vor und nach der Einführung der gemeinsamen Währung für elf europäische Länder, für die Europäische Währungsunion und für vier europäische Länder, die nicht erlassen hat "Euro" als gemeinsame Währung. Studie beschäftigt monatlichen Daten von Wechselkurs-und makroökonomischen Variablen von Januar 1980 bis April 2009 für die Analyse. Wir beschäftigten *AR (k)-EGARCH (p, q)*-Modelle für das Wachstum des nominalen und realen Wechselkurse für alle Länder vor und nach der Einführung der gemeinsamen Währung getrennt. In dieser Arbeit verwendet Pooled IV / TSLS. Beschreibende Statistik angegeben, dass die Einführung der gemeinsamen Währung Variationen der nominalen Wechselkurse stieg für alle Länder, die nicht erlassen hat "Euro" als auch für einige Länder, die Euro als gemeinsame Währung eingeführt. Allerdings Variation des realen

Wechselkurses Volatilität für Schweden und das Vereinigte Königreich nach 1999 verringert, während für die meisten anderen Länder, die Euro gestiegen sind in Variation des realen Wechselkurses Volatilität angenommen. Handels-und Staatsanleihen sich als vorteilhaft für Wachstumsrate des Index der industriellen Produktion ergeben. Negative Auswirkungen der Volatilität des nominalen und realen Wechselkurse nach der Einführung der gemeinsamen Währung für beide Gruppen von Ländern reduziert. Reduzierung der Höhe der negativen Auswirkungen ist höher für die Länder, die gemeinsame Währung verbunden. Wir können feststellen, dass alle Länder Vorteile genossen nach der Einführung der gemeinsamen Währung durch Reduktion in negativen Auswirkungen des realen Wechselkurses Volatilität sogar auch konfrontiert Anstieg des realen Wechselkurs-Volatilität. Es kann auch zu dem Schluss, dass Obstkorb ist nicht für jedes Land, das gemeinsame Währung verbunden gleiche sein.

Appendix D-III: Abstract-III K

Essay III: Macroeconomic Sources and Spillover Effects of Financial Markets Volatility

Abstract

Volatility in financial markets is highly explored area of research during last few decades. Possible reasons of high concentration on the markets are its unexplained and unexplored sources. Present study aims to check certain macroeconomic variables as determinants of financial markets (stock market and exchange rate) volatility. It also aims to analyze contribution of volatility of one financial market to the volatility of other financial market. Analysis is conducted using monthly data of 27 European countries from 2002 to 2008. Study employed *AR(k)-EGARCH(p,q)* models to measure volatility in financial markets. Study finds no significant interlink effects among volatilities of stock market returns and volatility of exchange rate returns. However, Economic growth contributes positively while trade contributed negatively to stock market volatility. On the other hand, these variables have no effect on volatility of exchange rate returns. Study also finds that inflation positively affects variations of stock market returns. On the contrary, high inflation reduces exchange rate volatility. In addition, study finds that increase in total reserves increases volatility in exchange rates.

Zusammenfassung

Die Volatilität an den Finanzmärkten ist hoch Gebiet der Forschung während erforscht letzten Jahrzehnte. Mög-lich aus Gründen der hohen Konzentration auf den Märkten sind seine unerklärliche und unerforscht ist. Ziel dieser Untersuchung ist zu prüfen, bestimmte makroökonomischen Variablen als Determinanten der finanziellen Märkte (Börsen und Wechselkurs) Volatilität. Darüber hinaus soll der Beitrag analysieren Volatilität eines Finanzmarktes auf die Volatilität der sonstigen finanziellen Markt. Analyse durchgeführt wird, mit Hilfe der monatlichen Daten von 27 europäischen Ländern aus 2002 bis 2008. Studie beschäftigt *AR (k)-EGARCH(p, q)*-Modelle zur Messung von Volatilität Finanzmärkte. Studie findet keine signifikanten Effekte zwischen verzahnen Volatilitäten der Börse zurück und die Volatilität des Wechselkurses zurück. Allerdings trägt das Wirtschaftswachstum positiv, während der Handel beigetragen negativ auf Volatilität an den Aktienmärkten. Auf der anderen Seite haben diese Variablen keinen Einfluss auf die Volatilität des Wechselkurses zurück. Studie auch fest, dass Inflation wirkt sich positiv auf Schwankungen der Börse zurück. Auf der Gegenteil, die hohe Inflation reduziert Wechselkursvolatilität. Darüber hinaus studieren fest, dass Zunahme der gesamten Reserven erhöht die Volatilität der Wechselkurse.

Appendix E: Curriculum L

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