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FINANCIAL INTEGRATION OF THE EUROPEAN FRONTIER EMERGING MARKETS

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ABSTRACT

This study investigates financial integration of the European frontier emerging markets. The purpose of the study is two-fold. First, the study investigates whether the European frontier emerging stock markets have become integrated into the world capital markets. As the second, the interdependences across the frontier emerging markets and their linkages to the three largest developed markets in Europe are examined.

The sample includes five European frontier emerging markets (Croatia, Estonia, Romania, Slovakia and Slovenia) and the three largest developed markets in Europe (United Kingdom, France and Germany). The data consist of the MSCI World equity index and daily stock indices. The sample extends from September 1997 to September 2007. Vector autoregressive modeling applied on the index return time series is used as an econometric framework of analysis including the following techniques: Granger causality test, impulse response function and variance decomposition.

The empirical findings indicate that the stock markets of Croatia, Estonia and Slovenia show considerable degree of financial integration with respect to the world market portfolio as well as to the three largest European stock markets, while on contrary the stock markets of Romania and Slovakia appear to be segmented relative to both, the world market and three major European stock markets. Furthermore, the results reveal a significant interdependence between Croatia and Slovenia, as well as a leading role of France and Estonia among investigated stock markets. In addition, a significant upward trend in stock indices of the European frontier emerging markets starting at the end of 2001 was observed. The results of this study suggest potential benefits from international portfolio diversification through investing in the frontier emerging markets in Europe. This study contributes to the existing literature by investigating one special subcategory of emerging markets, namely frontier emerging markets.

KEYWORDS: frontier emerging market, financial integration, diversification benefits

1. INTRODUCTION

Research in emerging markets finance has been rapidly expanding over the past two decades. Emerging markets have attracted a unique interest not only in the academic research, but also among practitioners connecting both investment and corporate finance with international economics, development economics, law, demographics and political science (Bekaert & Harvey 2003a: 429). At the same time, emerging markets' assets have become an increasingly important asset class over the past decade. Because of very high returns these assets have attracted attention of many investors in developed economies including the United States and Europe. Moreover, emerging markets have developed into an ever more relevant driver of global economic growth, as for instance much of global growth in the last few years being attributable to economies in Emerging Asia and also those in Latin America and Emerging Europe. And finally, emerging markets are increasingly connected with developed economies via foreign direct investments and the relocation of production.

A national financial market is assigned by financial market participants to a category of emerging markets if it is characterized by a recently instituted, or recently revitalized, set of domestic financial markets. The International Finance Corporation (IFC) defines an emerging market as a country that meets one of two criteria: first, it is located in a low- or middle-income economic region and second, its investable market capitalization is low relative to its most recent GDP figures. Nations terminate their emerging markets status once their income per capita exceeds the upper-income threshold for three consecutive years, and once their investable market capitalization/GDP ratio is near the average ratio for "developed markets" for three consecutive years. Nations that retain or introduce investment restrictions remain categorized as emerging, reflecting the IFC's opinion that "pervasive investment restrictions on portfolio investment should not exist in developed markets". (see IFC 1999.)

In 1996, the IFC introduced a new category of emerging markets, namely frontier markets. This grouping includes countries that have equity exchanges, but they are characterized by relatively thin trading activity. These markets tend to be relatively small and less liquid, even by emerging market standards, but they represent an investment opportunity and, in the past few years have provided stellar returns. When liquidity in these portfolio markets increases, frontier nations improve their status by entering the International Finance Corporation's universe of emerging market nations.

In order to develop their capital markets many Asian, European and South American countries liberalized own capital markets allowing inward and outward foreign equity investments without restrictions. Moreover, they relaxed restrictions on foreign ownership of assets in conjunction with macroeconomic and trade reforms (Bekaert & Harvey 2003b: 4). Those developments raise a number of intriguing questions. In a pioneering contribution, Errunza (1974) and later on Bekaert & Harvey (2003b) question, on one hand, what are, from the perspective of investors in developed markets, the diversification benefits of investing in these newly available emerging markets, and on the other hand, what are, from the perspective of developing countries, the effects of increased foreign capital on the development of domestic financial markets and, ultimately, on these countries' economic growth. These authors argue that financial integration is central to both questions.

In finance, markets are considered integrated when assets of identical risk command the same expected return irrespective of their domicile. Integration of emerging markets within the global capital market should be facilitated by equity markets liberalization which gives the opportunity for foreign investors to invest in domestic equity securities and the right for domestic investors to transact in foreign equity securities. The facilitating process arises as a consequence of improved international risk sharing and subsequent increase of investments (Bekaert & Harvey 2003b: 4, 6). However, the high level of economic instability that characterizes emerging countries taken as a whole should be considered as a possible limitation of potential diversification benefits associated with investments in emerging stock markets. Indeed, economic instability in particular regions and phenomenon of financial crisis contagion observed in the recent history considerably influence foreign investors' pricing of risk for the investment purposes in emerging stock markets.

1.1. Review of Previous Research

Some of the early research papers in international finance try to model the impact of market integration on stock prices (Stulz 1981a, 1981b; Errunza & Losq 1985; Eun & Janakiramanan 1986; Alexander, Eun & Janakiramanan 1988; Bekaert & Harvey 1995; Errunza, Hogan & Senbet 1998). A basic reasoning behind the market integration can be gained from considering asset prices in the context of the Sharpe (1964) and Lintner

(1965) capital asset pricing model (CAPM). In a completely segmented market, assets will be priced relative to the local market return. The local expected return is determined by the local beta and the local market risk premium. Considering the high volatility of local returns, it is likely that the local expected return is high. On contrary, in the integrated capital market the expected return depends on the beta of the world market portfolio and on the world risk premium. This expected return is expected to be much lower (Bekaert & Harvey 2003a: 431). Therefore, in the transition from a segmented to an integrated market the pattern of the price and expected return behavior should be as follows: prices should rise and expected returns should decrease.

Research into emerging market stock returns focuses on the importance of the characteristics of those markets for the investors' decisions regarding the asset allocation. Early study of Harvey (1995) shows that emerging markets exhibit high expected returns, as well as higher level of volatility compared to the developed markets; but inclusion of emerging market assets to the investment portfolio significantly enhances portfolio opportunities as a result of low correlations between emerging and developed equity markets. This pioneering work evolved into a growing body of literature that investigates the empirical distributions of emerging market equity returns with the following areas of research interest: the risk–return tradeoff within emerging markets (Harvey 1991; Bekaert & Harvey 1997), efficient investment frontiers within emerging markets (Barry, Peavy & Rodriguez 1998) and the portfolio diversification benefits that those markets provide to international investors by combining investments in emerging stock markets with investments in developed stock markets (Barry et al. 1998).

Regarding the literature about risk–return relationship in the emerging markets the main focus is on the global market risk and currency risk (Bailey & Chung 1995; De Santis & Imrohoroglu 1997; Pajuste, Kepitis & Högfeldt 2000; Mateus 2004), but particular attention is given also to certain specific risk factors such as political risk (Diamonte, Liew & Stevens 1996) and country risk (Erb, Harvey & Viskanta 1996a, 1996b), to the effect of the inclusion of emerging markets on the efficient frontier (Barry et al. 1998), and to the applicability of asset pricing models to observed emerging market returns (Harvey 1991, 1995).

An additional area of research considers the observed patterns of asset allocation (Barry et al. 1998) and focuses more on the liberalization (Bekaert & Harvey 1997; Bekaert, Harvey & Lundblad 2003; Bekaert & Harvey 2003b; Kim, Lyn & Zychowicz 2005) and

financial integration of emerging equity markets (Bekaert 1995; Bekaert & Harvey 1997, 2003a). Harvey (1995) examines emerging market returns in the sample of 20 countries and demonstrates that contrary to the evidence from developed markets, the global unconditional asset pricing models are not able to explain the cross-section of expected returns in emerging markets. In addition, his study also investigates the persistence of emerging market returns and shows that the level of serial correlation in emerging markets is on average much higher than serial correlation observed in developed markets. This serial correlation is symptomatic of slow adjustment to current information and low frequency of trading (Harvey 1995; Kawakatsu & Morey 1999).

Harvey (1995) examines the distribution of emerging market log returns in the pre and post-1990 period and finds that emerging market returns are not normally distributed. There is considerable variation in the skewness of the individual country returns and the excess kurtosis is almost always higher than zero indicating fatter tails relative to the normal distribution, which leads to the following implications. First, these facts influence the way in which volatility is modeled in emerging markets. The standard distributional models are rejected by the data in case of many countries (Bekaert & Harvey 1997). Second, the existence of higher moments means that alternative models for risk should be considered (Harvey & Siddique 2000; Harvey 2000; Estrada 2000). Third, information about these higher moments should be taken into consideration by investors when they make portfolio decisions (Bekaert, Erb, Harvey & Viskanta 1998).

Bekaert et al. (1998) examine departures from normality and discover that emerging markets returns are characterized by significant skewness and kurtosis. Bae, Lim & Wei (2006) find that stock returns in emerging markets are more positively skewed compared to the returns in developed markets and that the positive skewed stock markets tend to have lower corporate governance scores.

The number of empirical studies on the financial integration of emerging markets in Europe is limited. The studies are typically carried out using co-integration testing. For example, Gilmore & McManus (2002) use co-integration analysis to examine long-term relationship between three European emerging markets (the Czech Republic, Hungary and Poland) and the U.S. market from 1995 to 2001 and they do not find any evidence of long-run relationship. Rockinger & Urga (2001) incorporate the influences of some developed stock markets such as the UK, U.S. and Germany in the returns function for the emerging markets from 1994 to 1997 and find that the stock markets in the Czech

Republic, Hungary and Poland are integrated with that in the UK, but not with that in U.S. and Germany.

Yang, Hsiao, Li & Wang (2006) apply the co-integration analysis and the generalized variance decomposition to estimate long-run and short-run linkages across the stock markets in the U.S., Germany and four European emerging markets (Russia, Poland, Hungary and Czech Republic) and find that both long and short-run relationships are strengthened in the period 1999-2002 compared with the period before the Russian crisis.

Li & Majerowska (2007) investigate the linkages between emerging markets of Poland and Hungary and the developed markets of Germany and U.S. from January 1998 to December 2005 and conclude that two emerging markets are linked to the developed ones in terms of returns and volatility, but however the extent of the linkages is weak suggesting potential benefits for international portfolio diversification.

Saleem & Vaihekoski (2007) examines not only global market risk, but also local and currency risk in the Russian stock market from 1995 to 2006 using conditional international asset pricing models and find that the world market risk together with the currency and local market risks are priced on the Russian stock market.

Pajuste, Kepitis & Högfeldt (2000) investigate the return generating process in five Central and Eastern European stock markets (the Czech Republic, Estonia, Hungary, Poland and Slovenia) by analyzing a wide set of risk factors that might affect equity return fluctuations in these markets. They emphasize importance of a geographic proximity in explaining the level of a country's integration. That means that correlation between two markets is higher if the markets are closer geographically; e.g., Estonia and Hungary are closest to Russia, and are therefore more influenced by risk in Russian market. Similarly, the Czech Republic, which is located close to Germany, exhibits a stronger relationship with the German stock index.

In the studies about financial integration of the emerging markets less attention is given to the frontier emerging markets even though they provided high returns in the past few years. The empirical evidence concerning the integration and diversification benefits of frontier emerging markets, including European countries, is scarce. Therefore, that area of research is ripe for exploration. The recent study of Maneschiöld (2006) investigates financial integration between Baltic countries (Estonia, Latvia and Lithuania) and

international capital markets. The results suggest that international investors can obtain diversification benefits given a long-term investment horizon because of the low degree of integration between the Baltic and international capital markets.

Dvorak & Podpiera (2006) investigate the hypothesis that a dramatic rise in stock prices observed in the EU accession countries at the end of 2001 after the announcement of the European Union enlargement towards those countries was due to the integration of accession countries into the world market. The sample of accession countries includes three emerging markets (Czech Republic, Hungary and Poland) and five frontier emerging markets in Europe (Estonia, Latvia, Lithuania, Slovakia and Slovenia). The results of this study show that the rise in stock prices results from repricing of systematic risk where difference between local and world betas explain about 22% of the stock price increase.

Mateus (2004) uses sample of 13 EU accession countries (five of them are classified as the frontier emerging markets: Bulgaria, Estonia, Lithuania, Romania and Slovenia, while the rest of countries belong to the emerging markets group) to investigate the importance of global risk factors and predictability of stock market returns during the period 1997- 2002. The results reveal that the conditional asset-pricing models fail, on average, to price correctly the assets in selected countries indicating their partial integration with the world.

1.2. Purpose and Hypothesis of the Study

Market integration has emerged as an important research issue because of its implications on international capital budgeting and investments. Financial markets that are not integrated into the world capital markets may provide opportunities for international investors to obtain diversification benefits by investing in those segmented markets. Even though emerging markets' equity returns exhibit high levels of volatility, they are relatively less correlated with equity returns in the developed world, giving a possibility to construct low-risk portfolios (Bekaert & Harvey 2003b: 17). Therefore, the empirical investigation of dynamics and interdependence among these markets has become increasingly important.

The purpose of this study is two-fold. First, the study investigates whether the European frontier emerging stock markets have become integrated into the world capital markets by examining the sensitivity of the stock returns to the world-wide market risk factor. As the second, the interdependences across the frontier emerging markets and their linkages to the three largest developed markets in Europe are examined. In this study, it is hypothesized that the European frontier emerging markets represented by five selected countries are not yet integrated into the world capital markets. This is to be expected, given that those markets are relatively small and less liquid with relatively short history of stock exchanges comparing with developed markets. Regarding the issue of interdependencies among the frontier emerging markets and their linkages to the developed markets in Europe it is expected that there are linkages across emerging markets taking into consideration their regional and historical connections and similarities in the sense of the economy, but the extent of the linkages among them and linkages with developed markets is expected to be weak suggesting potential benefits for international portfolio diversification.

Given the fact that degree of financial integration affects investment decisions of international investors, important implication is that foreign investors may benefit from the reduction of risk by adding the stocks in the frontier emerging markets to their investment portfolio. Since international investors incorporate into their portfolio selection degree of financial integration between markets, the results of this study can shed light on the extent to which investors can benefit from international diversification in the countries classified as the European frontier emerging markets.

In the light of the existing literature on the financial integration between developed and emerging markets, this study contributes to the literature by investigating one special subcategory of emerging markets, namely frontier emerging markets. This subcategory is worth researching taking into consideration following findings of empirical studies. Several recent studies (Chelley-Steeley 2000; Wong, Penm, Terrell & Ching 2004; Hui 2005; Berben & Jansen 2005; Wongswan 2006) show that the interdependence among the international equity markets has increased substantially since the 1987 U.S. Stock Market Crash implying decreased benefits of international diversification. As an alternative for obtaining benefits from portfolio diversification, the new emerging markets have attracted the attention of international fund managers (Papaioannou & Tsetsekos 1997). But, there is also evidence of increasing degree of integration between new emerging markets (especially in Asia) and developed countries. Recent study of Tai (2007) shows that Asian emerging stock markets (India, Korea, Malaysia,

Philippines and Thailand) have become integrated into the world capital markets since their official liberalization dates.

In the situation when emerging markets are increasingly becoming integrated into the world markets, the alternative for any future further benefits of international diversification could be looking to the subcategory of frontier markets. In addition, the use of the European frontier emerging markets in this study is motivated by the fact that relatively few studies have examined those stock markets. Therefore, this study attempts to provide new empirical evidence on the issue of financial integration of emerging markets by using the sample of five frontier emerging markets in Europe for which was possible to obtain stock market index data for the last ten years.

The European frontier emerging stock markets which will be examined are selected according to the Standard and Poor's classification of frontier emerging markets. The sample includes five among nine European countries which are classified as the frontier emerging markets representing constituent universe for S&P/IFCG Extended Frontier 150 Index. This Index is designed to meet increasingly sophisticated needs of global investors, who are seeking to expand into markets less known but with a potential for return similar or more than other better known emerging markets counterparts. The countries are as follows: Croatia, Estonia, Romania, Slovakia and Slovenia.

In order to investigate whether frontier emerging markets' returns are driven by the world capital market returns in the sense of lead-lag co-dependent relationship, Granger causality test will be conducted separately for each country relative to the world. There will be two potential outcomes – each of them having different implications. The case in which movements of the world market returns do not cause frontier emerging market returns is indicative of frontier emerging market being segmented which implies existence of opportunities for international investors to obtain diversification benefits by investing in those segmented markets. Another potential outcome in which the world market returns cause frontier emerging market returns is indicative of frontier emerging market being integrated which implies evidence of increasing globalization of financial markets.

This study focuses on testing financial integration of the European frontier emerging markets by examining sensitivity of stock returns to only one factor - world-wide market risk factor proxied by the world market portfolio. The other important sources of risk that

can be priced in frontier emerging markets are currency and country-specific local risk, but they are out of scope of this study and can be seen as avenues for further research.

1.3. Construction of the Study

This study will be divided in six chapters. The first chapter presents introduction containing the research problem, purpose of the study and review of previous literature. Essential theoretical framework for research problem will be discussed in the second and third chapter. The portfolio theory, risk and return relationship and diversification are discussed in the second chapter, while emerging markets finance issues are subject of the third chapter. The fourth chapter will present a description of the data of the empirical study with preliminary statistics and also closer look will be taken into the research methodology. Empirical results will be presented and discussed in the fifth chapter as well as the conclusions of the study and suggestions for further research. The last chapter summarizes this study and its results.

2. THEORETICAL BACKGROUND

The main purpose of this chapter is to present essential theoretical background which can be considered as a starting point for better understanding of the financial integration issue. The first part of this chapter briefly introduces the Portfolio theory as a one of the main cornerstones in the finance theory, while the second and third parts give more comprehensive review of the risk-return relationship and diversification.

2.1. The Portfolio Theory

The modern portfolio theory was introduced by Harry Markowitz with his paper “Portfolio selection” which appeared in the 1952 Journal of Finance. He formulated the theory of optimal portfolio selection in the context of trade-offs between risk and return, focusing on the idea of portfolio diversification as a method of reducing risk - and thus began what has become known as "Modern Portfolio Theory".

The most important aspect of Markowitz’s work was to demonstrate that for the investor it is important to consider the contribution that security makes to the variance of his entire portfolio, rather than a security’s own risk as measured by security variance. That is primarily a question of security’s covariance with all the other securities in investor’s portfolio. Therefore, decision to hold a security should not be based on comparing its expected return and variance to others, but instead the decision to hold any security would depend on what other securities the investor wants to hold. Evaluation of securities cannot be properly done in isolation, but instead securities should be evaluated as a group (Rubinstein 2002: 1043). Markowitz’s approach became accepted and very often used among institutional portfolio managers who use it to structure their portfolios and to measure their performance (Rubinstein 2002: 1044). Markowitz’s basic principles of portfolio construction are the foundations for the relationship between risk and return.

2.2. Risk and Return Relationship

Investors are assumed to be seeking the maximum returns for a given level of risk or the minimum risk for a given level of return. In the case of risky assets the coming return is not known, but however investors have a certain expectations about coming returns

(Copeland & Weston 1988: 153). The expected rate of return of a security can be determined as follows (Bodie, Kane & Marcus 2002: 227):

$$(1) \qquad E(R) = \frac{E(P_1) + E(D) - P_0}{P_0},$$

where: $E(R)$ = the expected return of security,
$E(P_1)$ = the expected security price,
$E(D)$ = the expected dividend
and P_0 = security price.

The rate of return on a portfolio is a weighted average of the rates of return of each asset comprising the portfolio, with portfolio proportions as weights. From this statement it could be implied that the expected rate of return on a portfolio is a weighted average of the expected rate of return on each component asset (Bodie et al. 2002: 163). The portfolio expected return is determined as follows:

$$(2) \qquad E(R_p) = \sum_{i=1}^{n} w_i E(R_i),$$

where: $E(R_p)$ = the expected return of portfolio,
$E(R_i)$ = the expected return on each asset,
w_i = weight or the proportion of the portfolio allocated to each security,
$\sum w_i = 1$
and n = the number of securities in the portfolio.

However, investors need to know also the risk of the security. The measure of a risk can be defined as a standard deviation (σ) of the rate of return. The standard deviation is a square root of the variance, which is the expected value of the squared deviations from the expected return. The standard deviation and the variance measure uncertainty of possible outcomes also known as a probability distribution. Modern portfolio theory, in most of the cases, assumes normal distribution of the asset returns. (Copeland & Weston 1988: 153-154.)

The normal distribution assumption is convenient because the normal distribution can

be described completely by its mean and variance and furthermore, even if individual asset returns are not exactly normal, the distribution of returns of a large portfolio will still resemble a normal distribution quite closely. The evaluation of risky prospects based on the expected value and variance of possible outcomes is known as a mean-variance analysis. (Bodie et al. 2002: 175, 984.)

The main impact on the investor's appropriate risk-return trade-off will have a risk aversion. An investor is said to be risk averse if he prefers less risk to more risk, all else being equal. One reasonable function commonly used by financial theorists assigns a portfolio with expected return $E(r)$ and variance of returns σ^2 the following utility score:

$$U = E(r) - 0.005\, A\, \sigma^2, \tag{3}$$

where U is the utility value and A is an index of the investor's risk aversion. The factor of 0.005 represents just a scaling convention which gives the possibility to express the expected return and standard deviation in equation (3) as percentages rather than decimals. The utility score can be considered as a means of ranking portfolios meaning that when utility value is high a portfolio has more attractive risk-return profiles. (Bodie et al. 2002: 157; Elton & Gruber 2003: 210-220.)

Precise prediction of the relationship between the risk of an asset and its expected returns is given by the capital asset pricing model (CAPM). This relationship is important in the following two respects. First, it provides a benchmark rate of return for evaluation of possible investments and as second the model gives us possibility to make an forecast regarding the expected return on assets that have not yet been traded in the marketplace as it is case for example with initial public offering of stock. (Bodie et al. 2002: 258; Elton & Gruber 2003: 304-305.)

The capital asset pricing model (CAPM) was created simultaneously by William Sharpe (1964) and John Lintner (1965) and developed further by Mossin (1966). The CAPM is a cornerstone of modern financial economics and its significant importance is justified by the fact that William Sharp received the 1990 Nobel Prize for his work on the CAPM published in 1964 (Bodie & Merton 2000: 344).

In the CAPM standard deviation of return does not measure generally the risk of securities. The general measure of security's risk is its beta (the Greek letter β) (Bodie & Merton 2000: 348). Beta is known as a stock's sensitivity to changes in the value of

the market portfolio and it measures the marginal contribution of a stock to the risk of the market portfolio (Brealey & Myers 1996: 182). Beta is defined as follows (Copeland & Weston 1988: 199):

(4) $\beta_i = Cov\ (r_i\ ,\ r_M) / \sigma^2_{M,}$

where: σ^2_M = variance of market portfolio
and $Cov\ (r_i\ ,\ r_M)$ = covariance between returns on a stock *i* and market portfolio.

Stocks with betas greater than 1.0 are called aggressive stocks and their returns tend to respond more than one-for-one to changes in the return of the overall market. Defensive stocks have betas less than 1.0 and their returns vary less than one-for-one with market returns. The beta of a portfolio is calculated as an average of the betas of the securities in the portfolio, weighted by the investment in each security. (Brealey, Myers & Marcus 2004: 294, 298.)

The relationship between the asset beta and the expected return can be expressed in a linear way by using Security Market Line (SML). Therefore, the CAPM states that the expected return of every asset must lay on the SML (see Brealey & Myers 1996: 179-188).

Formula for the CAPM is described in the following equation:

(5) $r = r_f + \beta\ (r_m - r_f),$

where *r* is the expected return of a stock, r_f is the risk-free rate, β is the beta of a stock and r_m is the expected return on market (Brealey et al. 2004: 302). The expected return-beta relationship can be represented graphically by the Security Market Line (SML), which is shown in Figure 1.

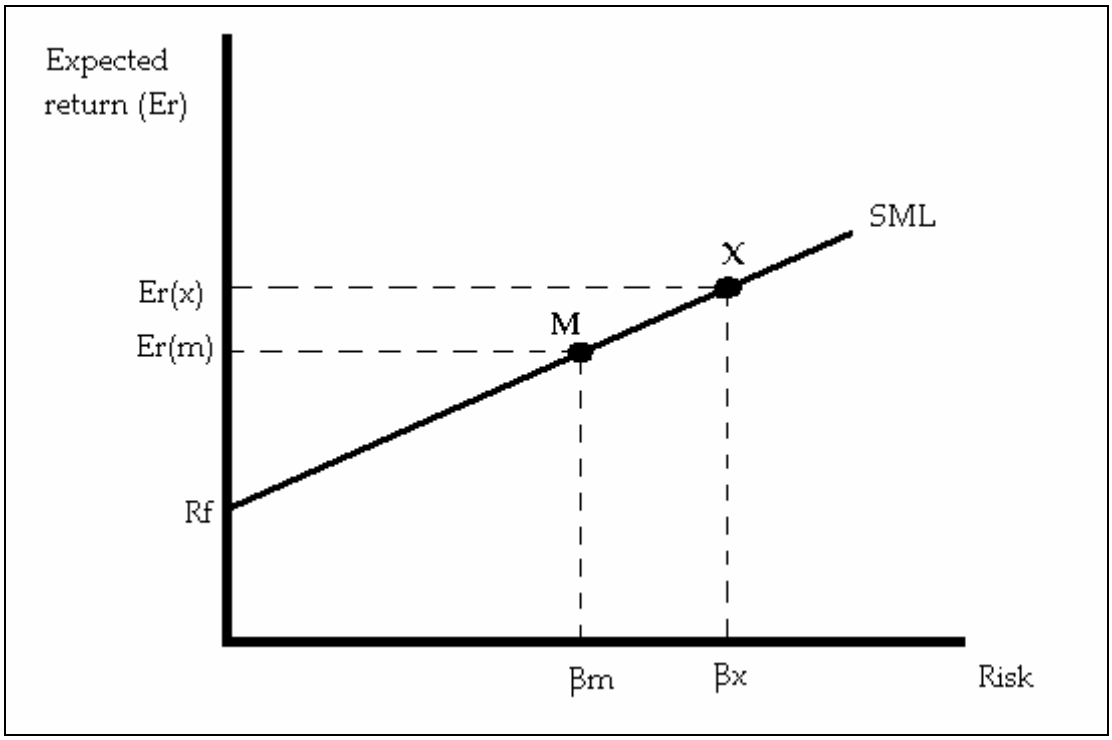

Figure 1. The security market line (Bodie et al. 2002: 273).

2.3. Diversification

Investors are able to significantly reduce the risk of the expected return of their investments by investing in a large number of different assets. This procedure of forming a portfolio with main aim to reduce risk in a given level of return is called diversification (Ross, Westerfield & Jordan 2003: 427-429). However, even extensive diversification cannot eliminate the risk completely. As the number of securities increases, portfolio standard deviation decreases, but cannot be reduced to zero. The risk that can be eliminated by diversification is known as unique risk, diversifiable or nonsystematic risk, while on the other hand the risk that remains even after extensive diversification is called systematic or market risk. Word risk is usually referred in finance to the systematic part of risk, since there is no pay for risk that can be eliminated (Copeland & Weston 1988: 198-202).

The risk of a portfolio depends not only on the risk of the securities which form portfolio, but also on the links present between the various securities, through the effect of diversification (Esch, Kieffer & Lopez 2005: 41). Diversification potential of an asset can be quantified using the concepts of covariance and correlation. The covariance as a simple statistical measure of co-movements between two random variables measures

how much the returns on two risky assets move in tandem. If asset returns move together they have positive covariance, while negative covariance means that asset returns vary inversely (Copeland & Weston 1988: 156-157).

The covariance of two securities can be calculated as follows (Copeland & Weston 1988: 156):

(6) $COV\,(X, Y) = E\,[\,(R_x - E(R_x))\,(R_y - E(R_y))]$,

where: $COV\,(X, Y)$ = the covariance between security *x* and *y*,
R_x = the realized return of security *x*,
R_y = the realized return of security *y*,
$E\,(R_x)$ = the expected return of security *x*
and $E\,(R_y)$ = the expected return of security *y*.

Since covariance is not independent of the units of measurement, it is a difficult measure to use in comparison purposes. For instance, the covariance of monthly returns will normally be higher than the covariance of any daily returns in the same market because the monthly returns have much higher order of magnitude than daily returns. For the comparison purposes, a standardized form of covariance is used. The standardized form is known as the correlation (Alexander 2001: 7). Therefore, the covariance is usually interpreted in the terms of the correlation coefficient, which scales the covariance to a value between -1 (perfect negative correlation) and +1 (perfect positive correlation). The correlation coefficient between two variables is calculated by dividing their covariance by the product of the standard deviations (Bodie et al. 2002: 166). High positive correlation indicates that returns are co-dependent because they tend to move together in the same direction, while high negative correlation indicates still highly co-dependence between returns, but difference is that they tend to move in opposite directions (Alexander 2001: 7).

The covariance term is important for calculation of the portfolio variance. In case of two risky assets combined into a portfolio with variances $\sigma_1^{\,2}$ and $\sigma_2^{\,2}$, respectively, and portfolio weights w_1 and w_2, the portfolio variance $\sigma_p^{\,2}$ is given by:

(7) $\sigma_p^{\,2} = w_1^{\,2}\,\sigma_1^{\,2} + w_2^{\,2}\,\sigma_2^{\,2} + 2\,w_1\,w_2\,Cov\,(r_1, r_2)$.

A positive covariance increases portfolio variance, while in contrast a negative

covariance reduces portfolio variance. The returns on negatively correlated assets tend to be offsetting, which implies stabilizing effect on portfolio returns. (Bodie et al. 2002: 166.)

In case of three risky assets combined into a portfolio, the portfolio variance will include three variances and six covariance terms, which clearly demonstrates that by increasing the number of securities in a portfolio the number of covariance terms increases more than the number of variances. Hence, the variability of well-diversified portfolio is determined mainly by the covariances. (Brealey & Myers 2003: 171.)

Markowitz (1959: 102) emphasizes importance of the covariance for portfolio selection. In portfolios which include large numbers of correlated securities, importance of variances shrinks comparing to the importance of covariances. The contribution of a security to the variability of a large portfolio is not determined according to the size of its own variance, but according to the sum of all its covariances with the other securities of the portfolio.

As the number of securities in a portfolio rapidly increases, the portfolio variance steadily approaches the average covariance. In case that average covariance equals zero there would be possibility to eliminate all risk by holding enough number of securities. In reality, common stocks that investors can buy usually move together having positive covariances which actually set the limits to the benefits of diversification. Diversification cannot eliminate market risk, which implies that diversified portfolios are affected by variation in the general level of the market. (Brealey & Myers 2003: 172-178.)

The market, from a theoretical point of view, can be considered as a portfolio which includes all the securities circulating on the market. Thus, the market return is defined as:

$$(8) \qquad R_{M,t} = \sum_{j=1}^{N} XjRjt,$$

where *Xj* represents the ratio of global equity market capitalization of the security (*j*) and that of all securities, while *N* represents number of securities. Because these figures are often difficult to process in practice meaning that financial analyst cannot track every stock, the concept is usually replaced by the concept of a *stock exchange index* that

represents the market in question (Esch et al. 2005: 39). Financial analysts and investors usually rely on market indices to summarize the return on different classes of securities (Brealey et al. 2004: 269).

Set of portfolios that maximize expected returns for each level of portfolio risk can be presented graphically by the efficient frontier. Every rational investor should select portfolio on the efficient frontier (Bodie et al. 2002: 240). If a portfolio is efficient it is not possible to get a higher average return without incurring greater standard deviation; it is not possible to get smaller standard deviation without giving up return on the average. If a portfolio is inefficient it means that there exists either some other portfolio with more average return and no more standard deviation, or some other portfolio with less standard deviation and no less average return. In the case of most inefficient portfolios there exist portfolios which exhibit not only more average return but also less standard deviation at the same time (Markowitz 1959: 22).

Figure 2 can be used as a simple illustration of benefits from international diversification. Points in the Figure 2 represent expected returns and standard deviations of stock indices of seven different countries over the period 1980 - 1993 as well as the equally weighted portfolio. The figure clearly demonstrates benefits from diversification. (Bodie et al. 2002: 233.)

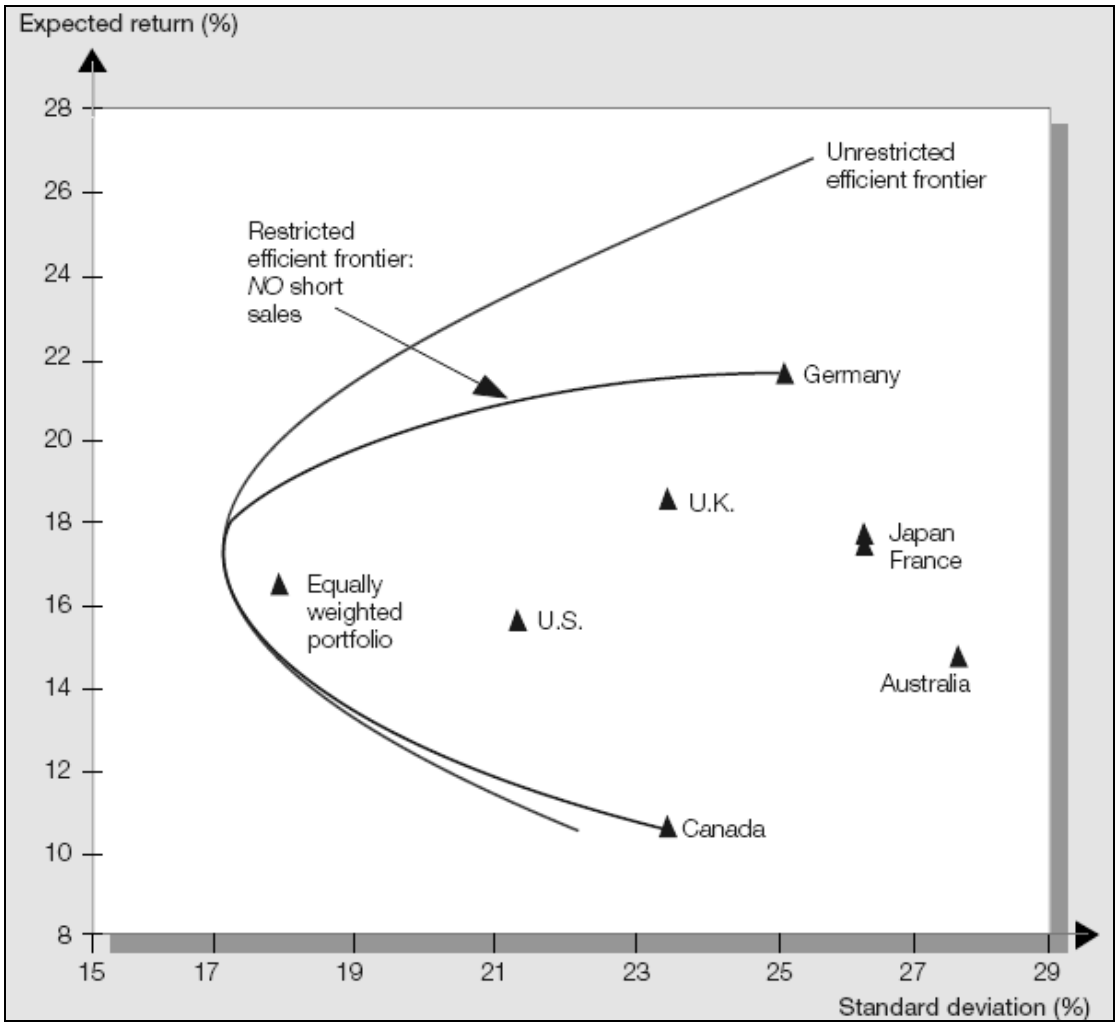

Figure 2. Efficient frontier with seven countries (Bodie et al. 2002: 233).

International diversification provides a market reduction in risk for portfolios that include stocks of foreign countries in addition to stocks of local country. Hence, rational investors should invest across borders because adding international to national investments increases the power of portfolio diversification. (Elton & Gruber 2003: 285.)

Early study of Solnik (1974: 51) investigates empirical estimates for the risk of an internationally diversified portfolio compared with a diversified portfolio that is purely domestic by using sample of seven major European stock markets and U.S. stock market. The risk is measured in terms of variability of returns. The results reveal that an internationally diversified portfolio would be one tenth as risky as a typical security and one half as risky as a well-diversified portfolio of U.S. stocks alone with the same

number of holdings. Hence, the gains from international diversification are substantial. The reasonableness of international diversification depends on the following factors: correlation coefficient across markets, the risk of each market, and the returns in each market (Elton & Gruber 2003: 262).

3. EMERGING MARKETS FINANCE

This chapter is divided into four sections. The first section focuses on the market integration and its connections with the liberalization process in emerging markets. The second section discusses the financial effects of market integration including the cost of capital and equity return volatility, as well as issues of capital flows and diversification benefits. The following section pays attention to the real sector, discussing the effects of the liberalization and integration process on economic growth, while the final section explains contagion issue in equity markets which refers to the cross-country spillover of crises.

3.1. Market Integration and Liberalization

Market integration is an important issue in international and development economics. In the field of international economics the main emphasis is on the potential welfare gains arising from market integration through the diversification benefits in terms of sharing risk, while in the development economic literature the main focus is on the investment and growth benefits arising from financial market integration (Bekaert, Harvey & Lumsdaine 2002a: 204) . Financial market integration refers to the notion that assets in all markets are subjects of exposure to the same set of risk factors with the risk premium on each factor being the same in all markets. This implies that the global value-weighted market portfolio is considered as the relevant risk factor in that situation (Saleem & Vaihekoski 2007: 3). In other words, financial market integration means that investor, whether local or foreign, considers assets in the local market as a part of the world portfolio (Dvorak & Podpiera 2006: 135).

By opening stock markets to foreign investors, the emerging economies could obtain potential benefits. Allowing foreign investments in domestic stock market can be seen as important opportunity to attract foreign capital and enhance development of equity markets which is positively related to the economic growth in the long run (Kim & Singal 2000: 26). In addition, inflows of foreign equity result in global diversification. According to model of global portfolio diversification developed by Obstfeld, an economy that liberalizes and opens its asset markets may experience a substantial rise in national welfare (Obstfeld 1994: 1310-1311). Furthermore, international risk sharing

through global diversification leads to improvements in resource allocation (Obstfeld 1994: 1310).

One important question which arises is how to measure degree of financial integration. It is obvious that financial integration is a process which measurement is a challenging issue (Bekaert & Harvey 2003b: 8). A starting point for answering aforementioned question is to determine the date when a market becomes integrated. The dating of market integration is in the most cases related to the capital market liberalization process, but because that process is usually gradual one it is not likely that dates of capital market reforms necessarily correspond to exact date of market integration (Bekaert, Harvey & Lumsdaine 2002a: 204).

In the development economics literature the term financial liberalization is usually referred to domestic financial liberalization including privatization process and reforms in banking sector, while the financial liberalization in the context of market integration is referred to allowing inward and outward foreign equity investments without restrictions. (Bekaert & Harvey 2003b: 6.)

The liberalization process is usually a gradual process due to existence of different kinds of investment barriers (Bekaert & Harvey 2003b: 8-9). According to Bekaert (1995) there exist three different types of barriers. The first type refers to legal barriers resulting from the differences in legal statuses of domestic and foreign investors; the second type refers to indirect barriers resulting from differences in availability of information, investor protection and selection of accounting standards, while the third type refers to emerging market specific risks related barriers (for example political risk, liquidity risk or economic policy risk) which have discouraging effect on foreign investments resulting in market segmentation.

Laeven & Perotti (2001: 1) argue that financial integration is a gradual process, taking place only gradually after liberalization, and generally speaking after any major reform policy regarding the market. The reasoning behind this statement is that investors respond with some diffidence to announced policies which may be reversed and only when they observe stable policies over time their confidence about the political commitment to market reforms starts to increase significantly.

3.2. Financial Effects of Market Integration

In many research papers in the field of emerging markets finance particular attention has been given to the effects of the liberalization process on various financial variables. The main focus is on the effects of the liberalization on equity returns and stock market volatility. (Bekaert & Harvey 2003b: 11.)

From the theoretical point of view, International asset pricing models (IAPMs) suggest lowering in the cost of capital for companies belonging to the segmented economies, but with access to the international market. Declines in expected returns in that case would be caused by diversification potential that these companies offer foreign investors. Hence, returns should exhibit the following pattern: in pre-liberalization period high equilibrium expected returns indicating the high cost of capital; during the liberalization period large positive returns reflecting price increases as the cost of capital falls, i.e., the revaluation effect; in post-liberalization period normal equilibrium expected returns, with the difference in the pre-liberalization period returns compared with the post-liberalization period returns (i.e., the change in the cost of capital) related to the diversification potential of the company. (Errunza & Miller 2000: 579.)

Henry (2000a: 302-303) argues that there exist three reasons for decreasing the cost of equity capital in the liberalizing country due to the liberalization process. The reasoning behind this statement is based on the facts that cost of equity capital consists of two components: the risk-free rate and the equity premium, and that the liberalization process affects both components through different mechanisms. The first reason is that stock market liberalization leads to increasing of net capital inflows which in turn could lead to lowering of the risk-free rate. The second reason is that the liberalization process improves international risk sharing between local and foreign investors which results in a reduction of the equity premium. Finally, increased capital inflows may cause rising of stock market liquidity (Levine & Zervos 1998: 1169) and higher liquidity then leads to the lowering of the equity premium (Ahimud & Mendelson 1986). Using a sample of 12 emerging markets, empirical study of Henry (2000b: 553) shows that stock market liberalization reduces the average cost of equity capital which is consistent with theoretical prediction of IAPMs that stock market liberalization may reduce cost of equity capital of the country in the period following liberalization by allowing for international risk sharing among domestic and foreign agents.

Regarding the issue of the financial effects of liberalization on volatility, it is not obvious from finance theory whether stock return volatility should increase or decrease due to the liberalization process (Bekaert & Harvey 2003b: 12). There is a reasonable expectation that a stock return volatility will decrease because of fact that integration process of emerging markets with the world markets makes equilibrating process more efficient. On contrast, the volatility of stock markets may increase as a result of high volatility of unrestricted capital flows (known as "hot money") which are affected by quick response of foreign investors to changes in emerging market economies (Kim & Singal 2000: 36).

Empirical study of Bekaert & Harvey (1997: 70) provides evidence that capital market liberalization significantly decreases stock market volatility in emerging markets, while study of De Santis & Imrohoroglu (1997: 575) confirms decreasing of stock market volatility with liberalization only for some emerging markets, but there is no evidence of a systematic effect of market liberalization on stock return volatility. Kim & Singal (2000: 42) find no significant impact of market liberalization on stock return volatility. Aggarwal, Inclan & Leal (1999: 54) examine the kinds of events which cause large shifts in the volatility of emerging stock markets using the sample of 10 largest emerging markets according to the International Finance Corporation (IFC) classification and find that the country-specific political, social and economic events are more important than global ones in causing major shifts in emerging markets' volatility.

The question regarding the effects of stock market liberalization on stock return volatility is further investigated in the study of Jayasuriya (2005: 188) which uses the sample of 18 emerging markets and finds that volatility may increase, decrease or remain unchanged in the period after liberalization. After including association of post-liberalization volatility with market characteristics and quality of institutions in analysis, the results reveal that countries with favorable market characteristics such as higher level of market transparency and investor protection, as well as better quality of institutions reflected in lower level of corruption and higher rule of law experience lower volatility in post-liberalization period.

The capital market liberalization process in emerging countries leads to increased portfolio flows into those countries. The financial liberalization changes market environment from low level of capital flows in pre-liberalization period to very significant level of capital flows in post-liberalization period. Those capital flows are subject to portfolio rebalancing (Bekaert & Harvey 2003b: 15-16). The empirical study

of Bekaert, Harvey & Lumsdaine (2002b: 339) which examines the joint dynamics of returns and net U.S. equity flows shows that net capital flows to emerging markets increase rapidly after liberalization as investors make rebalancing of their portfolios towards emerging markets, but however the equity flows are reduced three years after liberalization.

Another important issue in examining joint dynamics of capital flows and equity returns is to investigate effect of flows on returns. There is empirical evidence that increases in capital flows raise stock market prices as it was shown in studies of Froot, O'Connell & Seasholes (2001) and Clark & Berko (1997), but there is no consensus about question whether the effect is temporary or permanent. Froot et al. (2001: 192) argue that effect is temporary and that price pressure in emerging markets is substantial so that a cessation of inflow can reduce stock prices, which is in line with the price pressure hypothesis suggesting that inflow induced price increases would be subsequently reversed. On contrary, Clark & Berko (1997: 18) argue that greater risk sharing benefits and improved liquidity arising from foreign inflow create permanent price rises, which is consistent with the base-broadening hypothesis suggesting that broadening the investor base leads to increased risk sharing and diversification.

The possibility of the diversification benefits arising from exposure to emerging equity markets has attracted a significant attention of international investors (Bekaert & Urias 1996: 835). Early study of Divecha, Drach & Stefek (1992: 41) which examines investing in emerging markets shows that emerging markets are more volatile comparing to developed markets, but they are less correlated with each other and with developed markets which implies benefits reflected in lower portfolio risk for global investors investing in those emerging markets. Harvey (1995: 811) confirms those findings in the sample of 20 emerging equity markets demonstrating that addition of emerging market assets to a mean-variance efficient portfolio significantly enhances portfolio performance through a reduction of portfolio volatility and increase of expected returns.

However, there is some criticism in literature that those early studies ignore the high transaction costs and investments constrains related to emerging market investments. De Roon, Nijman & Werker (2001: 722-723) attempt to shed light on this issue by taking into account transaction costs and short sales constrains in the mean-variance spanning test methodology framework. The results reveal that in case when transaction costs and short sales constrains are ignored there are significant diversification benefits from investing in

emerging markets, but however diversification benefits are eliminated after allowing for transaction costs and short-sale constrains.

Li, Sarkar & Wang (2003: 58) criticize methodology of mean-variance spanning tests used in the study of De Roon et al. (2001) emphasizing that statistical tests show strong evidence of diversification benefits in case of investing in particular emerging markets, but no evidence of diversification benefits when investing in combination of these emerging markets. They argue that those illogical results arise from inadequacy of applied methodology reflected in the loss of explanatory power with adding more emerging markets in analysis. Li et al. (2003: 59) use a Bayesian approach, which eliminates inadequacy of mean-variance spanning methodology, to investigate the impact of short-sale constraints on the international diversification benefits. They find that the diversification benefits from investing in emerging markets remain substantial even in case when investors are faced with short-sale constraints.

De Santis & Gerard (1997: 1881) estimate by using the capital asset pricing model (CAPM) in international setting that the expected gains from international diversification to a U.S. investor equal 2.11% on average annually. Errunza, Hogan & Hung (1999: 2104) examine whether U.S. investor can obtain the gains of international diversification by making a portfolio of securities trading in the United States and find that most of the diversification benefits can be gained using domestically traded assets in country funds and American Depositary Receipts (ADR).

3.3. Real Effects of Financial Market Integration

In addition to examining financial effects of market integration in literature about emerging markets finance particular attention has also been given to examining the effects of the liberalization process on economic growth. The starting point for explaining relationship between the liberalization process and economic growth is theoretical prediction of international asset pricing model that stock market liberalization may reduce the cost of equity capital in the liberalizing country (Henry 2000a: 302). One important implication of this prediction is that reduction of the cost of capital will affect real investments and given that those additional investments are efficient then economic growth should increase (Bekaert & Harvey 2003b: 21).

The empirical study of Henry (2000a: 332) confirms the theoretical prediction that stock market liberalization is associated with increased investments. The study uses sample of 11 developing countries that liberalized their stock markets and clearly demonstrates that liberalizing countries experienced abnormally high growth rates of private investments in the post-liberalization period. In addition, the association of stock market liberalization and private investments growth persists even after inclusion of control variables such as world business cycle effects, contemporaneous economic reforms and domestic fundamentals.

Bekaert, Harvey & Lundblad (2001: 466, 497) provide further evidence of the relationship between the financial liberalization and real economic growth in emerging markets. They demonstrate that the liberalization of stock markets is associated with higher real growth with empirical results from sample of 30 countries (classified as either emerging or frontier by the International Finance Corporation) showing that average real economic growth increases between 1% and 2% per year in the period following the financial liberalization. The results are robust even after controlling for a comprehensive set of variables representing macroeconomic environment, banking development and stock market development.

The findings regarding the financial liberalization effects on economic growth are strengthened in Bekaert, Harvey & Lundblad (2005) by expanding the sample of countries to 95. The study shows an approximate increase of 1% in annual real GDP per capita following stock market liberalization. However, they emphasize possibility that financial liberalization coincide with other macroeconomic reforms and financial development which might be also the sources of increased growth. After adding control variables which capture macroeconomic reforms and financial development the liberalization effect does weaken slightly in some specifications indicating that reforms and financial development may account partly for the liberalization effect, but still results show statistically significant impact of stock market liberalization on the economic growth. (Bekaert, Harvey & Lundblad 2005: 40-41.)

3.4. Contagion

The increasing globalization of financial markets and the financial crises during 1990s such as the Mexican crisis in 1994, the “Asian Flu” crisis in 1997 and the “Russian virus”

crisis in 1998 has generated a large body of literature on contagion, which is term used to describe cross-country spillover of crises.

There is a widespread disagreement in literature about what term contagion entails. Forbes & Rigobon (2002: 2223-2225) make a distinction between terms contagion and interdependence. They define contagion as a significant increase in cross-market linkages after a shock to one country or group of countries, while the case in which two markets exhibit a high degree of comovements in the period of stability and continue to have high correlation after a shock to one market may not be interpreted as contagion. This case is labeled as interdependence and it implies strong linkages that exist between two markets irrespective of the state of economy. Thus, for detecting contagion it is of high importance to assess the linkages between markets before, during and after crisis.

Bekaert, Harvey & Ng (2005: 65-66) define contagion as excess correlation i.e. level of correlation over and above that what would be expected from economic fundamentals. They apply an asset pricing approach with a two-factor model, where U.S. equity market return and a regional equity portfolio return are used as a factors, to examine whether the Mexican crisis in 1994 and Asian crisis in 1997 resulted in contagion and demonstrate presence of contagion around Asian crisis, but not during Mexican crisis. Even though a correlation framework is commonly used to detect contagion in financial markets, there are some arguments that use of correlation coefficients is inadequate in testing for contagion. Baur & Schulze (2005: 22) argue that inadequacy of correlation coefficient for assessing market linkages arises from its sensitivity to heteroscedasticity and that correlation coefficient as a linear measure is not suitable in the case where contagion is an event characterized by non-linear changes of market association.

Bae, Karolyi & Stulz (2003: 719-721) use an alternative approach to measure financial contagion by abandoning correlation framework in defining contagion and instead focusing on determining a contagion in the terms of large absolute value daily returns, where contagion is defined as the coincidence of extreme equity return movements. They introduce term exceedance which is defined as the occurrence of an extreme return of a financial market at a certain point of time, while the joint occurrence of exceedances in two or more markets at the same point of time is labeled as coexceedance. The coexceedance measurement approach in analyzing contagion is further developed by Baur & Schulze (2005: 39-40) by using quantile regression framework. Their study shows that contagion depends on a regional (world) market return and its volatility, as well as that contagion is stronger for extreme negative

returns than for extreme positive returns. In addition, empirical evidence regarding Asian financial crisis in 1997 detects contagion from Asia to Europe and Latin America, but not to the United States.

Beside commonly used cross-market correlation coefficients, three additional different methodologies have been applied in empirical literature to investigate how domestic stock market shocks are transmitted internationally: ARCH and GARCH models, cointegration techniques and direct estimation of specific transmission mechanisms. ARCH and GARCH modeling approach focuses on estimating the variance and covariance based transmission among countries in analysis of market comovements. Cointegration techniques have a main aim to detect changes in the cointegrating vector between markets over a longer time horizon, while direct estimation of specific transmission mechanisms is based on attempts to measure contribution of different factors to country's sensitivity to financial crisis. (Forbes & Rigobon 2002: 2227-2229.)

One important research issue that is broadly examined in literature concerning contagion is certainly the question why crises spread across countries (Bekaert & Harvey 2003b: 26). Masson (1998: 3) identifies three main channels for a transmission of the crisis: "monsoonal" effects, "spillovers" and pure contagion effects. "Monsoonal" effects arise from common causes, meaning that affected countries experience common external shock or have similarities in economic fundamentals. Spillovers arise as a result of linkages and interdependencies among financial markets. And finally, pure contagion effects refer to the cases when crisis in one market may trigger crisis in another markets for reasons unexplained by macroeconomic fundamentals.

4. DATA AND METHODOLOGY

This chapter first introduces the data used in the study with the brief description of the frontier emerging markets and the three largest developed markets in Europe as well as the indices included in the sample. After that, the research methodology is presented.

4.1. Data

The sample of the European frontier emerging markets examined in the study includes Croatia, Estonia, Romania, Slovakia and Slovenia, while the developed markets in Europe are represented by Germany, United Kingdom and France. All the data used in the empirical part of the study are extracted from the Thomson Datastream database, which is highly respected historical financial numerical database. The data consist of daily observations of the stock indices in each of the investigated frontier emerging and developed markets in Europe and daily observations of the Morgan Stanley Capital International (MSCI) World equity market index which is widely accepted benchmark index used to proxy the world market portfolio. The stock indices of the frontier emerging markets are in local currency terms, while MSCI World Index is expressed in US dollar terms. French and German indices are expressed in euro and index of United Kingdom in pounds.

The daily returns in each market are computed as the natural logarithmic differences: $ln\ (p_t / p_{t-1})$ where p_t is either the stock index of the frontier emerging or developed market or MSCI World Index at time t. The sample period extends from September 24, 1997 to September 26, 2007, which includes 2611 daily observations for each series. The sample period is chosen on the basis that it represents the longest common time period over which data is available.

In this study the frontier emerging stock markets are proxied by the country total stock market indices, which are value-weighted indices constructed consistently across countries and are representative of each country's stock market. Similarly, the world stock market is proxied with the Morgan Stanley Capital International - MSCI World Index. The MSCI World Index is a free float-adjusted market capitalization index that is designed to measure global developed market equity performance. The developed markets are represented by their major stock market indices.

For each country in the sample of the five European frontier emerging markets daily returns on stock market indices are calculated from September 24, 1997 to September 26, 2007 and compared with the returns of developed markets and returns of diversified world market equity portfolio represented by MSCI World Index for the same period of time.

4.1.1. Market Environment

The following stock exchanges are used to represent the frontier emerging markets in Europe:

- Croatian stock market is represented by the Zagreb Stock Exchange which was founded in 1991 and the official Zagreb Stock Exchange share index CROBEX, which has been published since September 1997. In March 2007 the Zagreb Stock Exchange was merged with the other Croatian stock exchange Varazdin Stock Exchange (VSE) to form a unique Croatian capital market. At the end of October 2007 the market capitalization of the stocks in the Zagreb Stock Exchange was EUR 48.1 billion. (Zagreb Stock Exchange 2008.)

- Estonian stock market is represented by the Tallinn Stock Exchange, established in 1995 and share index OMXTallinn. The Talinn Stock Exchange is the only regulated securities market in Estonia and it is a part of OMX group, which owns and operates exchanges in Nordic and Baltic countries. At the end of October 2007 the market capitalization of the stocks in the Talinn Stock Exchange was EUR 4.5 billion. (OMX Group 2008.)

- The Bucharest Stock Exchange, founded in 1995, and its share index BET introduced in September 1997 represent Romanian stock market. At the end of October 2007 the market capitalization of the stocks in the Bucharest Stock Exchange was EUR 27.7 billion. (Bucharest Stock Exchange 2008.)

- Slovakian stock market is represented by the Bratislava Stock Exchange, established in 1991 and its share index SAX, calculated from 1993. The market capitalization of the stocks in the Bratislava Stock Exchange was EUR 2.7 billion at the end of October 2007. (Bratislava Stock Exchange 2008.)

- And finally, Slovenian stock market is represented by the Ljubljana Stock Exchange, founded in 1989 and the share index SBI 20, introduced in 1993. The market capitalization of the stocks in the Ljubljana Stock Exchange was EUR 18.9 billion at the end of October 2007. (Ljubljana Stock Exchange 2008.)

The developed markets in Europe are represented by the Stock Exchanges in Frankfurt, London and Paris and their major stock market indices CDAX, FTSE100 and SBF250 respectively. The Frankfurt Stock Exchange is one of the world's largest trading centers for securities and with a share in turnover of about 90 percent, it is the largest of the seven German stock exchanges. The CDAX index includes the shares of all domestic companies listed in Prime and General Standard and represents German equity market in its entirety (Deutsche Börse Group 2008). The London Stock Exchange is one of the world's oldest stock exchanges with the history of more than 300 years and also one of the largest in the world. The FTSE 100 index is by far the most widely used UK stock market indicator because it comprises the 100 most highly capitalized blue chip companies, representing approximately 81% of the UK market (London Stock Exchange 2008). The Paris Stock Exchange, known as Euronext Paris from 2000 onwards, merged with the Amsterdam and Brussels exchanges in September 2000 to form Euronext NV which is the second largest exchange in Europe behind the London Stock Exchange. The SBF 250 index is usually used as a benchmark for the long-term performance of equity portfolios in France (Euronext 2008).

Table 1 shows some important dates pertaining to stock market liberalization in the five European frontier emerging markets investigated in this study. The second column indicates dates of the removal of legal restrictions on foreign investments with additional footnotes pointing out that the legal restrictions on foreign investments were lifted gradually. The third column shows dates when the Emerging Markets Database (EMDB), as the most commonly used source of the data for the emerging stock markets maintained by the Standard & Poor's, started to provide data for each of the markets. And finally, the fourth column indicates starting dates of the first issuing of the American Depositary Receipts (ADR) for each country. An American Depositary Receipt is certificate issued by U.S. depositary banks and represents ownership in the shares of a foreign company trading on the financial markets in the United States of America. The main purpose of ADR is to facilitate investing in foreign stocks for the American investors (see Securities and Exchange Commission of the United States 2008).

Table 1. Relevant dates in the stock market liberalization process.

Country	Restrictions lifted	Start of EMDB coverage	First ADR
Croatia	1998*	January 1998	April 1996
Estonia	1996**	April 1998	December 1997
Romania	NA	January 1998	April 1998
Slovakia	April 1998***	January 1996	April 1996
Slovenia	1999****	January 1996	June 1997

Notes: 1. * = More restriction lifted in 2002, ** = More liberalization in 2000. Restrictions on certain industries, *** = More controls lifted in 2000, **** = Until 1999 foreign sales within 7 years taxed 12%; 25% foreign ownership limit.

2. Source: Bekaert and Harvey's chronology of Economic, Political and Financial Events in Emerging Markets, and Bank of New York list of depository receipts (Dvorak & Podpiera 2006: 136).

Table 2 shows the main economic indicators for all investigated markets. Panel A reports the indicators for the three developed markets in Europe, while Panel B reports the same indicators but for the European frontier emerging markets. In general, it can be noted from the table that degree of economic development in the frontier emerging markets as measured by GDP per capita is much lower comparing to the three developed markets. The level of economic development varies considerably among the frontier emerging markets and for instance, Slovenia has the highest GDP per capita (19,021 U.S. $), while Romania exhibits the lowest level with only 5,633 U.S. $. In addition, the inflation rate in each of the frontier emerging markets is higher compared to the developed markets indicating lower level of monetary stability with respect to the developed markets. Similarly to GDP per capita, level of inflation rates also varies considerably among the frontier emerging markets. Slovenia has the lowest inflation rate (2.5 %) which is very close to the rates of the developed markets, while Romania has the highest rate of even 6.6%. Table 2 reports also current account balance expressed in billions of U.S. $ as well as a percent of GDP. The current account balance is negative for all five frontier emerging markets generally indicating that level of the import exceeds level of the export in foreign trade activity.

Table 2. Economic indicators for the year 2006.

Panel A: The developed markets

	Germany	France	UK
GDP *	2,915.8	2,252.2	2,398.9
GDP/capita**	35,432	36,708	39,630
Inflation rate***	1.8	1.9	2.3
Current account balance****	147.1	-27.7	-77.2
Current account balance*****	5.0	-1.2	-3.2

Panel B: The frontier emerging markets

	Croatia	Estonia	Romania	Slovakia	Slovenia
GDP*	42.9	16.6	121.9	55.1	38.2
GDP/capita**	9,664	12,352	5,633	10,182	19,021
Inflation rate***	3.2	4.4	6.6	4.4	2.5
Current account balance****	-3.3	-2.5	-12.5	-4.5	-0.9
Current account balance*****	-7.8	-15.5	-10.3	-8.3	-2.5

Notes:

1. * = GDP is expressed in billions of U.S. dollars

   ** = GDP/capita is expressed in U.S. dollars

   *** = Inflation rate is expressed as annual percent change

   **** = Current account balance is expressed in billions of U.S. dollars

   ***** = Current account balance is expressed as a percent of GDP

Current account balance is defined as a balance on current transactions excluding exceptional financing.

2. Source: International Monetary Fund (World Economic Outlook Database, October 2007).

Figure 3 presents the time plots of the index series during the period under study. Looking to the graphs gives the impression that indices of the frontier emerging markets follow a relatively similar movement, while MSCI World index and indices of developed European markets exhibit different pattern. The main difference is that the frontier emerging markets started to have upwards trend in the middle of 2001, while the world market and developed European markets were moving downwards reaching their troughs at the end of 2002 and the first quarter of 2003. It is interesting to observe that during the period under study indices of Germany, France and United Kingdom reached their minimal values at the same date (11.03.2003) suggesting strong linkages between those markets. From the middle of 2003 it seems that world market index and indices of developed European markets exhibit also upward trend similarly like the frontier emerging markets.

Analyzing the patterns of the frontier emerging markets indices it is notable that Croatia, Estonia, Romania and Slovenia have very similar movements during whole period under study, while Slovakia shows somewhat different pattern having very sharp increase in index value from mid-2003 to mid-2005 reaching its peak in August 2005, but after that index started to decrease slightly. The upward trend in stock indices of the frontier emerging markets in Europe that are objects of this study could be result of increased interest of foreign investors following the announcements of expansion of the European Union (EU) towards Estonia, Slovenia and Slovakia who joined EU in 2004 and Romania who joined in 2007, while Croatia still has a status of a candidate country for the EU membership.

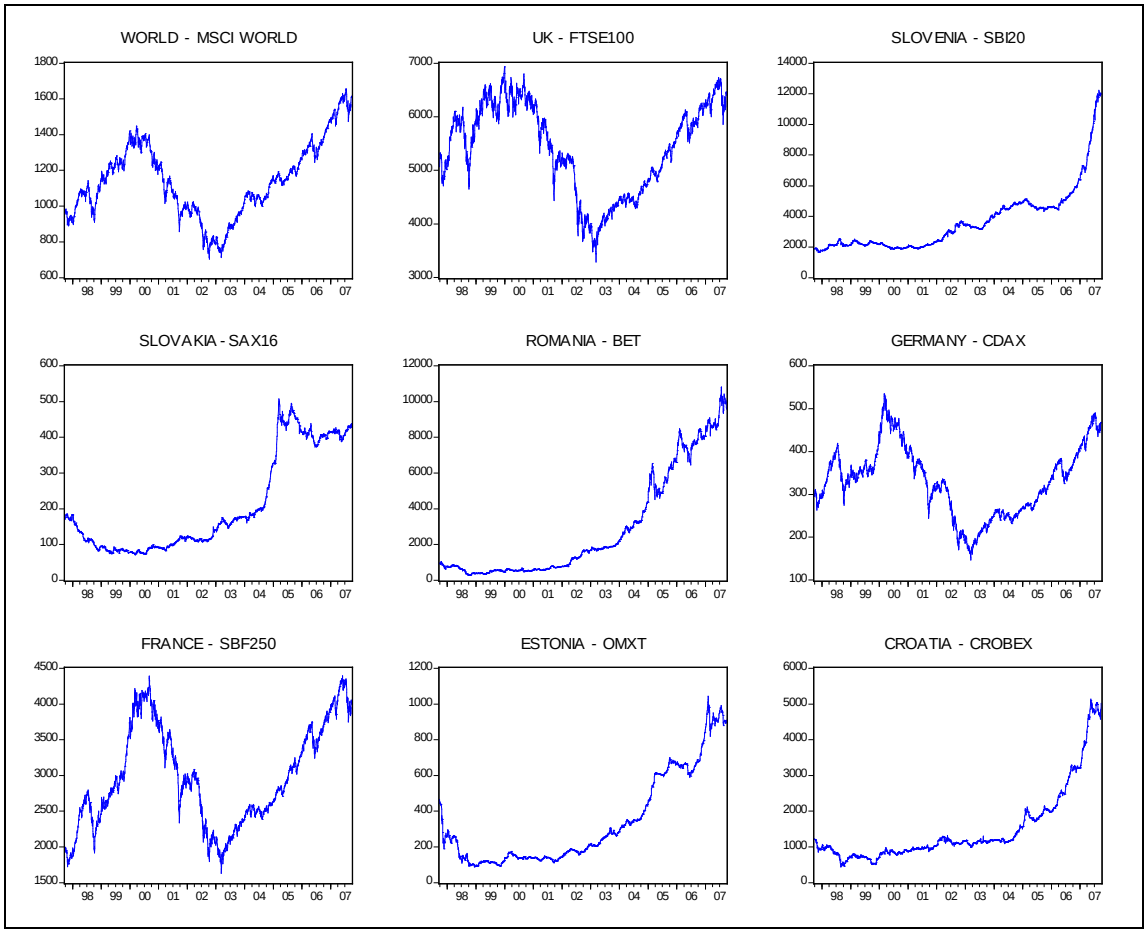

Figure 3. Stock indices from September 24, 1997 to September 26, 2007.

4.1.2. Descriptive Statistics for the Return Series

Table 3 reports summary statistics for all daily returns series. Panel A shows descriptive statistics for MSCI World index and developed markets, while Panel B reports statistics for the frontier emerging markets in the sample. Panel C reports correlations between index-returns time series for all countries included in the sample.

Table 3. Summary statistics of the daily returns from September 24, 1997 to September 26, 2007.

Panel A: The world and the developed markets

	World	Germany	France	UK
Mean	0.0002	0.0002	0.0003	0.0001
Median	0.0006	0.0006	0.0003	0.0000
Maximum	0.0460	0.0685	0.0626	0.0590
Minimum	-0.0452	-0.0749	-0.0745	-0.0589
Standard Deviation	0.0088	0.0140	0.0126	0.0114
Skewness	-0.1570	-0.2280	-0.1919	-0.1809
Kurtosis	5.2318	5.7601	5.7329	5.6464
Jarque-Bera	552.42	851.10	828.23	775.85
Probability	0.0000	0.0000	0.0000	0.0000
Observations	2610	2610	2610	2610

Panel B: The frontier emerging markets

	Croatia	Estonia	Romania	Slovakia	Slovenia
Mean	0.0005	0.0003	0.0009	0.0004	0.0007
Median	0.0000	0.0006	0.0000	0.0000	0.0002
Maximum	0.1747	0.1287	0.1154	0.0957	0.1102
Minimum	-0.1338	-0.2158	-0.1190	-0.1148	-0.1134
Standard Deviation	0.0171	0.0172	0.0169	0.0132	0.0084
Skewness	0.0416	-1.4708	-0.0241	-0.4606	0.0473
Kurtosis	18.1794	29.4126	9.6758	10.4496	33.7845
Jarque-Bera	25058.44	76808.26	4846.87	6127.62	103062.00
Probability	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	2610	2610	2610	2610	2610

Table 3 (continued). Summary statistics of the daily returns from September 24, 1997 to September 26, 2007.

Panel C: Correlation coefficients of daily returns for all markets

	World	Germany	France	UK	Croatia	Estonia	Romania	Slovakia
Germany	0.73							
France	0.71	0.85						
UK	0.68	0.75	0.83					
Croatia	0.13	0.18	0.18	0.18				
Estonia	0.12	0.15	0.17	0.13	0.06			
Romania	0.03	0.05	0.04	0.03	0.05	0.03		
Slovakia	0.05	0.02	0.02	0.03	0.02	0.00	-0.02	
Slovenia	0.05	0.08	0.06	0.05	0.11	0.08	0.10	0.00

During the period under study, the performance of shares in the group of frontier emerging markets measured by the average daily returns is the best in Romania (0.09%), but Romania is also relatively volatile market with a standard deviation of 1.69 %. The lowest average returns of the five frontier emerging markets are exhibited in Estonia (0.03%), but still they are slightly higher than average world market returns (0.02%). While Estonian market exhibits the lowest returns in the group of frontier emerging markets, its volatility is the highest in the group measured by standard deviation of 1.72%. Taking into consideration both features of returns, mean and standard deviation, it is obvious that among the five frontier emerging markets Slovenia has the best position with the second highest average returns in the group (0.07%) and the lowest level of return volatility of 0.84%. In addition, the returns of Slovenia are positively skewed indicating that large positive stock returns are more common than large negative returns.

Table 3 also reports the Jarque-Bera statistics, which tests normality based on both skewness and excess kurtosis. It is notable from the table that Jarque-Bera statistics reject the null hypothesis that the returns are normally distributed for all cases. The returns of all three developed markets' indices, as well as returns of MSCI World index and indices of Estonia, Romania and Slovakia have a negative skewness, indicating that large negative stock returns are more common than large positive returns, while returns of indices of Croatia and Slovenia are positively skewed indicating opposite case. In addition, kurtosis in all the returns series exceeds 3 indicating that series are leptokurtic having fatter tails and higher peaks relative to the normal.

Comparing the performance of the frontier emerging markets with the world market it is notable that all frontier emerging markets have higher average daily returns than the world market, but also higher volatility, as measured by the standard deviation with exception of Slovenia who exhibits slightly lower volatility level (0.84%) than the world market (0.88%). The volatility levels of returns in Estonia, Croatia, Romania and Slovakia are much higher comparing to the volatility of the world market (0.88%) with the standard deviations of 1.72%, 1.71%, 1.69% and 1.32% respectively.

Comparing the performance of the frontier emerging markets with the developed European markets it can be observed that all frontier emerging markets have higher average daily returns than Germany and United Kingdom, while in comparison with France only Estonia exhibits the same level of average returns, but all the other frontier emerging markets still have higher returns. Regarding the volatility level comparison, it is notable that volatility levels of Croatia, Estonia and Romania as measured by the standard deviation are higher than volatilities of the three developed markets, while volatility of Slovenia is lower than volatilities of the three developed markets. Volatility level of Slovakia is very close to the volatility levels of Germany and France.

In addition to the return and volatility comparison reported in the panel A and panel B, it can be noted from the panel C that returns of Romania, Slovakia and Slovenia have very low correlations with the world index returns and returns of the developed European markets (less than 0.10), while Croatia and Estonia exhibit slightly higher correlations relative to the world and the developed markets (range from 0.12 – 0.18). In contrast, returns of the developed European markets are extremely highly correlated with the world returns and at the same time extremely highly correlated between each other. Regarding the correlations among the frontier emerging markets it is notable that correlations between those markets are very low with the exception in the case of Croatia and Slovenia where correlation coefficient is 0.11 (the highest correlation in the group of the frontier emerging markets). Correlation between Croatia and Slovenia can be explain by their historical and regional links as they are neighbouring countries which had been parts of the same country (former Yugoslavia) for more then 40 years and have strong industrial and economic relationship. For instance, Croatia is important trading partner for Slovenia which is ilustrated by the fact that in the structure of Slovenian export Croatia takes place with about 9% . Export to the EU countries is 69% of total Slovenia's export, while among countries outside the EU Croatia is major trading partner (Statistical Office of the Republic of Slovenia 2007).

The volatilities of all investigated markets are illustrated by Figure 4 which displays the returns of the share price indices during the period under study. The features of average return and volatility are consistent with the observation by Harvey (1995) that emerging markets exhibit high-expected returns and high volatility.

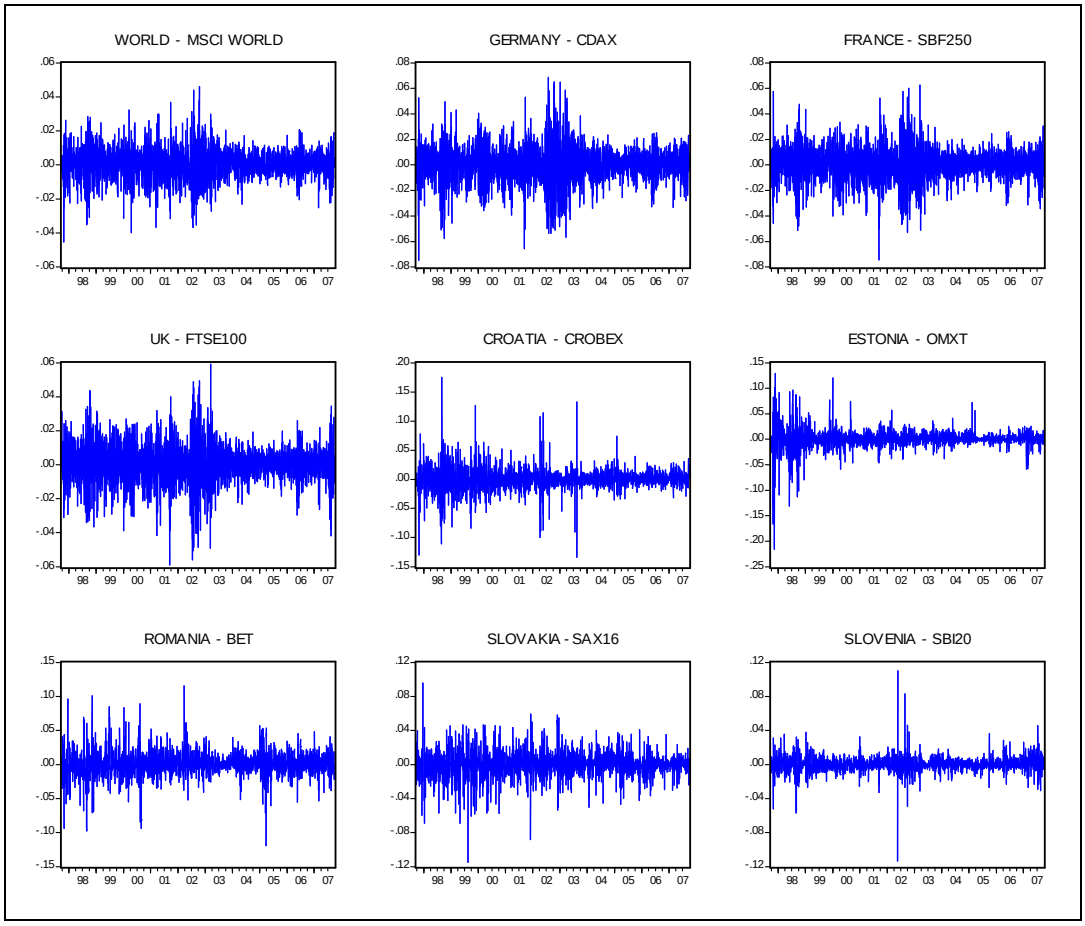

Figure 4. Daily returns of the stock indices from September 24, 1997 to September 26, 2007.

4.2. Methodology

This subchapter introduces econometric framework for the empirical analysis in the first part, while the second part contains description of the empirical model used to analyze issue of the financial integration of the frontier emerging markets.

4.2.1. Econometric Framework of Analysis

This empirical study is carried out using a Vector Autoregressive (VAR) methodology as a statistical methodology for the analysis of financial time series. VAR models are often used in finance to analyze certain aspects of the relationships between the variables of interest because they represent the correlations among a set of variables. In addition, VAR modeling is commonly used for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach treats every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

One of the key questions that can be addressed with vector autoregressions is how useful some variables are for forecasting others. This issue is examined by Granger causality test which is a technique for determining whether one time series is useful in forecasting another. Granger (1969) has defined a concept of causality which main idea is that a cause cannot come after the effect. Thus, if a variable *x* affects a variable *z* the former should help improving the predictions of the latter variable. Granger causality is causality in the sense that one series leads or lags another.

The bivariate VAR (p) model is of the following form:

$$(9) \qquad x_t = c_1 + \sum_{i=1}^{p} \alpha_{1i} x_{t-i} + \sum_{i=1}^{p} \beta_{1i} y_{t-i} + \varepsilon_{1t}$$

$$(10) \qquad y_t = c_2 + \sum_{i=1}^{p} \alpha_{2i} x_{t-i} + \sum_{i=1}^{p} \beta_{2i} y_{t-i} + \varepsilon_{2t.}$$

The test for Granger causality from *x* to *y* is an *F*-test for the joint significance of $\alpha_{21,} \ldots, \alpha_{2p}$ in an OLS regression. Similarly, the test for Granger causality from *y* to *x* is an *F*-test for the joint significance of $\beta_{11, \ldots,} \beta_{1p.}$

Evidence of Granger causality provides many insights into the dynamics of return in different financial markets and lead-lag co-dependent relationships between financial markets. (Alexander 2001.)

Even though Granger causality test provides information about potential lead-lag relationships between variables of a system, it may not provide complete picture about the interactions between the variables of a system. It is of interest also to know the response of one variable to an impulse in another variable in a system that involves a number of further variables, because a shock to the *i*-th variable not only directly affects the *i*-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. The effect of a one-time shock to one of the innovations on current and future values of the endogenous variables is traced by an impulse response function (Lutkepohl 2005: 41-66). Therefore, impulse response analysis is important in interpreting the results of VAR model.

In order to further interpret the results of VAR model, variance decomposition analysis is used. While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR, which means that variance decomposition analysis can be used to assess the fraction of variation in one variable caused by innovations in the other variables in the system (Lutkepohl 2005: 41-66). Therefore, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in VAR.

4.2.2. Empirical Model

The selection of suitable econometric methodology for this study depends on the properties of the index returns time-series. In case of the stationarity of all index returns time-series, vector autoregressive (VAR) model is appropriate methodology. The stationarity of time-series is examined by conducting the augmented Dickey-Fuller and Phillips-Perron unit root tests. Table 4 reports the results of the unit root tests. Both unit root tests are performed with and without a time trend and results regarding stationarity remain unchanged. The lag length for the unit root tests is determined by the Schwarz information criterion. The critical value for the tests at the 1 % significance level is –3.44.

Table 4. Unit root tests.

	ADF	p-value	PP	p-value
Croatia	-52.221	0.0001	-52.210	0.0001
Estonia	-12.234	0.0000	-43.292	0.0000
Romania	-39.684	0.0000	-39.722	0.0000
Slovakia	-51.639	0.0001	-51.742	0.0001
Slovenia	-45.091	0.0001	-45.063	0.0001
World	-43.706	0.0000	-43.299	0.0000
Germany	-51.190	0.0001	-51.191	0.0001
France	-49.688	0.0001	-49.733	0.0001
UK	-33.198	0.0000	-52.456	0.0001

Taking into consideration that the unit root tests confirm stationarity of the index returns time-series, VAR modeling is used to examine the causal dynamics of index returns. Thus, it is assumed that the index returns of Croatia, Estonia, Romania, Slovakia, Slovenia and world index returns are described by the following unrestricted VAR(*p*) model (in the following text denoted as Model 1):

$$\mathbf{X}_t = \boldsymbol{\alpha} + \sum_{i=1}^{p} \boldsymbol{\Phi}_i \mathbf{X}_{t-i} + \boldsymbol{\varepsilon}_t, \tag{11}$$

where $\mathbf{X}_t = (X_{CROATIA,t}, X_{ESTONIA,t}, X_{ROMANIA,t}, X_{SLOVAKIA,t}, X_{SLOVENIA,t}, X_{WORLD,t})'$ is a covariance stationary 6×1 vector of index returns X_t, $\boldsymbol{\alpha}$ is a 6×1 vector of intercepts, $\{\boldsymbol{\Phi}i, i = 1, 2, \ldots, p\}$ is a 6×6 matrix of autoregressive coefficients, $\boldsymbol{\varepsilon}_t$ is a 6×1 vector of random disturbances with zero mean and positive definite covariance matrix, and p indicates the lag length, i.e., order of the system.

Similarly, for the purpose of examining linkages between the frontier emerging markets and developed markets in Europe unrestricted VAR(p) model including returns of Croatia, Estonia, Romania, Slovakia, Slovenia, Germany, United Kingdom and France is employed (in the following text denoted as Model 2):

$$\mathbf{X}_t = \boldsymbol{\alpha} + \sum_{i=1}^{p} \boldsymbol{\Phi}_i \mathbf{X}_{t-i} + \boldsymbol{\varepsilon}_t, \tag{12}$$

where $\mathbf{X}_t$ =($X_{CROATIA,t}$, $X_{ESTONIA,t}$, $X_{ROMANIA,t}$, $X_{SLOVAKIA,t}$, $X_{SLOVENIA,t}$, $X_{FRANCE,t}$, $X_{GERMANY,t}$, $X_{UK,t}$)´ is a covariance stationary 8×1 vector of index returns X_t , α is a 8×1 vector of intercepts, {$\mathbf{\Phi}i$, i= 1, 2,…, p} is a 8×8 matrix of autoregressive coefficients, $\boldsymbol{\varepsilon}_t$ is a 8×1 vector of random disturbances with zero mean and positive definite covariance matrix, and p indicates the lag length, i.e., order of the system.

In this study, the order of the VAR is determined by applying Akaike's, Schwartz's, Hannan-Quinn information criteria, Final prediction error and modified likelihood ratio test for the selection of appropriate lag length. Table 5 reports the results of the lag length criteria and the likelihood ratio test for Model 1 and Model 2.

For Model 1 Schwartz's and Hannan-Quinn information criteria suggest lag length of 1, Final prediction error and Akaike's suggest 7, while likelihood ratio test suggests lag length of 8. The adequacy of the lag length is confirmed by using residual test. The LM tests of the residuals of VAR(1) and VAR(2) models indicate significant serial correlation, while residuals of VAR(3) model are not significantly correlated. Thus, lag length of three is chosen which means that further analysis in the study is based on the VAR system described by Equation (11) with p=3.

For Model 2 Schwartz's and Hannan-Quinn information criteria suggest lag length of 1, Final prediction error and Akaike's suggest 7, while likelihood ratio test suggests lag length of 8. The adequacy of the lag length is confirmed by using residual test. The LM tests of the residuals indicate significant serial correlation up to lag seven, while the residuals of VAR(7) model are not highly significantly correlated. Thus, lag length of seven is chosen which means that further analysis in the study is based on the VAR system described by Equation (12) with p=7.

Table 5. VAR lag order selection criteria.

Panel A. Frontier emerging markets and world (Model 1)

Lag	LR	FPE	AIC	SC	HQ
0	NA	2.30E-23	-35.10	-35.08	-35.10
1	528.00	1.93E-23	-35.28	-35.18*	-35.24*
2	105.30	1.90E-23	-35.29	-35.11	-35.23
3	80.09	1.90E-23	-35.29	-35.04	-35.20
4	48.15	1.91E-23	-35.28	-34.95	-35.16
5	101.03	1.89E-23	-35.29	-34.88	-35.14
6	71.71	1.89E-23	-35.29	-34.79	-35.11
7	104.47	1.87e-23*	-35.31*	-34.73	-35.10
8	58.99 *	1.87E-23	-35.30	-34.64	-35.06

Panel B. Frontier emerging markets and developed markets in Europe (Model 2)

Lag	LR	FPE	AIC	SC	HQ
0	NA	9.30E-32	-48.75	-48.73	-48.74
1	579.75	7.81E-32	-48.92	-48.76*	-48.86*
2	153.09	7.74E-32	-48.93	-48.63	-48.82
3	184.45	7.57E-32	-48.96	-48.51	-48.79
4	96.54	7.65E-32	-48.94	-48.35	-48.73
5	150.51	7.58E-32	-48.95	-48.21	-48.69
6	110.32	7.63E-32	-48.95	-48.06	-48.63
7	164.06	7.51e-32*	-48.96*	-47.94	-48.59
8	97.96*	7.59E-32	-48.95	-47.78	-48.53

Notes: * indicates lag order suggested by criterion.

5. EMPIRICAL RESULTS

This chapter first introduces the empirical results of the study and after that the conclusions of the results and main findings of the study are presented, as well as suggestions for further research.

5.1. Presentation of the Results

In this subchapter, the empirical results are reported separately for VAR(3) model describing causal dynamics between returns of the frontier emerging markets and returns of the world index (denoted as Model 1) and for VAR(7) model describing causal dynamics between returns of the frontier emerging markets and developed markets in Europe (denoted as Model 2).

The empirical results from tests for Granger causality between the world market and the frontier emerging markets are presented in Table 6. The results show that returns of the world market highly significantly (at 1% level) Granger cause returns of Croatia, Estonia and Slovenia, while returns of Romania and Slovakia are not Granger caused by returns of the world market. These results indicate that markets of Croatia, Estonia and Slovenia seem to be integrated with respect to the world market, while Romanian and Slovakian markets are segmented with respect to the world market.

Regarding the causality between the frontier emerging markets it may be noted that Estonia seems to be dominant market Granger causing returns of Croatia, Slovenia and Romania at 1% significance level. Bidirectional causality at 1% level is observed only between Croatia and Slovenia indicating strong interdependence among those two markets. This finding can be explained with the fact that they are neighboring countries which had been parts of same country (former Yugoslavia) for more than 40 years and have strong industrial and economic relationships. It can be noted also bidirectional causality between Slovenia and Estonia, but direction from Slovenia to Estonia appears to be somewhat less significant (10% level). Unidirectional causality is observed in the Romania → Slovenia and Croatia → Romania market relationships, but evidence is not strong (10% level of significance). It is interesting to note that Slovakia is not Granger caused by either world or other frontier emerging markets and moreover Slovakia does not Granger cause any of the markets providing strong evidence that Slovakian market is segmented with respect to the world and other frontier emerging markets in Europe.

Table 6. Granger causality tests - the world and the frontier emerging markets (Model 1).

Markets	F-statistics	Probability
World → Croatia	20.272	0.000 ***
World → Estonia	29.502	0.000 ***
World → Romania	1.691	0.167
World → Slovakia	1.019	0.383
World → Slovenia	21.175	0.000 ***
Croatia → Estonia	0.735	0.530
Croatia → Romania	2.249	0.081 *
Croatia → Slovakia	0.129	0.943
Croatia → Slovenia	8.630	0.000 ***
Estonia → Croatia	9.259	0.000 ***
Estonia → Romania	4.500	0.004 ***
Estonia → Slovakia	1.563	0.196
Estonia → Slovenia	4.015	0.007 ***
Romania → Croatia	1.736	0.158
Romania → Estonia	1.567	0.195
Romania → Slovakia	0.284	0.837
Romania → Slovenia	2.190	0.087 *
Slovakia → Croatia	0.306	0.821
Slovakia → Estonia	1.501	0.212
Slovakia → Romania	0.709	0.547
Slovakia → Slovenia	0.130	0.942
Slovenia → Croatia	10.215	0.000 ***
Slovenia → Estonia	2.228	0.083 *
Slovenia → Romania	1.763	0.152
Slovenia → Slovakia	0.042	0.988

Notes: Significance levels of p-values are indicated as follows: * = Significant at 10 % level, ** = Significant at 5% level and *** = Significant at 1% level.

Table 7. Granger causality tests – the developed markets and the frontier emerging markets (Model 2).

Panel A. Granger causality tests (the developed markets and the frontier emerging markets)

Markets	F-statistics	Probability
France → Croatia	3.198	0.002 ***
France → Estonia	6.834	0.000 ***
France → Romania	0.548	0.798
France → Slovakia	2.353	0.021 **
France → Slovenia	4.854	0.000 ***
Germany → Croatia	3.013	0.004 ***
Germany → Estonia	5.962	0.000 ***
Germany → Romania	0.468	0.858
Germany → Slovakia	2.197	0.031 **
Germany → Slovenia	4.870	0.000 ***
UK → Croatia	3.356	0.001 ***
UK → Estonia	4.125	0.000 ***
UK → Romania	0.613	0.745
UK → Slovakia	1.593	0.133
UK → Slovenia	5.019	0.000 ***

Panel B. Granger causality tests among the developed markets

Markets	F-statistics	Probability
UK → France	2.918	0.005 ***
UK → Germany	1.393	0.203
France → Germany	3.500	0.001 ***
France → UK	2.644	0.010 ***
Germany → France	7.019	0.000 ***
Germany → UK	3.965	0.000 ***

Table 7 (continued). Granger causality tests – the developed markets and the frontier emerging markets (Model 2).

Panel C. Granger causality tests among the frontier emerging markets

Markets	F-statistics	Probability
Croatia → Estonia	3.397	0.001 ***
Croatia → Slovenia	5.249	0.000 ***
Estonia → Croatia	8.693	0.000 ***
Estonia → Romania	2.872	0.005 ***
Estonia → Slovenia	3.094	0.003 ***
Romania → Estonia	2.008	0.051 *
Romania → Slovakia	1.776	0.088 *
Romania → Slovenia	1.963	0.056 *
Slovenia → Croatia	5.545	0.000 ***
Slovenia → Estonia	2.269	0.026 **
Slovenia → Romania	1.775	0.088 *

Notes: 1. Significance levels of p-values are indicated as follows: * = Significant at 10 % level, ** = Significant at 5% level and *** = Significant at 1% level.

2. Panel C reports results for only those combinations that reveal significant causality relations among the frontier emerging markets (total number of tests among the frontier emerging markets is 20, while the number of significant tests is 11).

The empirical results from tests for Granger causality between the developed European markets and the frontier emerging markets are presented in Table 7. Panel A represents Granger causality tests from the developed markets to the frontier emerging markets, panel B reports causalities only between the developed markets while panel C reports results for only those combinations that reveal significant causality relations among the frontier emerging markets. As can be noted from Panel A returns of Croatia, Estonia and Slovenia are highly significantly Granger caused by returns of all three developed markets (France, Germany and UK), while returns of Slovakia are Granger caused by returns of France and Germany (at 5% level), but not with returns of UK. It is interesting to observe that returns of Romania are not Granger caused by either of developed markets. Those findings confirm previous results obtained in Model 1 that Croatian, Estonian and Slovenian markets seem to be integrated with respect to the world market, while Romanian market is still segmented not only with respect to the world market, but also with respect to developed European markets. In case of Slovakia, results show that

this market is integrated with respect to France and Germany, although these relations appear to be slightly less significant (at 5% level).

From Panel B it is obvious that the developed European markets exhibit highly significant (at 1% level) bidirectional causalities with the only exception of UK → Germany direction providing evidence of increasing interdependences among developed markets which is consistent with findings of Chelley-Steeley 2000; Wong et al. 2004; Hui 2005; Berben & Jansen 2005 and Wongswan 2006.

When causalities among the frontier emerging markets are examined (Panel C), bidirectional causality at 1% level of significance is observed in two cases: Croatia and Estonia, and Croatia and Slovenia, while bidirectional causality also exists between Estonia and Slovenia, and Estonia and Romania, but directions Slovenia → Estonia and Romania → Estonia are somewhat less significant. Causal relationship between Romania and Slovenia appears to be also bidirectional, but only at 10% level of significance. Unidirectional causality is observed in case Romania → Slovakia, but the evidence is weak (at 10 % level).

Figures 5-9 (Appendix 1) present the impulse responses (indicated by the solid lines) of returns in the frontier emerging markets to a shock in returns of the world market and other frontier emerging markets (Model 1). The dashed lines indicate the Monte Carlo simulated 95% confidence intervals. Day 1 represents contemporaneous effect, Day 2 indicates 1-day lagged effect, Day 3 indicates 2-day lagged effect and so on. The impulse response analysis is conducted by using generalized impulses defined according to Pesaran & Shin (1998) in order to avoid problem of ordering variables in the system. Hence, analysis is based on generalized one standard deviation shocks on the returns.

Regarding the impulse response function of the returns of the frontier emerging markets to a shock in the returns of the world market it can be noticed that after contemporaneous effect (Day 1), the returns of Croatia, Estonia and Slovenia increase in Day 2, but after that they start to decay. In case of Croatia and Slovenia there are no further responses to the world market shocks after Day 5, while in case of Estonia there is no response after Day 3. Opposite to the pattern of Croatian, Estonian and Slovenian response to the world market shocks, Slovakian and Romanian markets exhibit no response to the world market shocks. Those findings are in line with previous results of Granger causality tests. Therefore, the world market significantly Granger causes Croatian, Estonian and Slovenian markets, and these countries respond to a shock from the world market. On the

other hand, Slovakian and Romanian markets are not Granger caused by the world market and these countries do not respond to a shock from the world market.

Regarding the impulse response function of the returns of the frontier emerging markets to a shock in the returns of other frontier emerging markets in the system it can be noticed that Croatian market responds to shocks in Slovenian market and vice versa and whole impact seems to be incorporated within five days. Furthermore, those two markets respond also to impulses coming from Estonian market, but extent of response seems to be less significant. The whole impact is incorporated within 5 days in case of Slovenia and within 4 days in case of Croatia.

The results regarding the impulse responses of returns in the frontier emerging markets to a shock in returns of developed European markets (Model 2) are presented in Figures 10-14 (Appendix 2). It is notable from the graphs that Croatian and Estonian returns respond similarly to the shocks in all three developed markets. A shock in the returns of France, Germany and UK affects returns of Croatia and Estonia contemporaneously with the whole impact being incorporated within three days. Slovenian market also exhibits response to the shocks coming from France, Germany and UK and the impact of a shock seems to be incorporated into Slovenian returns within three days. However, response does not appear to be so significant. In case of Romania and Slovakia no significant response to the shocks in returns of France, Germany and UK is observed. These findings are also consistent with the results of Granger causality tests which revealed significant causalities with direction from all three developed markets (France, Germany and UK) to the markets of Croatia, Estonia and Slovenia, and no significant causality with respect to the three developed markets causing Romanian market. In case of Slovakia Granger causality test revealed causality at 5 % significance level, where Slovakian returns are Granger caused by returns of France and Germany, but not with returns of UK.

In addition to responses of the frontier emerging markets to shocks in developed markets reported in Figures 10-14, Figures 15-17 (Appendix 2) show responses of the three developed markets to shocks occurring in these three developed markets. In this case it is interesting to observe that a shock in the returns of one developed market significantly affects the returns of other two developed markets contemporaneously, while the whole impact seems to be incorporated into returns of affected markets within two days indicating strong interdependencies among developed European equity markets.

The results regarding variance decompositions for Model 1 are reported in Figures 18-22 (Appendix 3). The dashed lines in the figure represent 95% confidence intervals based on the Monte Carlo simulation. The results of variance decomposition show that returns of the world market have no substantial impact on the returns of the frontier emerging markets. For instance, the highest impact of the world market returns on the frontier emerging markets returns appeared to be in case of Estonia where the world market returns explain approximately 5% of the forecast variance of Estonian returns starting from two days ahead up to ten days ahead. In the case of Croatia, the fraction of variance explained by the world market returns is about 3.5%, while corresponding figure in the case of Slovenia is about 2.5%. These figures also correspond to the period starting from two days ahead up to ten days ahead.

Taking into consideration very low level of these figures it seems that world market returns make only a minor contribution to the total variances of Estonian, Croatian and Slovenian returns. In the case of Romania and Slovakia, the results show that the fraction of variance explained by the world market returns is less than 0.5% during whole period of 10 days demonstrating that the forecast variance is solely caused by innovations in itself. This finding clearly indicates that Romanian and Slovakian markets are unique in the sense that they are not affected at all by returns of the world market confirming previous results that those markets are segmented with respect to the world market.

The results regarding variance decompositions for Model 2 are given in Figures 23-27 (Appendix 4). The results show in the case of Croatia that about 5% of variance forecasts of the Croatian returns are attributable to innovations in the returns of the three developed markets with the following structure: France (4%), Germany (0.5%) and UK (0.5%). It is interesting to note that Slovenian and Estonian markets also have some minor impact on Croatian market contributing with about 1.5 % and 2% respectively to the variations of Croatian returns (ten days ahead). In the case of Estonia, the fraction of variance explained by the developed markets is about 6% two days ahead and 7% ten days ahead, with almost whole impact coming from France, while UK and Germany contribute with less than 1 % each. Slovenian returns exhibit relatively similar behavior like Estonian returns where about 2% of two days ahead and 4% of ten days ahead variance forecasts of the returns is attributable to innovations in the returns of the three developed markets with the biggest impact coming from France followed by Germany, while the impact of UK is almost equal zero. In addition to these minor impacts of developed markets on Slovenian returns it is notable that Croatian returns contribute with about 2% to the variance of returns in Slovenia. The case of Romania reveals that almost all of the forecast variance

of Romanian returns is caused by its own innovations suggesting that the returns of the other markets (either developed or frontier emerging) do not have any significant impact on the Romanian returns. A similar pattern is observable in the case of Slovakia where results demonstrate that neither of examined markets has impact on Slovakian returns with individual contribution of each market to the variance of returns being much lower than even 1 %.

In general, from the results regarding variance decomposition for Model 2 it can be ascertain that in case of Croatia, Estonia and Slovenia the developed markets make only a minor contribution to the total variance of Croatian, Estonian and Slovenian returns, while in the case of Romania and Slovakia even a minor contribution of developed markets to the variance of Romanian and Slovakian returns is absent. These results confirm previous findings that Romanian and Slovakian stock markets seem to be segmented from the developed European markets, while the results regarding Croatia, Estonia and Slovenia demonstrate the lower degree of integration compared to the results obtained by using Granger causality tests.

5.2. Conclusions of the Study and Suggestions for Further Research

In general, the results of this study indicate that stock markets of Croatia, Estonia and Slovenia show considerable degree of financial integration with respect to the world market portfolio as well as with respect to the three largest stock markets in Europe (UK, France and Germany). This conclusion is based on the results of Granger causality tests and impulse response analysis, while variance decomposition analysis illustrates lower degree of integration. By contrast, the stock markets of Romania and Slovakia appear to be segmented not only relative to the world market, but also relative to the three major European stock markets. In addition, the results suggest that French market seems to be leading market among the three major developed European stock markets since it exhibits the biggest influence on returns in the frontier emerging markets.

Regarding the question of interdependencies among the frontier emerging markets the following conclusions can be drawn from the results. First, the results demonstrate strong relationship between Croatia and Slovenia reflected in highly significant bidirectional causality as revealed by Granger causality tests and additionally supported by impulse response analysis and variance decompositions. This finding indicates significant interdependence between Croatian and Slovenian markets.

Second, among the frontier emerging markets Estonia seems to have a considerable impact on some of the other frontier emerging markets, particularly on Slovenian and Croatian markets as it was demonstrated in Granger causality tests by highly significant causality going from Estonia towards Croatia and Slovenia and supported by impulse response analysis even though extent of impulse responses appears to be less significant. Furthermore, Estonia exhibits some influence on Romanian market which is evident from significant Granger causality with direction from Estonia to Romania, but this is not additionally supported by impulse responses and variance decompositions. These findings reveal that Estonia can be seen as a leading market among the investigated frontier emerging markets in Europe. One potential explanation for this surprising finding might be the fact that Estonian stock market is a part of OMX group, which owns and operates exchanges in Nordic countries. Taking into consideration that Nordic countries belong to the group of developed European stock markets and that developed stock markets are becoming increasingly interdependent it might be possible that movements and trends in Estonian stock market already reflect movements and trends in the developed European markets and then these movements are further transmitted towards the other frontier emerging markets showing considerable degree of integration with respect to the developed markets.

Third, a significant upward trend in stock indices of the European frontier emerging markets is observed starting at the end of 2001. This time point coincides with the announcement of the European Union (EU) enlargement towards Central and Eastern European countries including Estonia, Slovakia and Slovenia who joined EU in 2004 (Romania joined EU in 2007, while Croatia still negotiates the entry and currently has status of candidate country). This observation of sharp stock price increases in the post-2001 period might be explained by the possibility that announcement of the EU enlargement accelerated integration of the frontier emerging stock markets with respect to the developed European and the world markets. This arises from the fact that clear prospects for the EU accession and elimination of all restrictions on movement of capital associated with enlargement may decrease political, liquidity and corporate governance risks that were often perceived in those countries prior to the EU membership.

The empirical findings of this study might have important implications for international investors who are continuously in quest of new challenging markets that may provide higher returns and lower risk for their portfolios. Taking into consideration findings that Slovakian and Romanian markets are not yet integrated into the world market and developed European markets it is logical to ascertain that international investors may

benefit from international portfolio diversification by adding stocks of those markets into their portfolios. Furthermore, even though Croatia, Estonia and Slovenia exhibit considerable degree of financial integration with respect to the world market portfolio and developed European markets their correlations with the world and developed markets are still low enough making it possible to construct low-risk portfolios by including stocks from those markets into internationally diversified portfolios and obtain diversification benefits.

However, in interpreting results of this study for investment purposes additional attention should be paid to the fact that this study investigates question of financial integration of the frontier emerging markets by focusing on examining sensitivity of the stock returns to only one risk factor – namely global market risk, while the other possibly important risk factors such as currency and country-specific risks are not taken into consideration. This particular limitation of the study should give impetus to further research. Therefore, the one possible extension of this study would be to investigate whether currency and local risks are priced in the frontier emerging markets and for instance alternative research methodology of multivariate GARCH framework could be used to conduct research. Alternatively, a firm-level or industry-level stock returns could be used instead of returns on aggregate market indices in order to get better insights into the risk factors unique to each country.

In addition, the finding regarding the post-2001 upward trend in stock indices of the frontier emerging markets in Europe as a possible consequence of the European Union enlargement announcement and process points to the need for further research: for instance, investigating effects of the EU enlargement on stock markets in new EU-members which are classified as the frontier emerging markets in order to find out whether the EU integration is responsible for the integration of stock markets in those countries.

6. SUMMARY

Emerging markets finance has emerged as a challenging research issue over past two decades. The significance of the emerging markets is reflected in the fact that they have become a relevant driver of global economic growth in the recent years. The research question of special importance within emerging markets finance is certainly question of the financial market integration because of its implications on international capital budgeting and investments. Financial markets that are not integrated into the world capital markets may provide opportunities for international investors to obtain diversification benefits through increased risk sharing by investing in those segmented markets. This study investigates the question of financial integration by focusing on special subcategory of emerging markets - namely frontier emerging markets. This subcategory represents markets which tend to be relatively small and less liquid, even by emerging market standards, but they represent an investment opportunity and, in the past few years, have provided very high returns.

The purpose of this study is to examine the financial integration of the European frontier emerging stock markets in the following two respects: first, the study investigates whether the European frontier emerging stock markets have become integrated into the world capital markets by analyzing the sensitivity of the stock returns to the world-wide market risk factor; second, the interdependences across the frontier emerging markets and their linkages to the three largest developed markets in Europe are examined. The sample of the frontier emerging markets includes five European countries: Croatia, Estonia, Romania, Slovakia and Slovenia, while the developed markets are represented by France, Germany and United Kingdom.

The data set consist of daily stock indices in each of the investigated frontier emerging and developed markets in Europe and daily observations of the Morgan Stanley Capital International (MSCI) World equity market index which serves the purpose of benchmark index used to proxy the world market portfolio. The sample covers time period from September 24, 1997 to September 26, 2007 representing the longest common time period over which data is available. The empirical study is conducted by using a Vector Autoregressive (VAR) methodology as a statistical methodology for the analysis of financial time series. VAR modeling is applied on the index return time series and following techniques within VAR framework are used in order to interpret

results of the study: Granger causality test, impulse response function and variance decomposition.

The following conclusions are derived from the results:

- the stock markets of Croatia, Estonia and Slovenia show considerable degree of financial integration with respect to the world market portfolio as well as with respect to the three largest stock markets in Europe (UK, France and Germany), while on contrary the stock markets of Romania and Slovakia appear to be segmented not only relative to the world market, but also relative to the three major European stock markets,
- the French market seems to be leading market among the three major developed European markets exhibiting the biggest influence on returns in frontier emerging markets,
- a significant interdependence between Croatian and Slovenian markets,
- Estonia can be seen as a leading market among investigated frontier emerging markets in Europe,
- a significant upward trend in stock indices of the European frontier emerging markets starting at the end of 2001.

The results of this study suggest potential benefits from international portfolio diversification through investing in the frontier emerging markets in Europe. However, in interpreting results of this study for investment purposes additional attention should be paid to the fact that this study considers only one source of risk – namely global market risk, while the other possibly important risk factors such as currency and country-specific risks are not taken into consideration. Inclusion of these additional risk factors into risk-return settings in examining financial market integration can be seen as the avenue for further research, as well as the use of alternative research methodology such as multivariate GARCH modeling. The other possible extension of this study could be investigating the role of the European Union enlargement in the financial market integration of the new European Union members which are classified as the frontier emerging markets.

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APPENDICES

APPENDIX 1. Impulse Response Functions for Model 1.

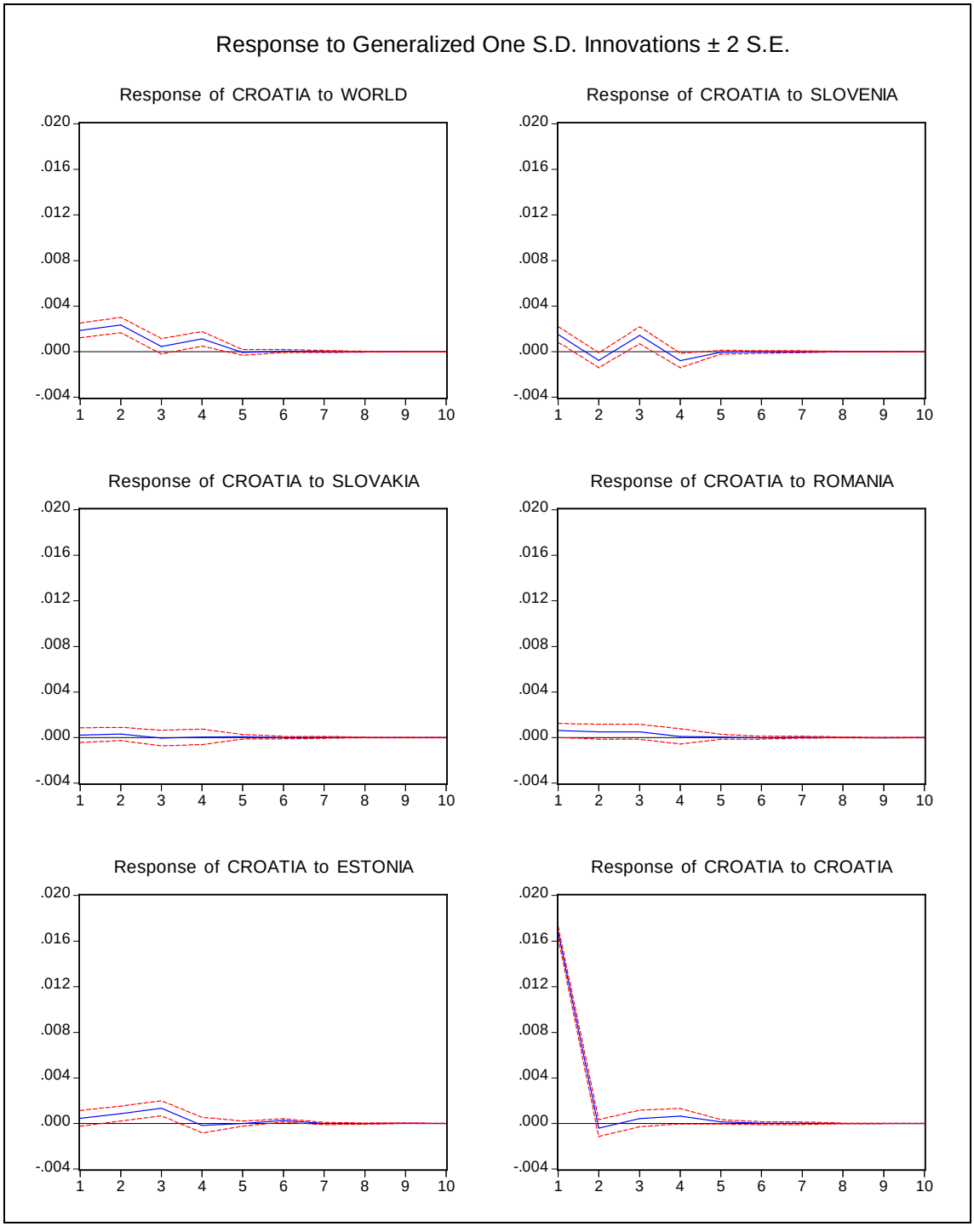

Figure 5. Impulse response function: Croatia (Model 1).

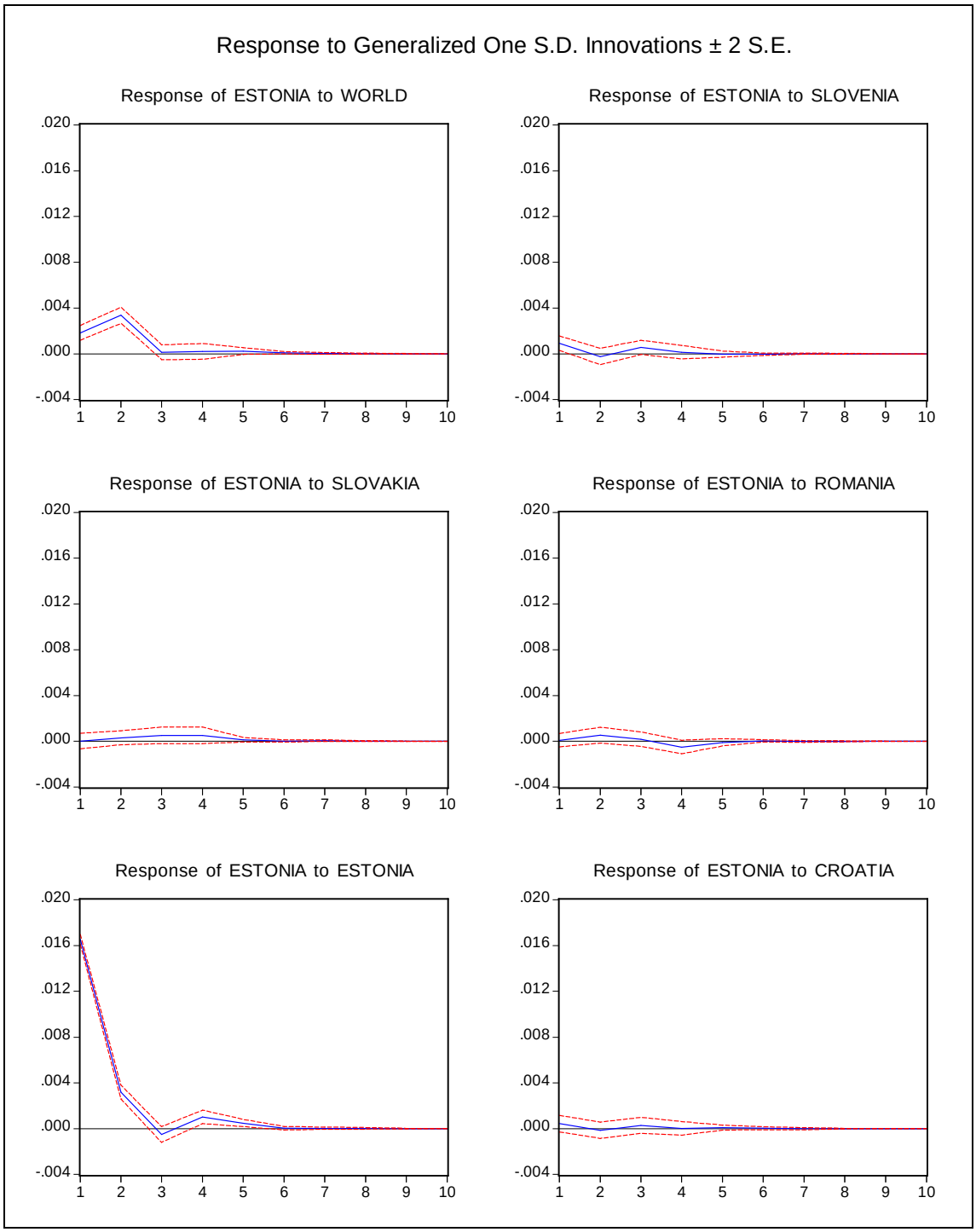

Figure 6. Impulse response function: Estonia (Model 1).

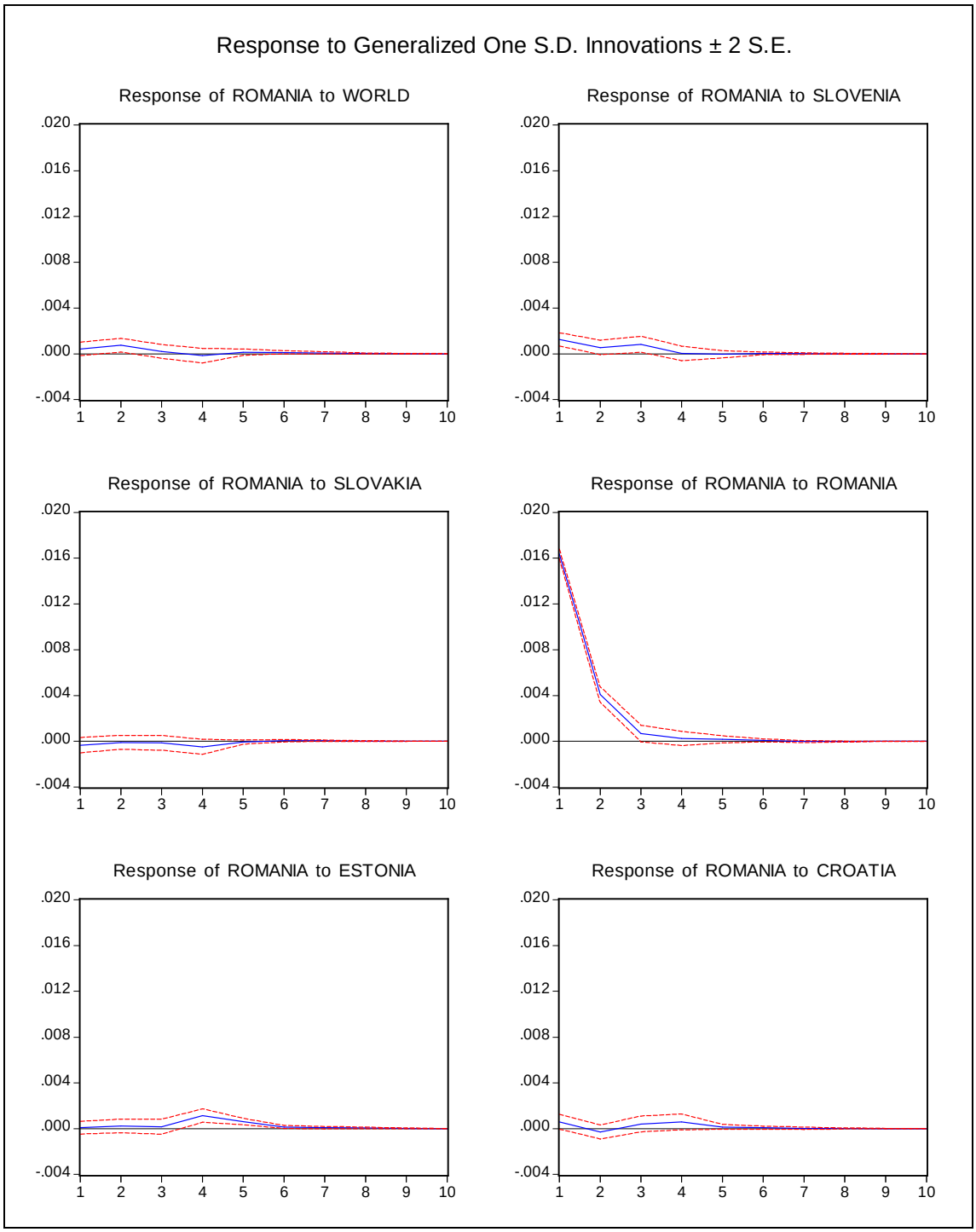

Figure 7. Impulse response function: Romania (Model 1).

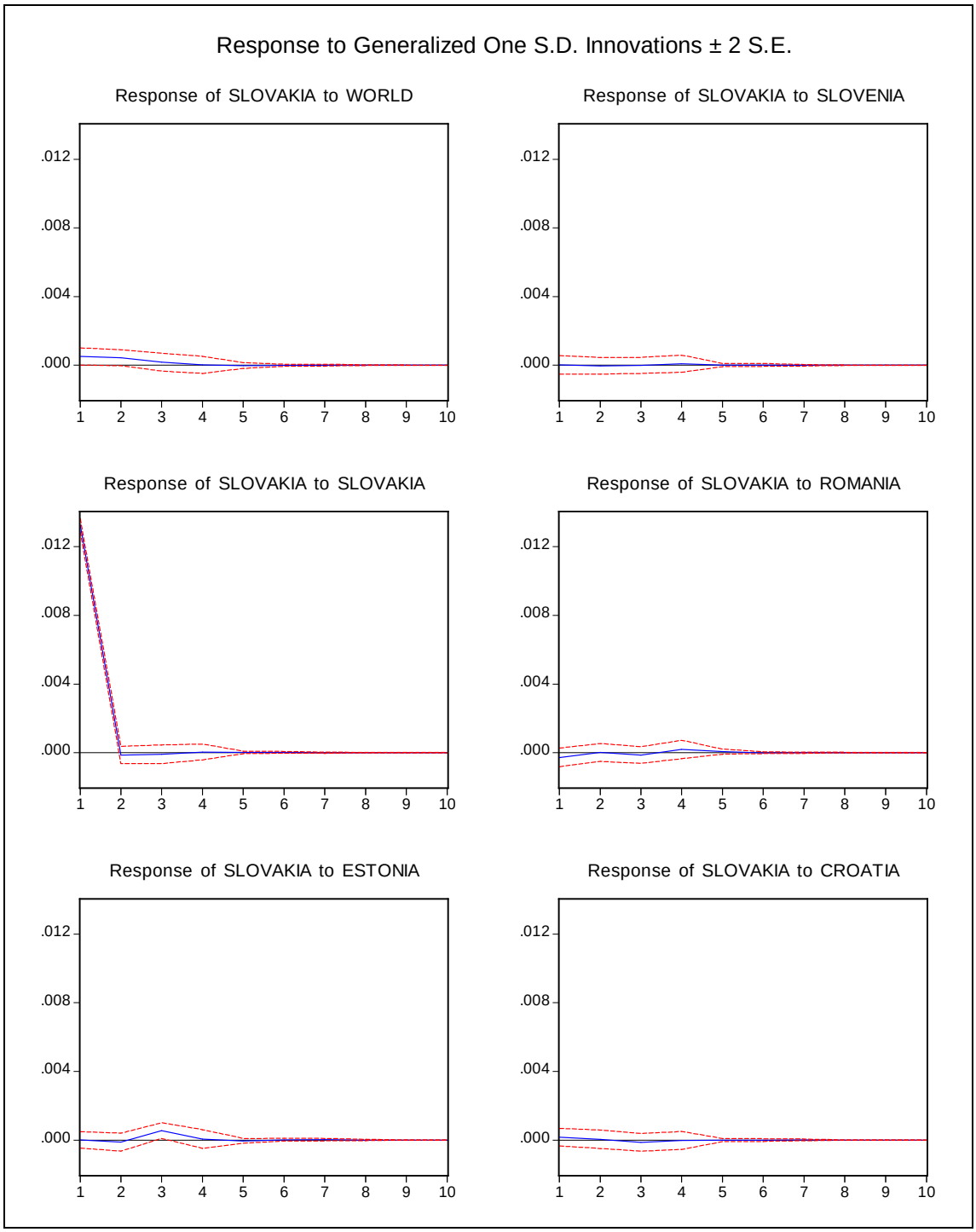

Figure 8. Impulse response function: Slovakia (Model 1).

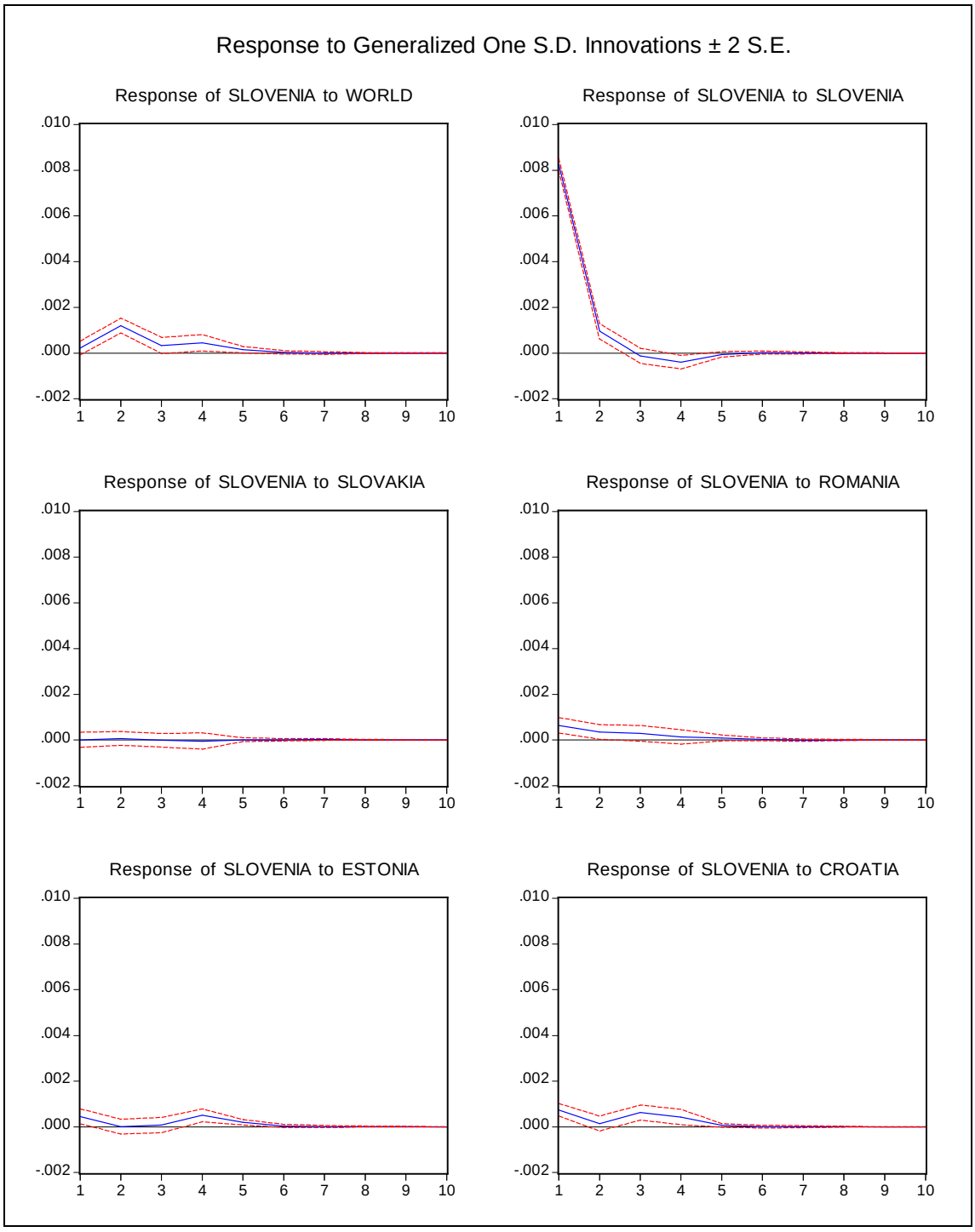

Figure 9. Impulse response function: Slovenia (Model 1).

APPENDIX 2. Impulse Response Functions for Model 2.

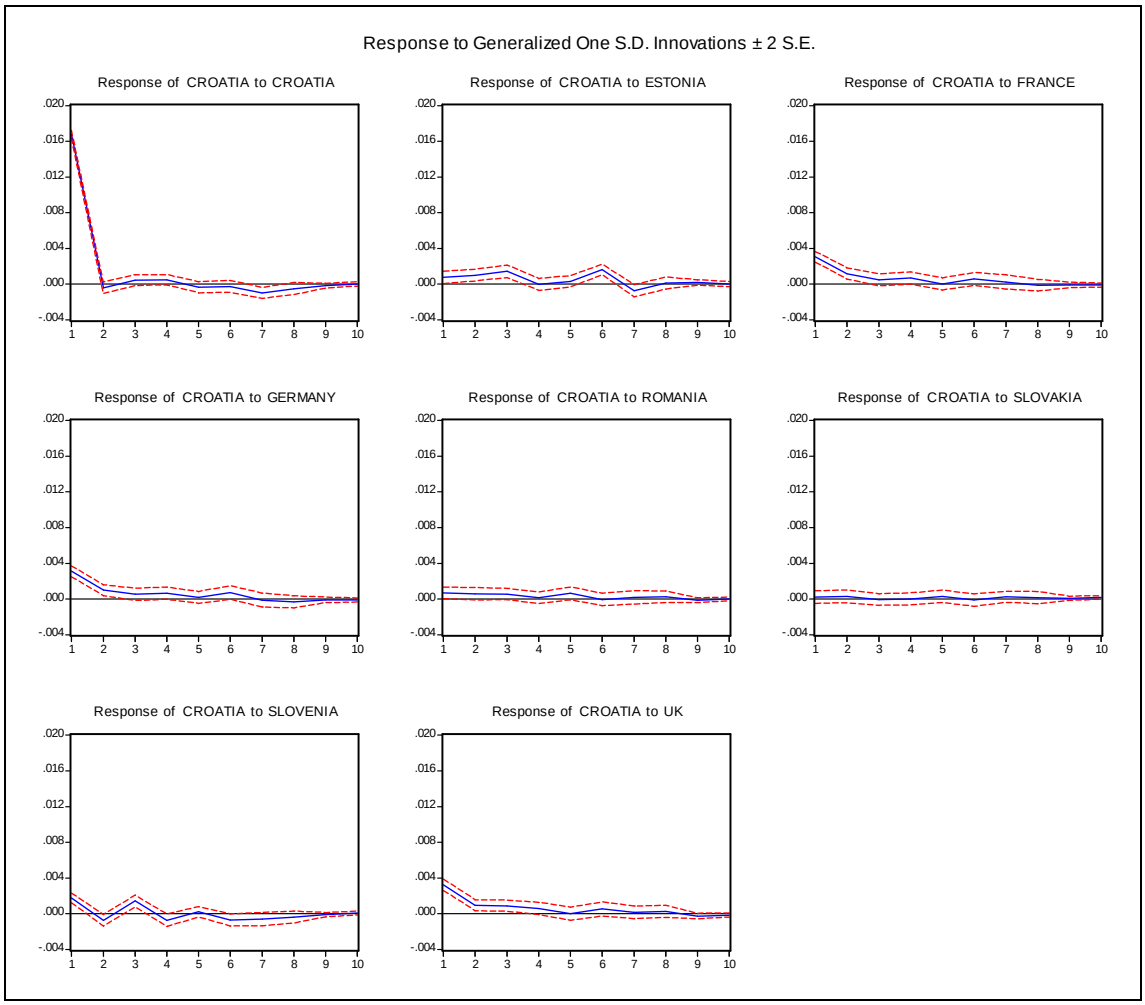

Figure 10. Impulse response function: Croatia (Model 2).

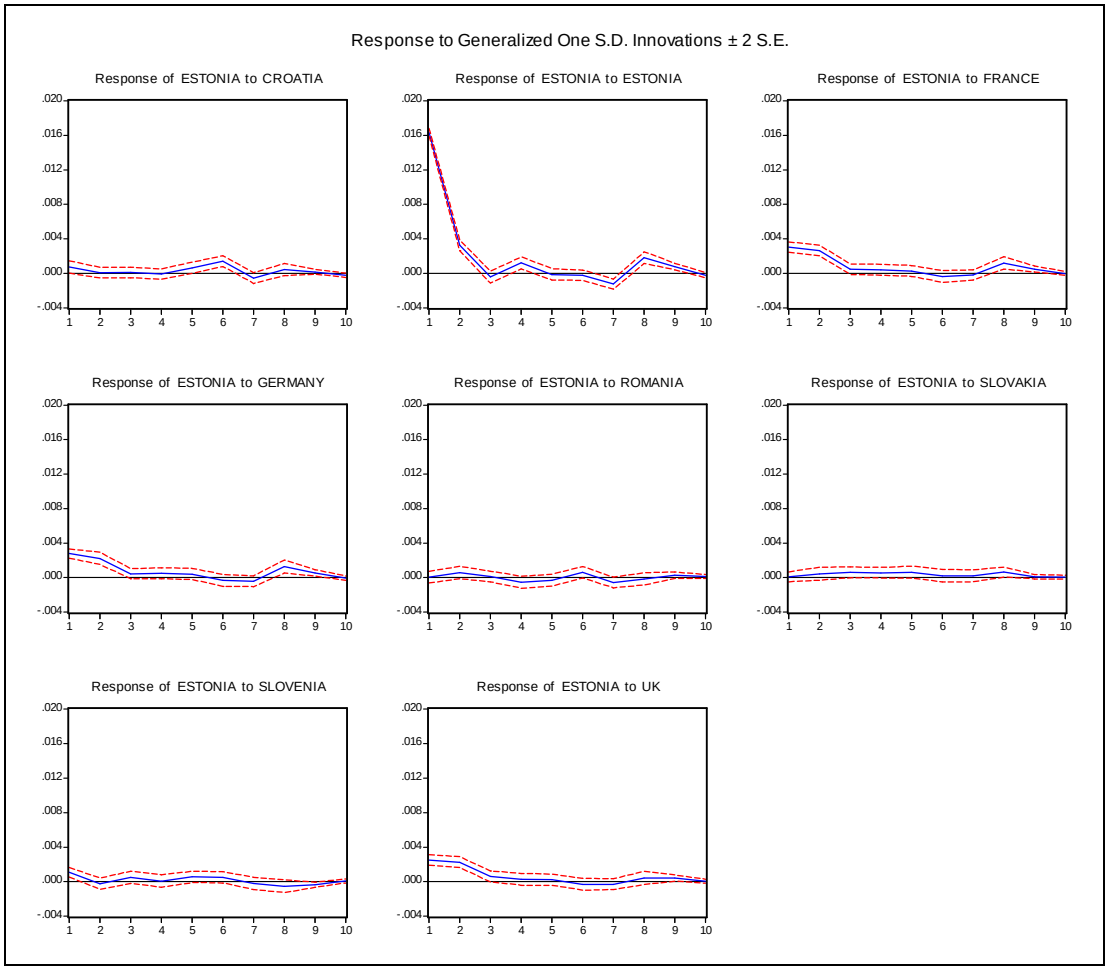

Figure 11. Impulse response function: Estonia (Model 2).

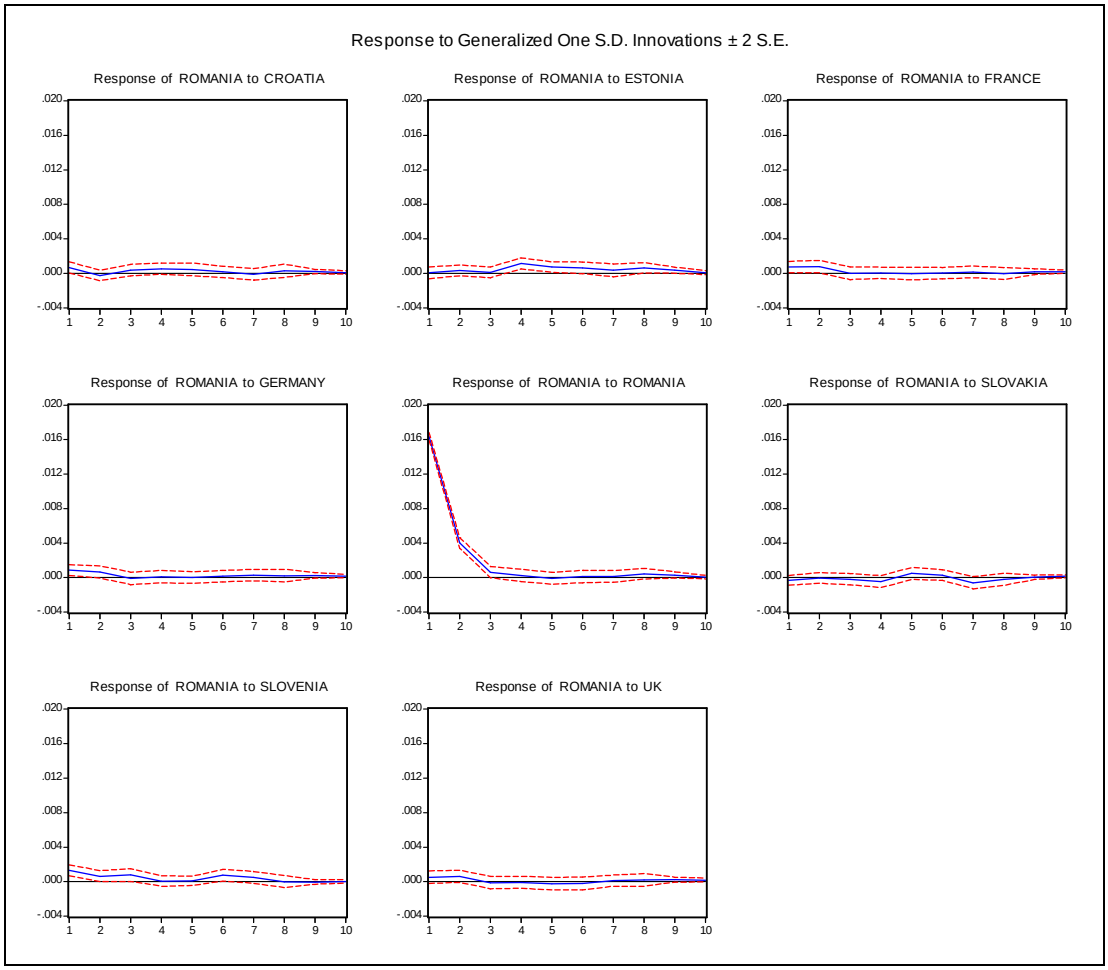

Figure 12. Impulse response function: Romania (Model 2).

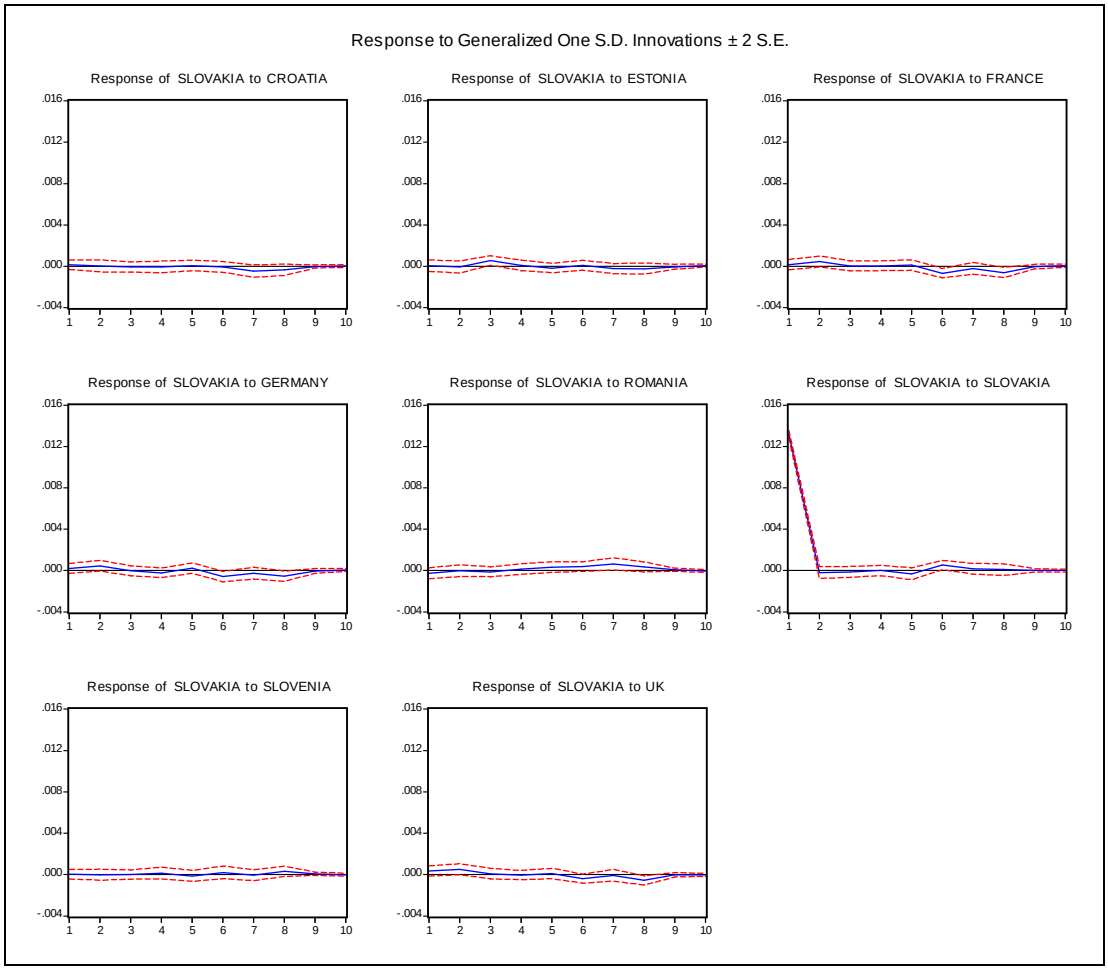

Figure 13. Impulse response function: Slovakia (Model 2).

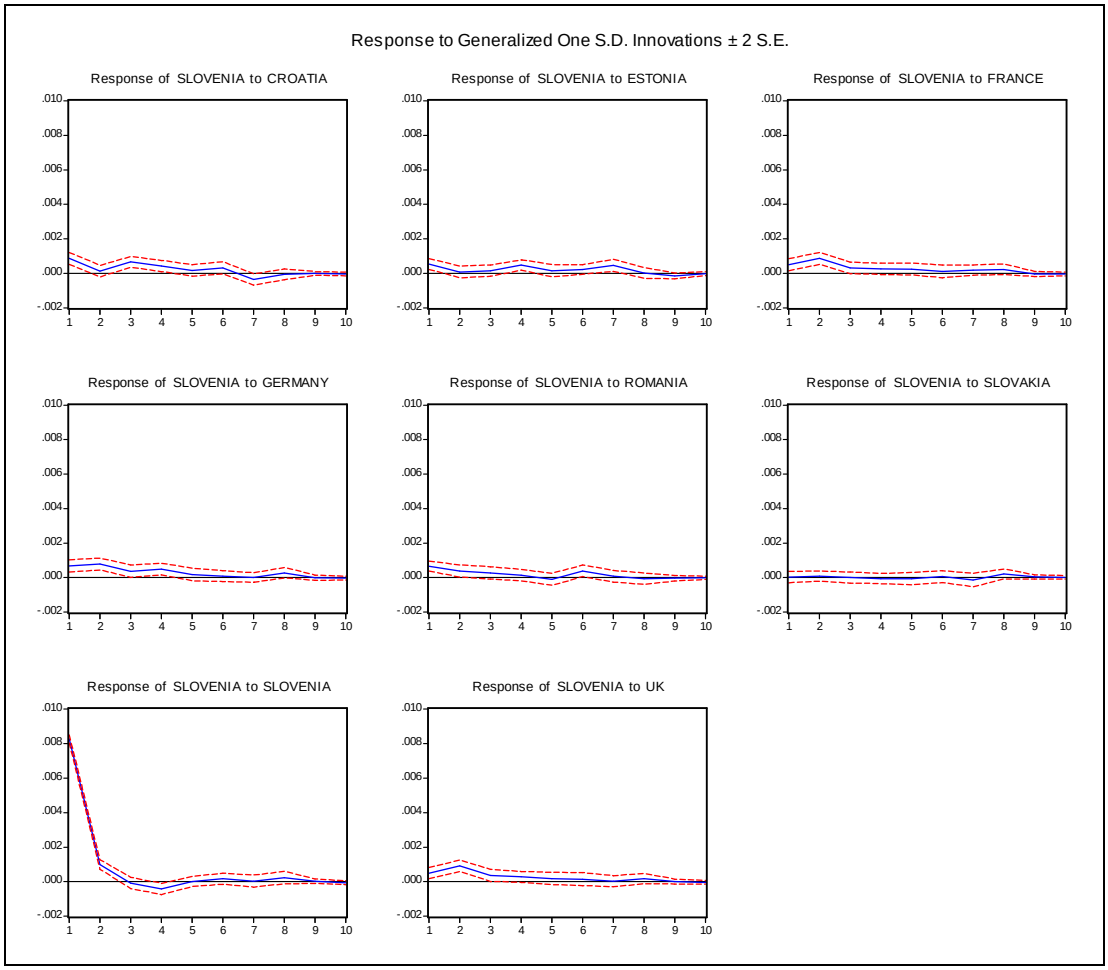

Figure 14. Impulse response function: Slovenia (Model 2).

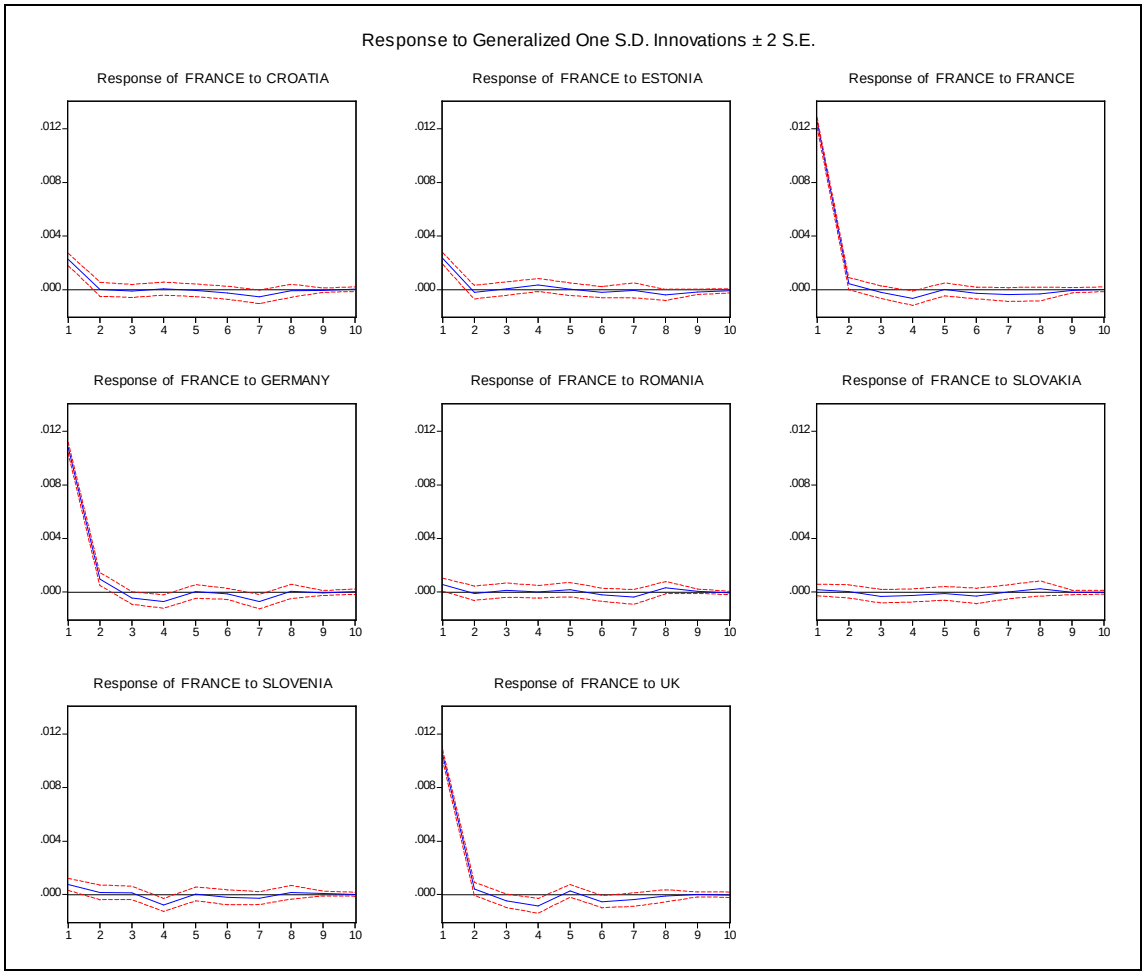

Figure 15. Impulse response function: France (Model 2).

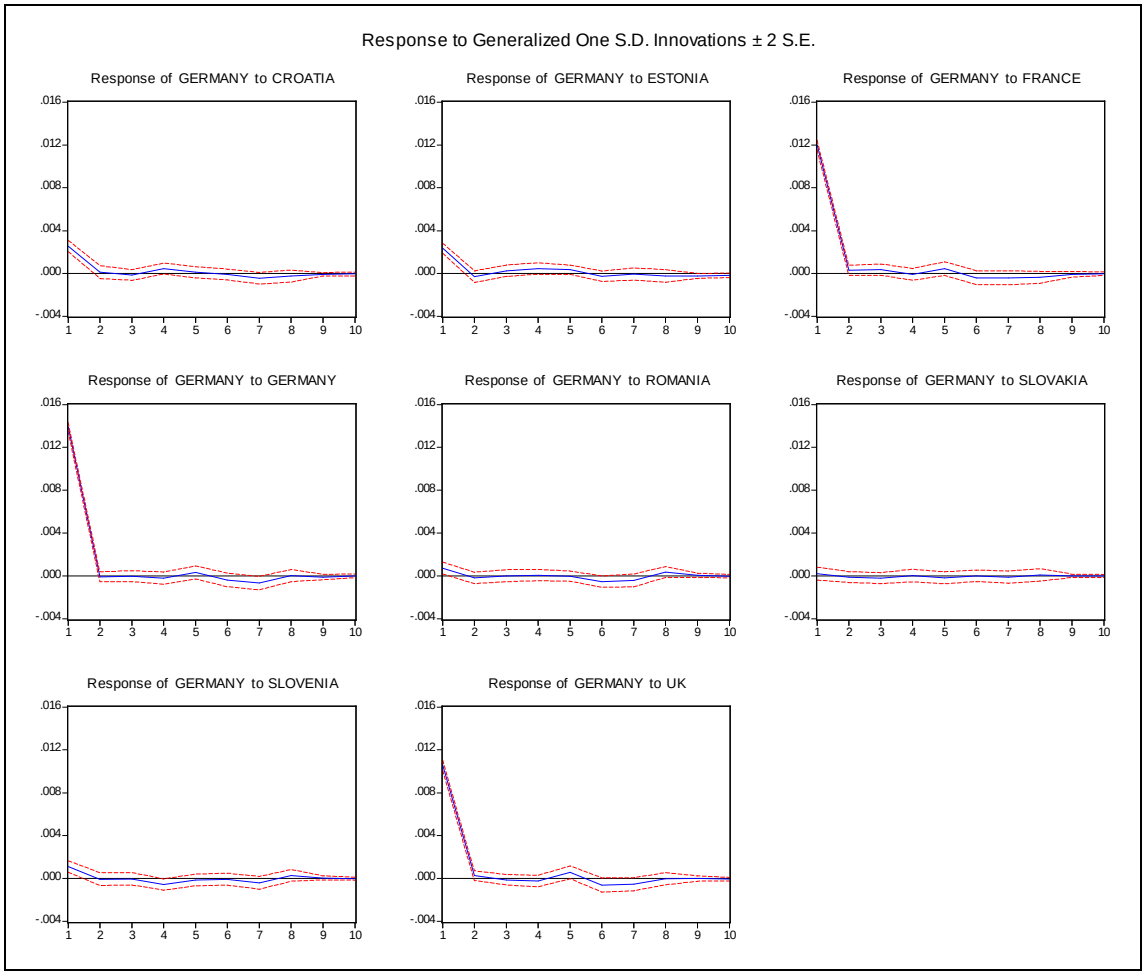

Figure 16. Impulse response function: Germany (Model 2).

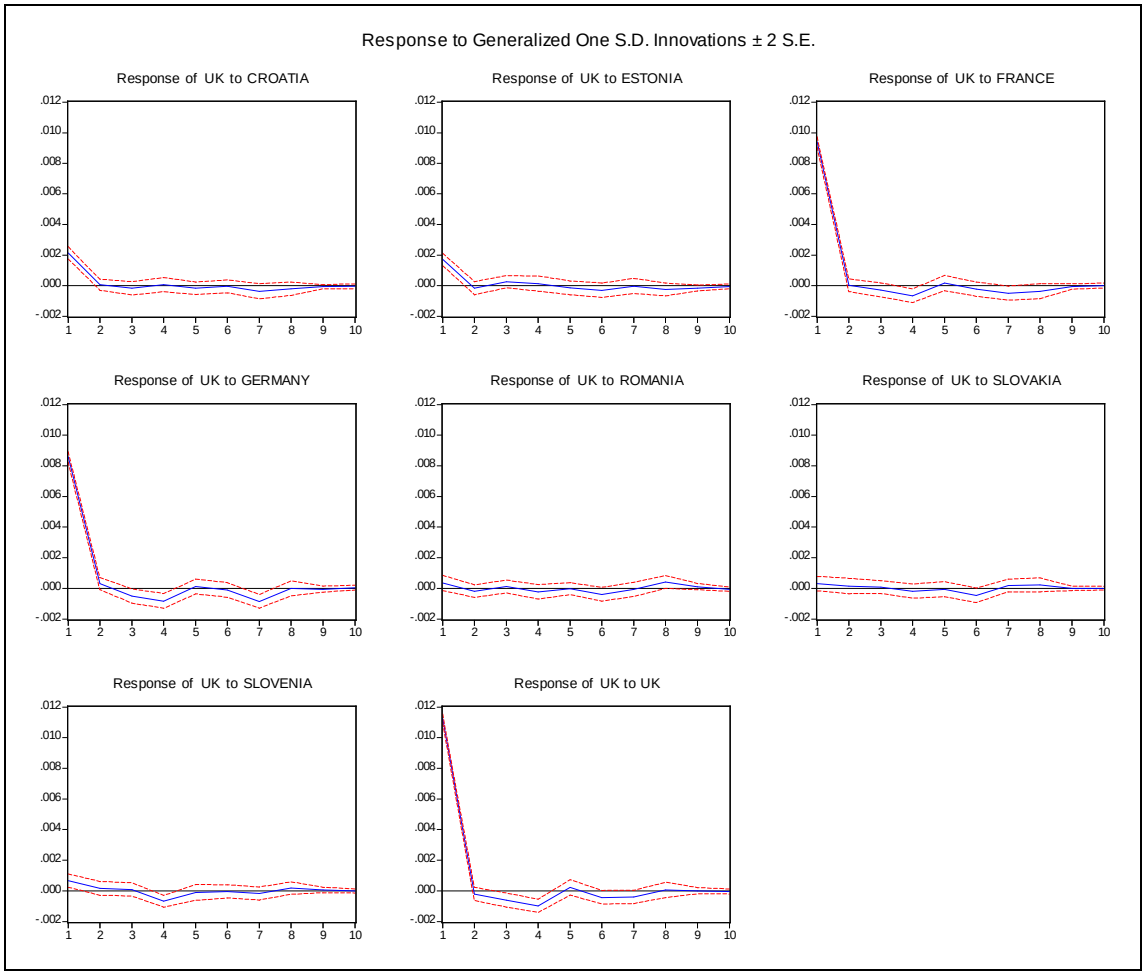

Figure 17. Impulse response function: UK (Model 2).

APPENDIX 3. Variance Decompositions for Model 1.

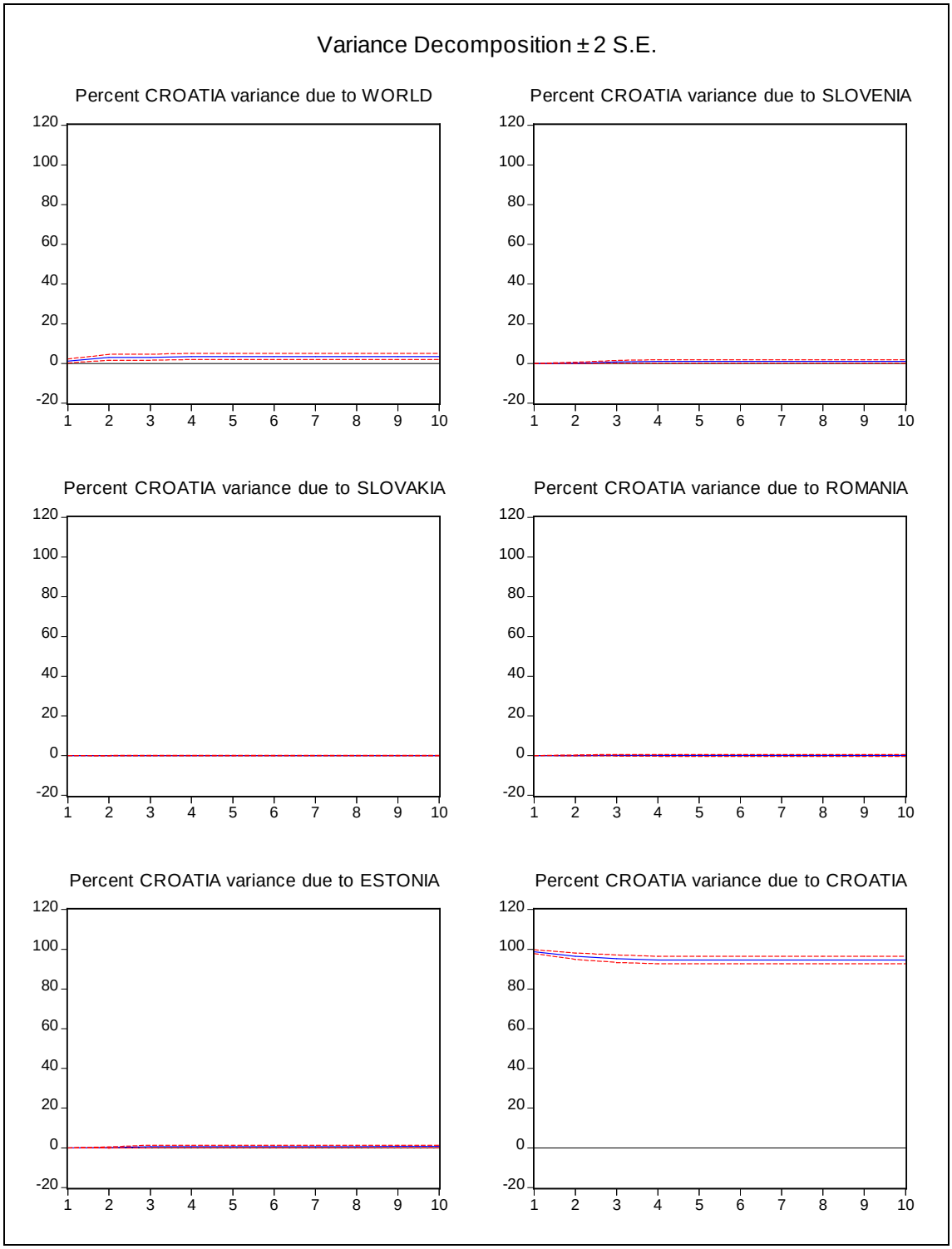

Figure 18. Variance decomposition: Croatia (Model 1).

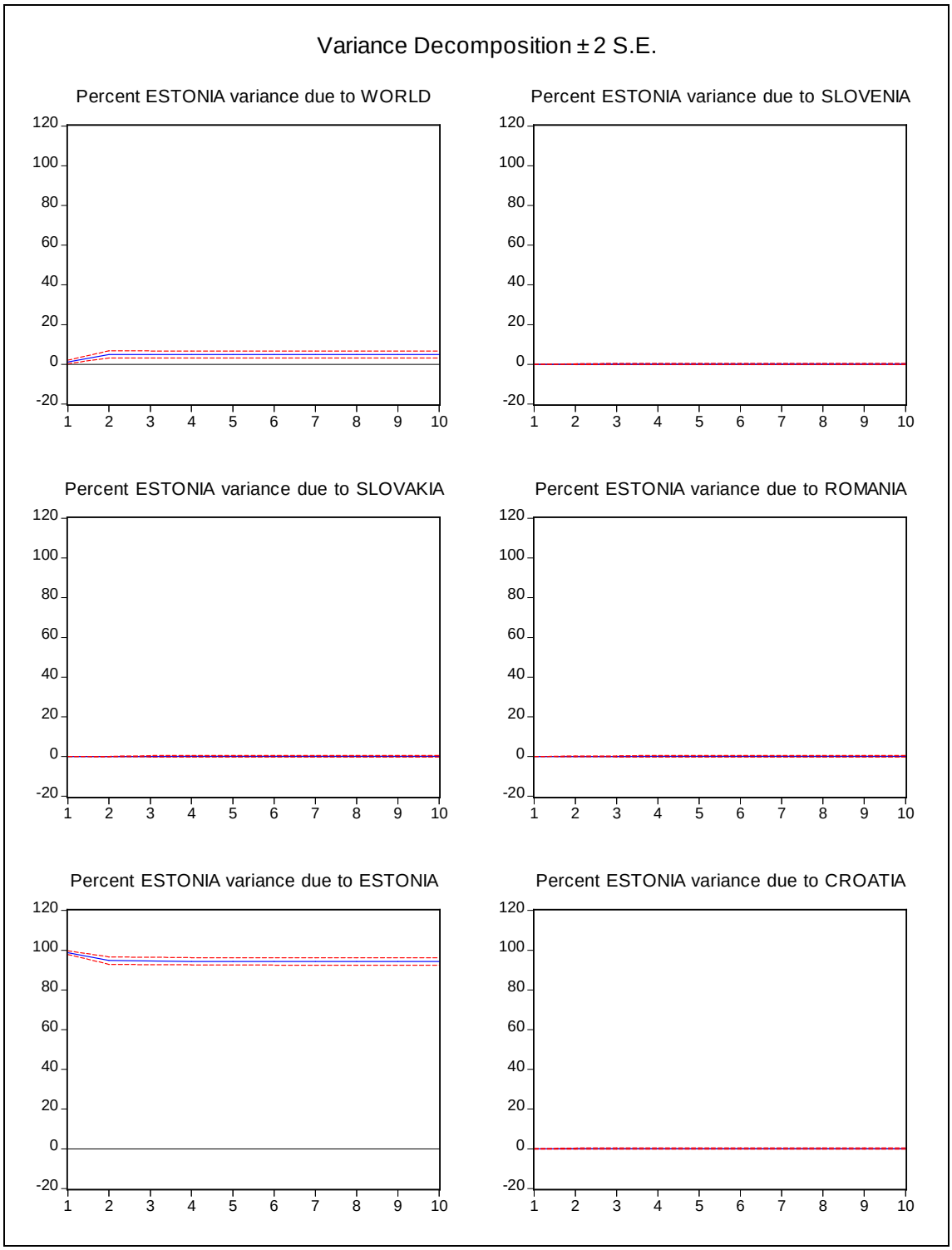

Figure 19. Variance decomposition: Estonia (Model 1).

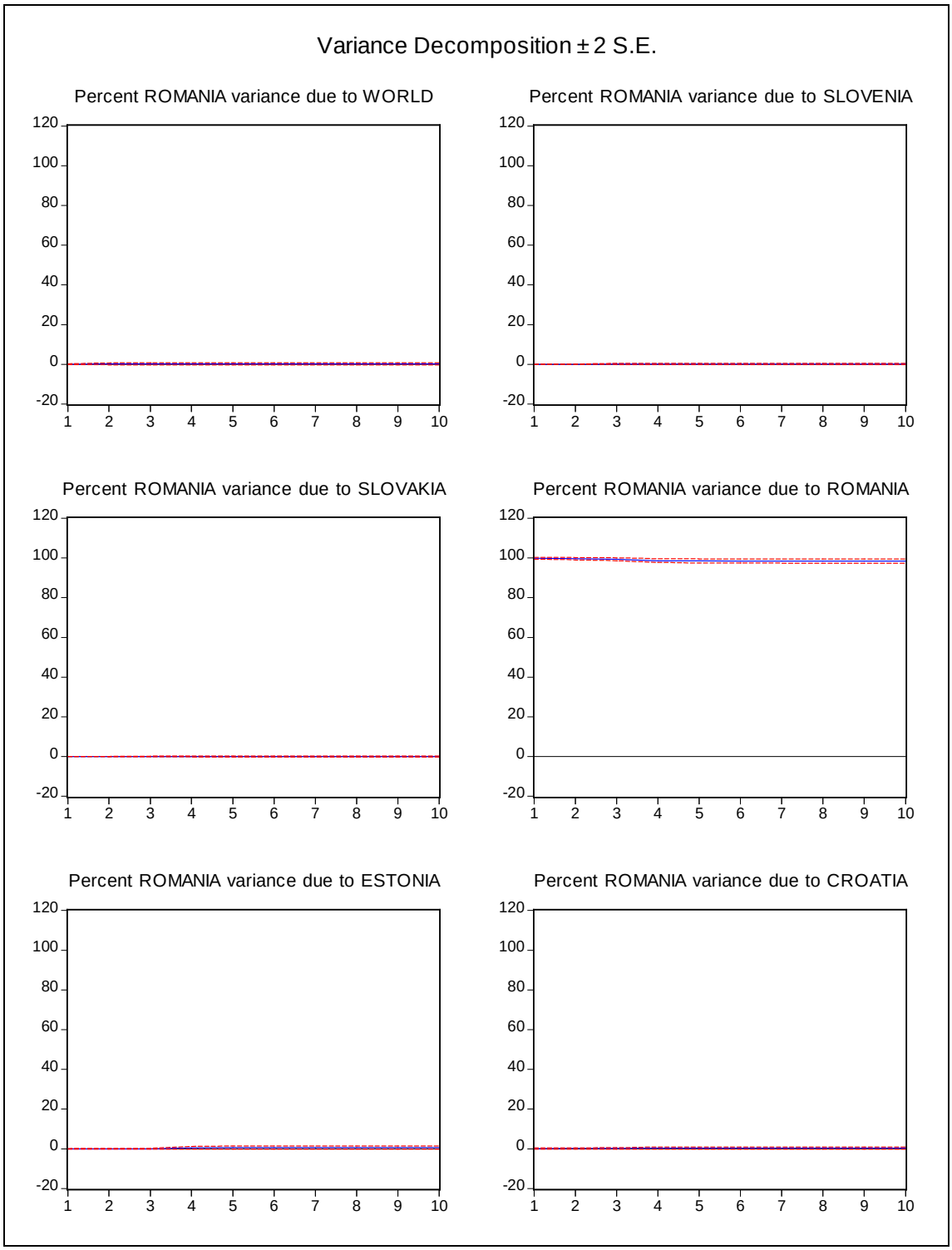

Figure 20. Variance decomposition: Romania (Model 1).

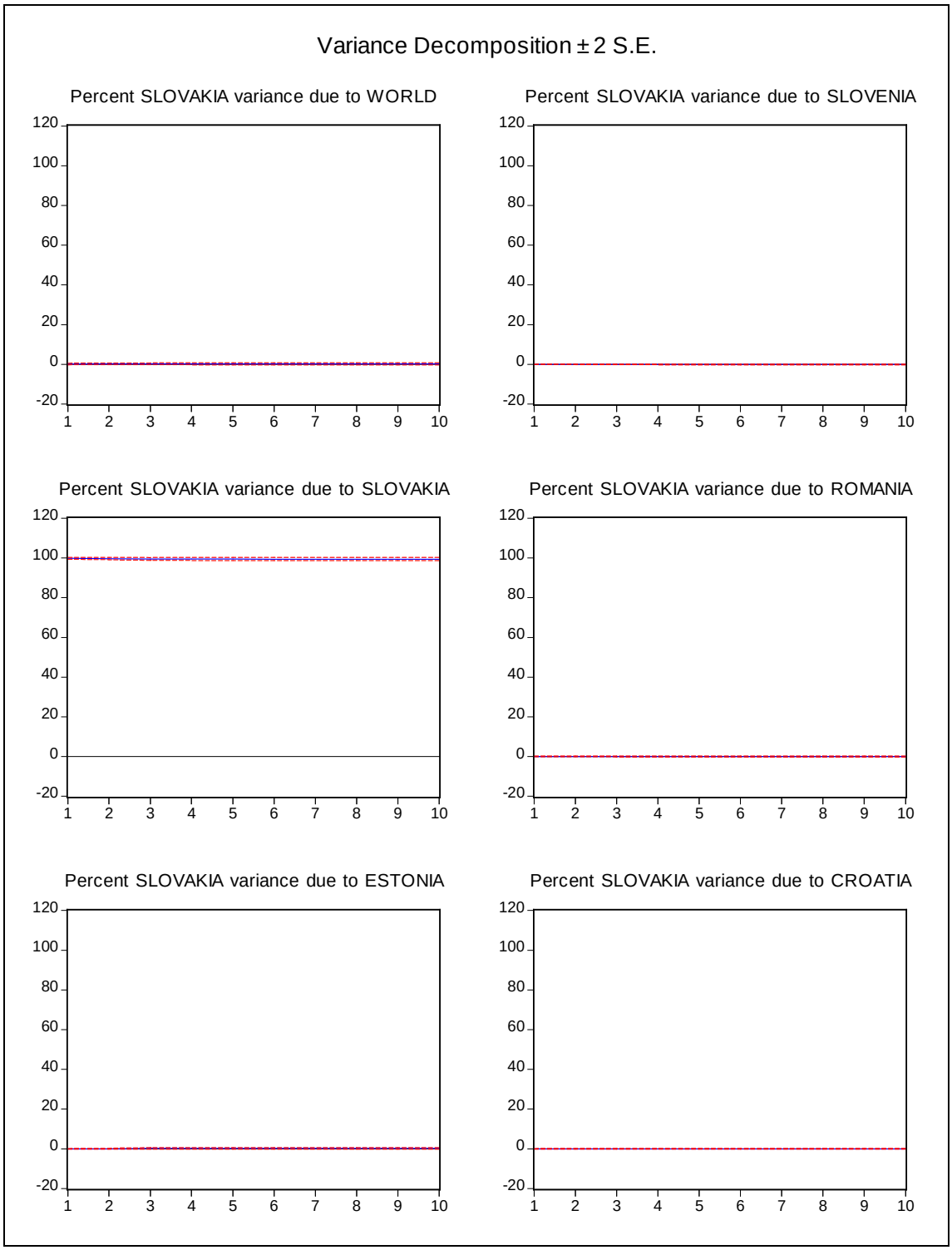

Figure 21. Variance decomposition: Slovakia (Model 1).

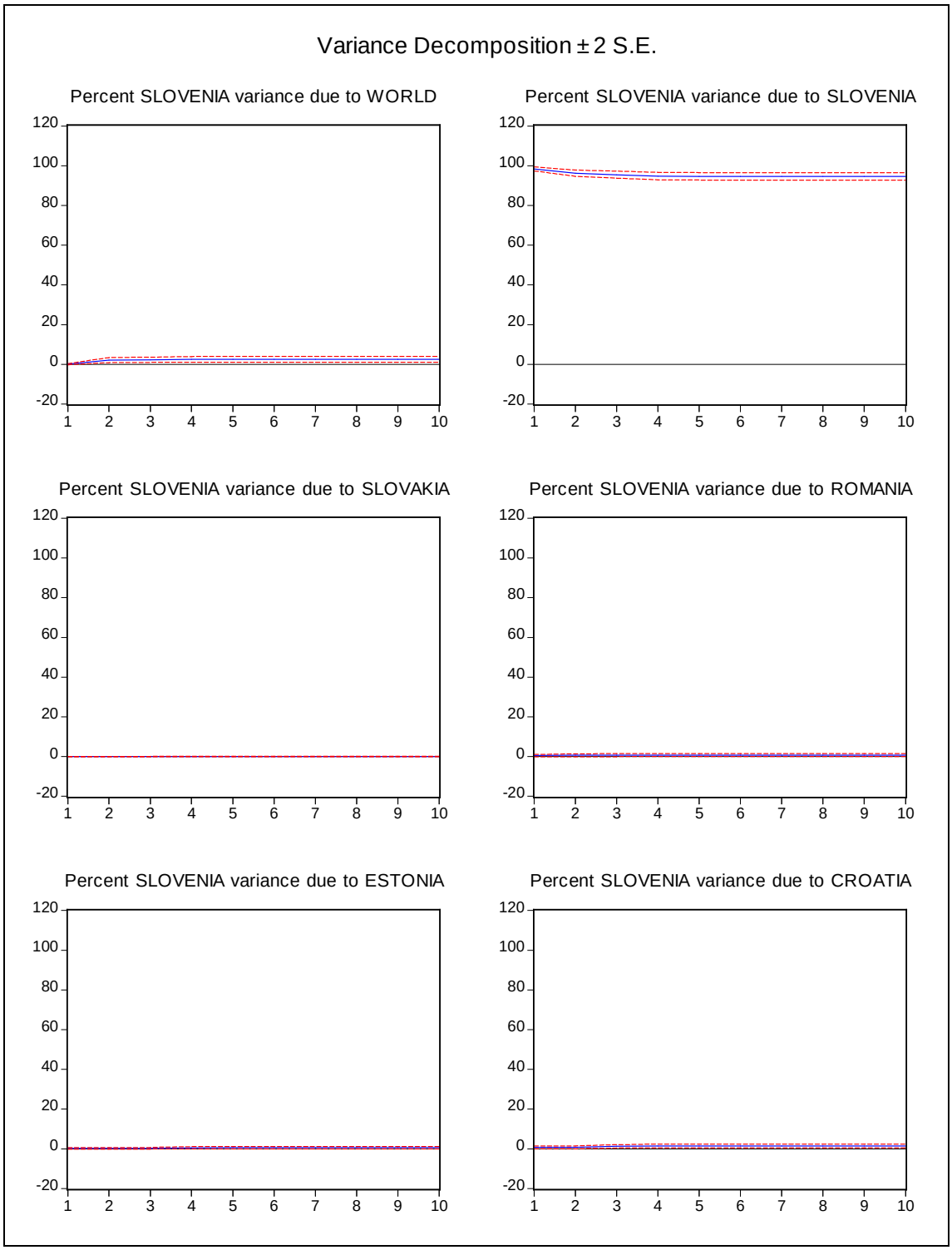

Figure 22. Variance decomposition: Slovenia (Model 1).

APPENDIX 4. Variance Decompositions for Model 2.

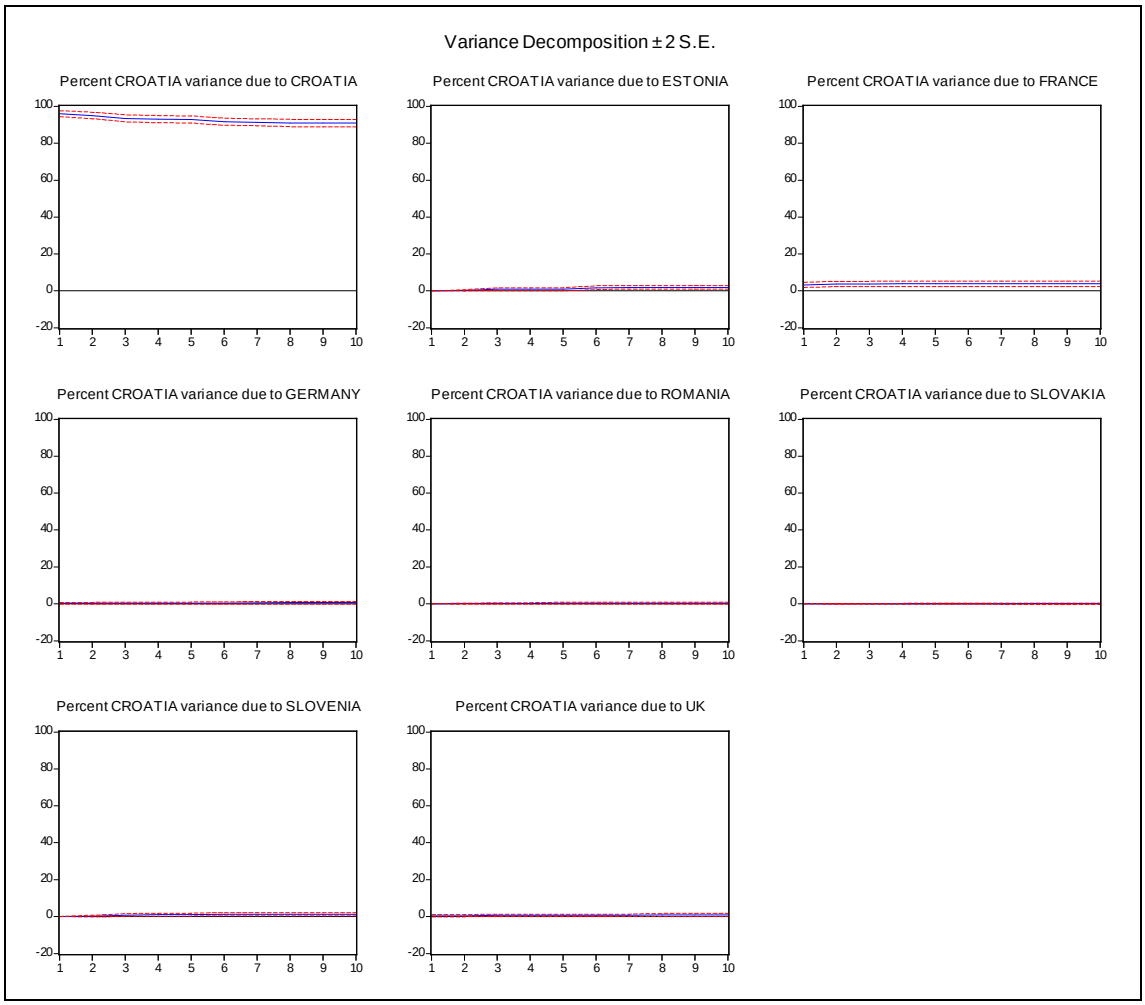

Figure 23. Variance decomposition: Croatia (Model 2)

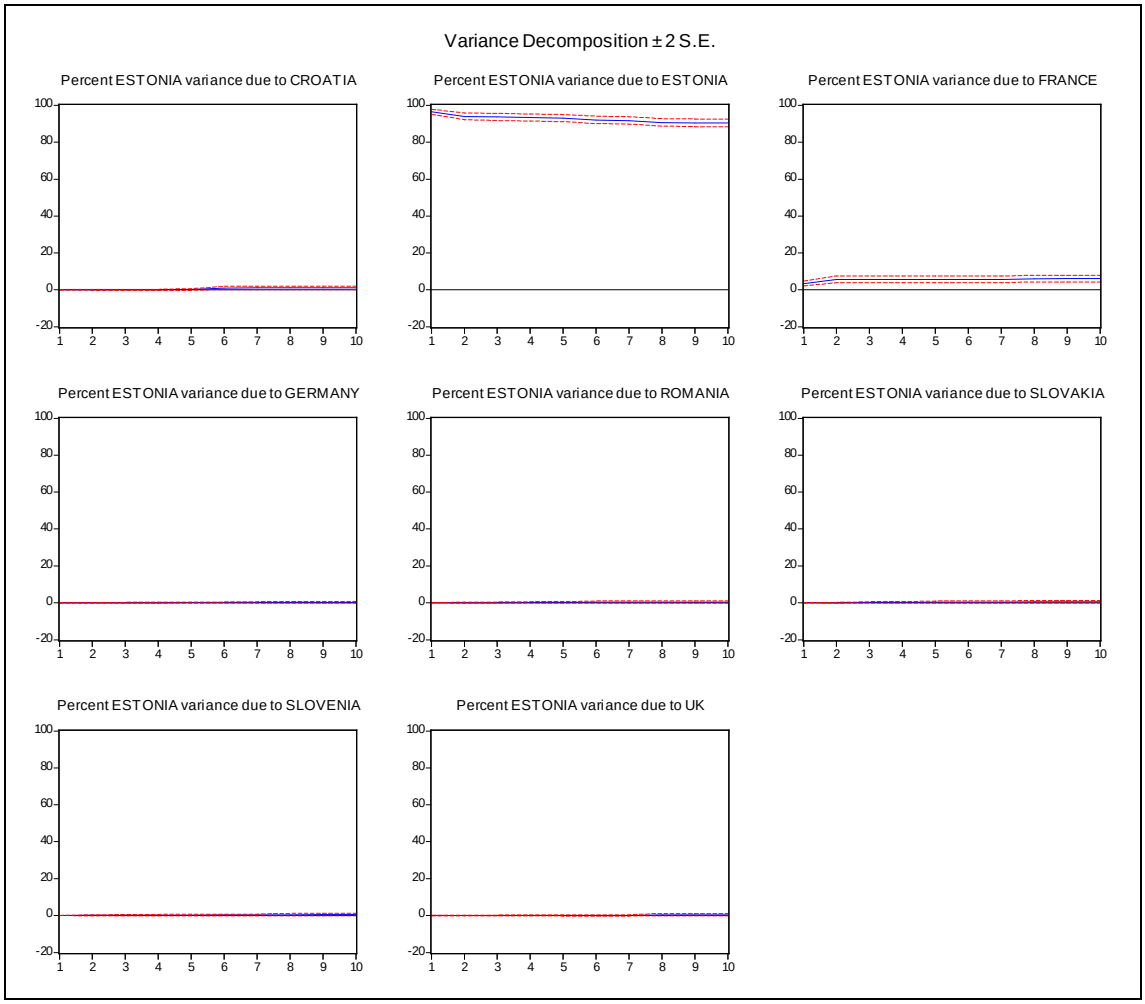

Figure 24. Variance decomposition: Estonia (Model 2)

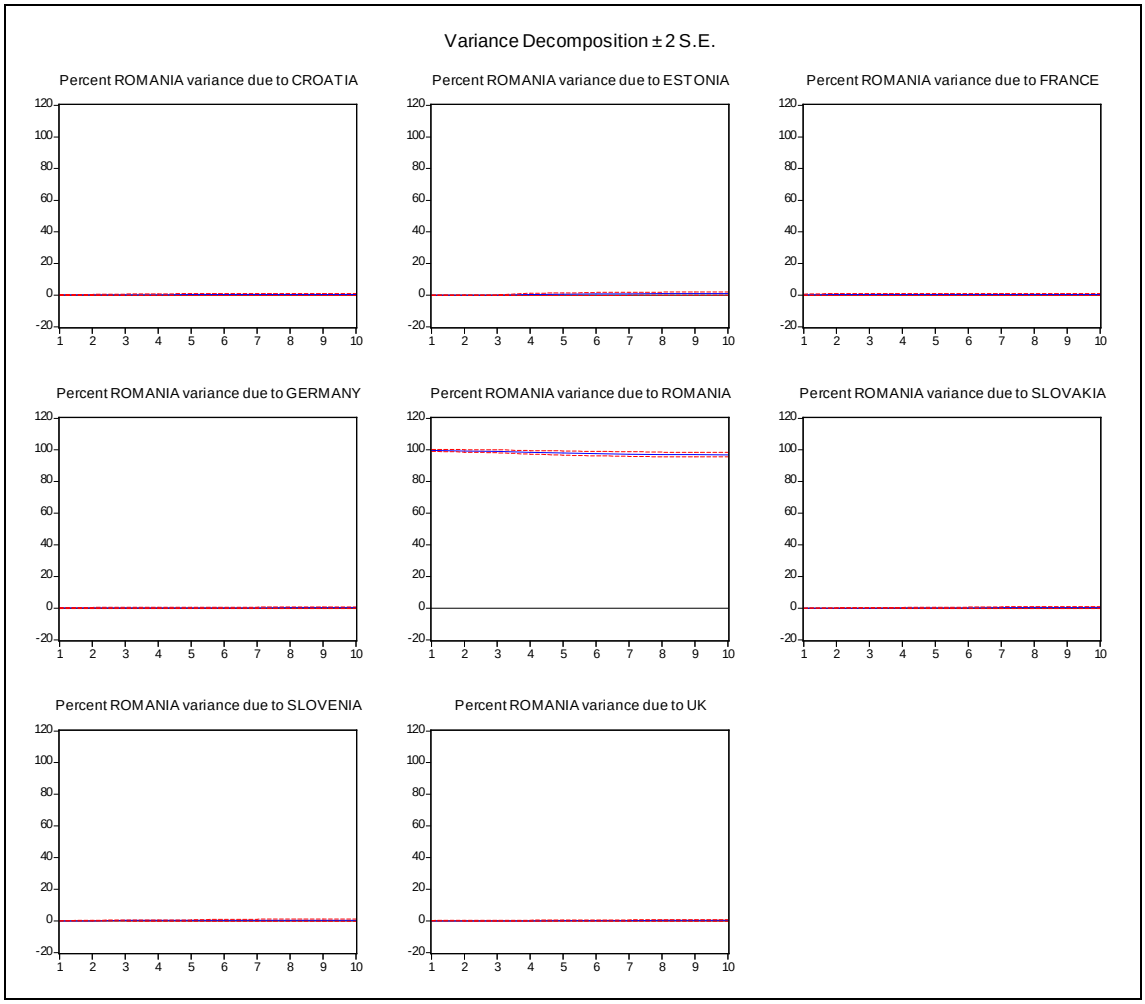

Figure 25. Variance decomposition: Romania (Model 2)

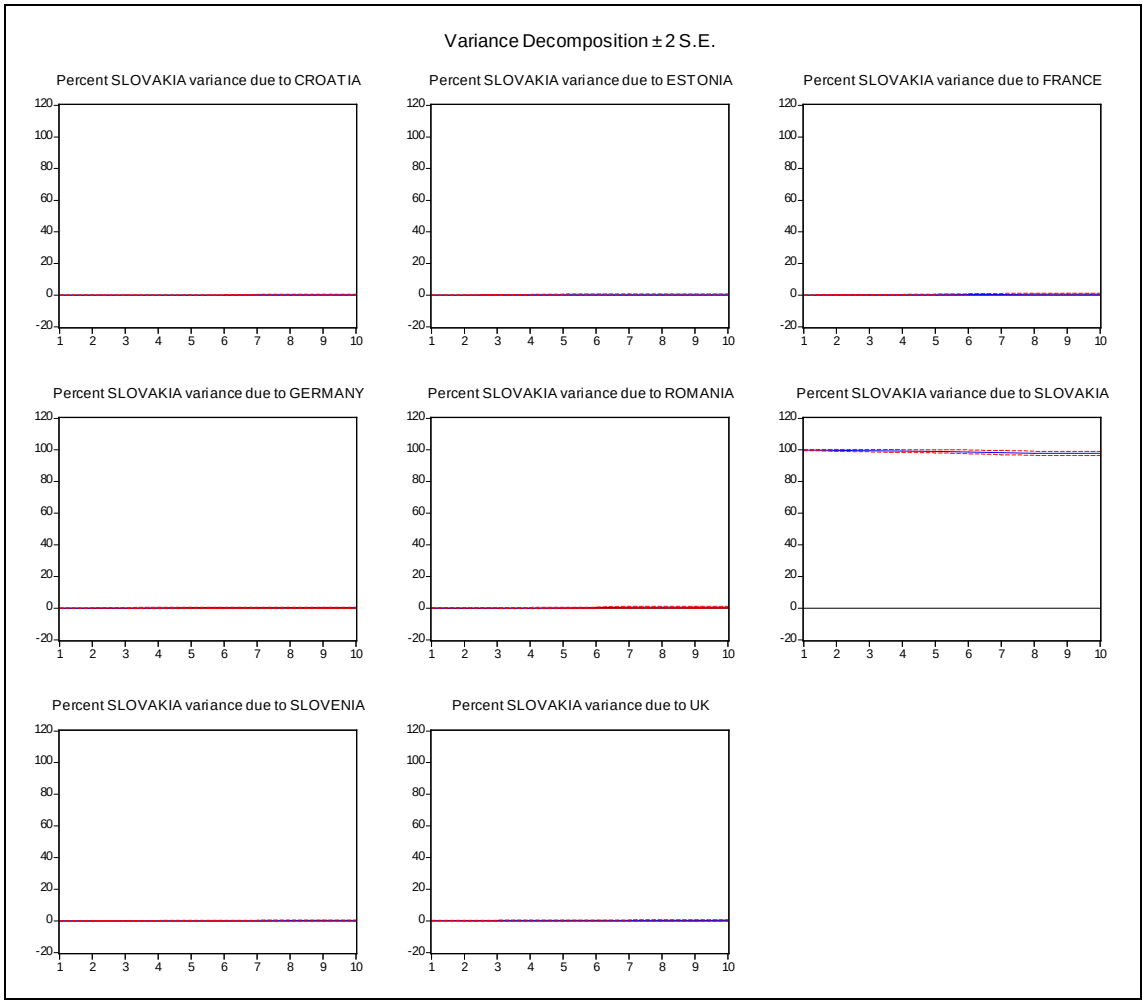

Figure 26. Variance decomposition: Slovakia (Model 2)

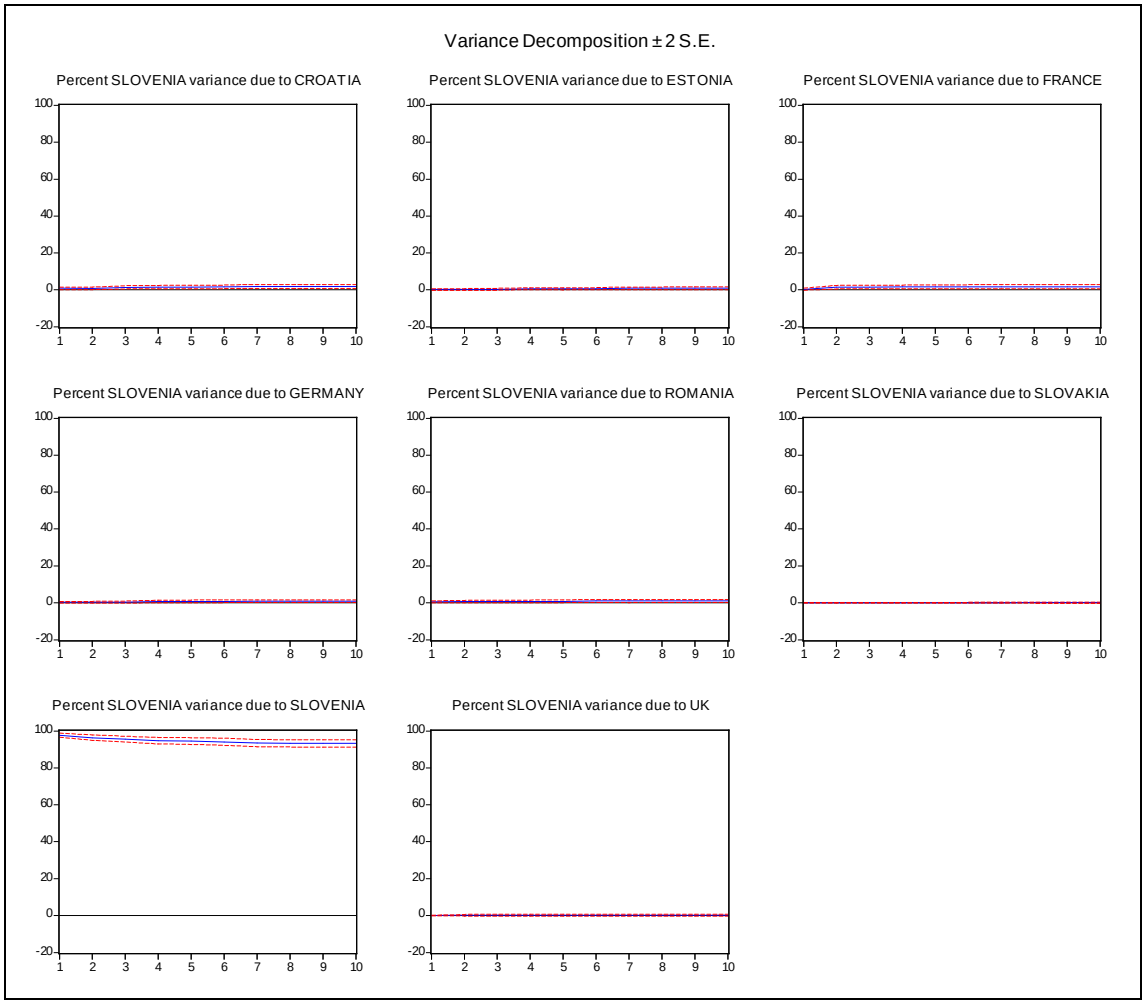

Figure 27. Variance decomposition: Slovenia (Model 2)