FINANCIAL INTEGRATION OF STOCK MARKETS IN THE SELECTED FORMER YUGOSLAV COUNTRIES

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FINANCIAL INTEGRATION OF STOCK MARKETS IN THE SELECTED FORMER YUGOSLAV COUNTRIES

1. INTRODUCTION

The purpose of this study is to establish the level of integration between the stock markets of the selected former Yugoslav countries and major international markets as a way of exploring possible diversification benefits for investors. The market integration is defined here as a co-movement of stock prices. Markets are considered to be integrated if national stock prices share a common long-run relationship. The integration between the markets in the former Yugoslav countries and those in developed countries is studied through the analysis of correlation, Granger causality tests and the application of Johansen cointegration analysis. The analysis will be done using the Eviews6 (student version) econometric modeling package.

Stock markets in the former Yugoslav countries have been widely ignored by international investors due to economic and political uncertainty, and the lack of common accounting standards and corporate transparency. Economic conditions across the former Yugoslav countries are different: the official GDP per capita in 2006 were estimated at US$4,444 in Serbia, US$6,500 in Bosnia, US$14,300 in Croatia and US$24,356 in Slovenia. Real GDP growth rates vary slightly from 5,6% in Croatia to 6,8% in Bosnia and Slovenia.

Integration of financial markets has been studied extensively over the past two decades. Due to liberalization and deregulation of capital markets in developed countries international stock markets have become more integrated which in return implied reduced benefits from international diversification. Moreover, the increase of capital flows, including Foreign Direct Investments (FDI) from developed to developing countries has resulted in a significant rise in the degree of integration of capital markets. This had prompted the US and investors from developed European countries to increasingly start looking into the diversification benefits in the emerging markets.

The linkage between stock markets of developed countries to emerging markets of Asia and South America have been studied in e.g. DeFusco, Geppert and Tsetsekos (1996), and Central and East European countries in Scheicher (2001) and Voronkova (2004). There seem to be no studies done between the emerging countries of Southeast Europe and their mature counterparts. Vizek and Tadic (2006) were probably the first to study the multilateral integration of equity markets of Croatia and selected Central and East European countries including Slovenia, and bilateral integration between Croatia and Germany. Yet, no studies were done on the integration of Croatia and Slovenia with other developed economies, nor between Croatia and Slovenia and other emerging economies of former Yugoslavia such as Serbia and Bosnia.

1.1. Statement of the problem

Stock markets exist in the former Yugoslav countries, but they vary in the degree of development from one another. Some of the markets are much more efficient in generating the capital and have a way greater market capitalization than the others. Regional stock markets differ tremendously in terms of size and liquidity, as well as securities traded, e.g. Sarajevo Stock Exchange currently only offers trading in equity shares and funds, Belgrade Stock Exchange primarily offers trading in shares but also bonds, Zagreb Stock Exchange trades shares, bonds and commercial bills, while Ljubljana Stock Exchange is more sophisticated in the instruments it trades: equities, bonds, funds and structured products.

During 2007, €649m worth of trades were executed on the Sarajevo Stock Exchange, while €3.5bn, €2.23bn, and €2.0bn were executed on the Zagreb, Ljubljana, and Belgrade stock exchanges respectively. Although Ljubljana Stock Exchange enables trading in a wider range of securities, it is the Zagreb Stock Exchange that leads in the overall activity. Among the exchanges of former Yugoslav countries in 2007, the Zagreb Stock Exchange accounts for 39% of total regional trade and more than 52% or the regional market capitalization, Figure 1 and 2.

Figure 1 Regional turnover in 2007

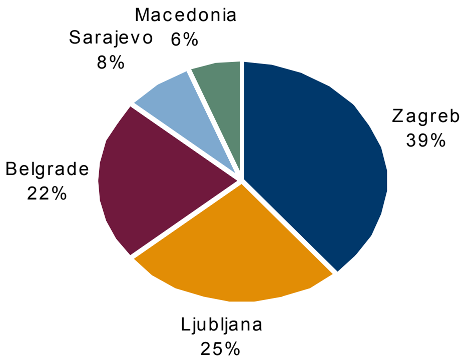
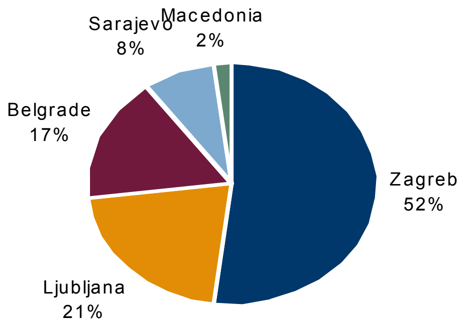


Figure 2 Regional market capitalization in 2007



As these stock markets are becoming increasingly important for the region and could potentially offer diversification benefits to international investors, this study will attempt to shed some light on the way that they cointegrate with each other and with the stock markets of the developed countries.

The stock exchange examined in this paper are the following:

- Sarajevo Stock Exchange (Bosnia and Herzegovina)
- Zagreb Stock Exchange (Croatia)
- Belgrade Stock Exchange (Serbia)
- Ljubljana Stock Exchange (Slovenia)

The aim of this project is to investigate the cointegration of these capital markets. Specifically, the study examines the following:

- *the bilateral integration of stock markets in the selected former Yugoslav countries,*
- *the multilateral integration of stock markets in the selected former Yugoslav countries,*
- *the bilateral integration of each stock exchange of the selected former Yugoslav countries with the S&P 500 (the US stock exchange), FTSE 100 (the UK stock exchange), Nikkei 225 (Japanese stock exchange) and the ATX (Austrian stock exchange).*

1.2. Motivation for the study

There are several different reasons why economists focus on the study of financial integration. One is that the economic growth of a country is linked to financial integration. Pagano (1993) shows the link between the financial markets integration and economic growth.

Companies whose shares are traded on an integrated stock market are able to raise capital by reaching investors in other countries.

Stock market integration results in reduced volatility of equity stocks traded in integrated markets (Hamara, 2002).

The final step for policy makers pursuing monetary integration is adoption of the Euro by new Member States. Monetary integration can only be successful if economic and financial integration have taken place first (Vizek and Dadic, 2005).

There are almost no papers written on the young stock markets examined in this study. I believe that my research will be able to shed some light on the above issues regarding the stock markets of former Yugoslav countries.

And finally, it is interesting to study these markets because of their rapid transition from the planned to open market economies.

The present paper contributes to the literature on international market integration by investigating possible diversification benefits for the Austrian, the UK, the US and Japanese investors in the markets of Bosnia, Croatia, Serbia and Slovenia.

1.3. Organization of the study

This study has seven chapters. Chapter One is introductory chapter, followed by Chapter Two which looks at the previous research done on the topic and outlines methodologies applied as well as markets examined in previous studies. Chapter Three provides some background reading on the selected former Yugoslav countries by looking at their respective key economic indicators, banking sector, foreign investments, economic integration and their stock markets. Chapter Four presents some statistical concepts around time series analysis and examines relevant econometric techniques that will be used to test for market integration. Chapter Five provides results of the bilateral and multilateral integration of the selected former Yugoslav countries. Chapter Six presents the results of the integration analysis between the stock markets of the selected former Yugoslav countries and major international markets. Final Chapter Seven provides summary and conclusions drawn from the study findings.

2. LITERATURE REVIEW

The cointegration methodology developed by Engle and Granger (1987) and Johansen (1988) have helped spur numerous studies on long-run comovements between stock markets as a way of identifying diversification opportunities within the portfolio theory context. Cointegration has also become a standard technique in analyzing the behavior and relationships of economic factors, such as exchange rates, interest rates, capital expenditure, inflation, etc. The literature coverage of the topic is rather wide and in order to narrow the scope of the review of the papers that have used cointegration as a methodology in their study, I will primarily focus on presenting results of those academic papers that have studied the degree of integration between equity markets.

The focal point of many academic papers have been market crashes (the October 1987 stock market crash, Asian and Russian crises of 1997) and the shock waves sent out across the stock markets around the globe.

Arshanapalli and Doukas (1993) find that degree of international comovements in stock price indices changes after the crises periods. Specifically, they find that France, Germany and UK stock markets are not related to the US stock market in the pre-October 1997-crash period, but report strong interdependence between the three major European and the US stock markets in a post-crash period.

Choudhry, Lu and Peng (2007) examine the change in the long run relationship between eight Far East countries around the Asian financial crisis of 1997. They also check the effect that the US and Japan may have on the relationship between the smaller Far East stock markets before, during and after the crisis. Choudhry et al conduct an empirical analysis by means of several different tests: rolling correlation coefficients and the Johansen multivariate cointegration test to investigate for the long run relationship and causality test and band spectrum regression in order to investigate the influence of the US and Japanese markets on those of the Far East. Cointegration results show stationary long run relationships between the stock markets of the Far East countries before, during and after the crisis. The highest of significant vectors was found during the crisis period. Both the causality test and band spectrum regression results indicate that the US and Japan influence the Far East markets with the US having a stronger relationship and increasing its influence and role during and after the crisis.

Manning (2002) applies two different methodologies in order to study equity markets in South East Asia. By applying the Johansen maximum likelihood approach Manning finds two cointegrating vectors. These two common trends indicate at least partial convergence among the studied nine Asian equity markets. By applying the Haldane and Hall Kalman Filter technique, Manning identifies two periods of convergence of the Asian markets, 1988-1990 and 1992-mid-1997, with divergence occurring both in 1990-1992 and the Asian crises of 1997.

However, studies on the long-run comovements between stock markets have traditionally focused on mature markets of the United States and Western Europe and the emerging markets of Asia and Latin America. For example, cointegration relations between the developed European and the US markets have been examined in the studies by Kasa (1992) and Blackman et al. (1994) who found evidence of cointegration. Contrary to such findings, using the ten year data of the stock market indices of the US, the UK, Japan, West Germany and the Netherlands, Byers and Peel (1993) find little evidence of cointegration either on a bivariate or multivariate basis. Latin American markets were examined by DeFusco, Geppert and Tsetsekos (1996), Arbeláez, Urrutía, and Abbas (2001), Chan, Firth, and Rui (2002), and Choudhry (1997). DeFusco et al. apply Johansen and Juselius cointegration procedure to the US and 13 emerging markets which were grouped into three georgraphic areas (Latin America, Pacific Basin and Mediterranean). Each grouping also included the US. The findings show no cointegrating relationship within the examined groups. As the correlations between the examined countries were found to be low, the authors concluded that the apparent lack of integration of these three emerging regions should result in diversification benefits.

Increased attention had also been paid to the interrelationships between the Scandinavian financial markets and the leading economies of the world. For example, Malkamäki et al. (1993) investigated causality patterns of the Scandinavian stock markets relative to worldwide returns. He finds that the Nikkei stock market seems to be a good proxy for the international economic forces relative to Finnish financial market. The impact of the financial markets of the Far East on Scandinavian asset returns was also demonstrated in Östermark and Aaltonen (1999), and evidence of the cointegration between the Finnish and Japanese financial markets is provided in Östermark (2000).

Much less attention had been given to the markets of Central and Eastern (CE) Europe. Linne (1998) in Jochum et al. (1999) using weekly data for selected Eastern European markets and a number of mature markets finds evidence of cointegration between the CE markets, yet no cointegration relations with mature markets. Linne concludes that the markets in the transition economies are mainly driven by domestic factors.

Jochum, Kirchgässner and Platek (1999) examined the behavior of the Eastern European markets as a group (Poland, the Czech Republic, Hungary and Russia) and the US previous to and during the 1997/98 crisis. Using daily data for the 1995 – 1998 period and applying the Johansen methodology, Jochum et al. show the existence of the long-run relationship between the Eastern European markets up to the first major shakeout in the Russian stock market in October 1997. However, their results show that there is no such long-run relationship following the event, but that the short-run interaction between the markets increases.

Scheicher (2001) studies integration between the stock markets of the Czech Republic, Hungary and Poland among each other and with the global market. In his studies he uses daily data for the 1995-1997 period. He estimates a vector autoregression model with multivariate GARCH to evaluate the impact of price and volatility shocks. Scheicher shows that Eastern European markets are influenced by Western markets to some degree. Furthermore, his results evidence integration between the Eastern European markets analyzed in the study, in particular between Hungary and Poland.

Gilmore and McManus (2002) studied the short- and long- term relationships between the US stock market and the selected three Central European markets (the Czech Republic, Hungary and Poland). They use weekly data over the 1995-2001 period.

Gilmore and McManus found low short-term correlations to exist which are indicative of benefits for short-term investors. In order to explore possible existence of long-term comovements, they apply Johansen cointegration procedure and find no evidence of cointegration on either bilateral basis between the US and the Central European markets individually or multilateral basis. Thus, they conclude US investors can benefit from diversifying into the Central European equity markets. Furthermore, the Granger causality test revealed a causality running from the Hungarian market to the Polish market. There was no causality found in either direction between the Central European and the US stock markets. However, the study by Gilmore and McManus focuses primarily on the links with the US market, leaving the relations with the developed European markets unexamined.

In a similar study, Voronkova (2004) examines the long-run links between the three emerging CE markets (the Czech Republic, Hungary, and Poland), three developed European stock markets (Great Britain, France, and Germany), and the US. She uses weekly data that covers a period of almost 10 years, from 1993 to 2002. Voronkoava applies Engle and Granger and Johansen bivariate and multivariate tests and compares them to the findings of the Gregory – Hansen test. She uses this approach in order to investigate whether the Gregory and Hansen methodology could possibly provide more eveidence on the presence of long-run relationships that the conventional cointegrations tests would not detect. The results point towards the existence of six additional cointegration relationships (one within the group of Central European markets and five between the Central European and the mature markets). Most importantly, Voronkova finds evidence of links between the emerging CE markets within the region and globally that is stronger than has previously been reported. Unlike the previous study of Gilmore and McManus (2002) her study supported the hypothesis that the emerging CE markets have become increasingly integrated with the world markets.

Vizek and Dadic (2006) are probably the first to examine the cointegration between Croatia and selected Central and East European countries (including Slovenia), and Croatia and Germany. They use daily data for the 1997-2005 period and apply Johansen cointegration procedure in their study. The results indicate the existence of multilateral integration among equity markets of Central and Eastern Europe economies, and also found evidence of multilateral equity market integration between the entire group of CEE countries and German equity market. When analyzing bivariate relationship between Croatia and Germany no evidence of a linkage was found. They obtained the same result when examining the bilateral integration between other CEE countries and Germany. They conclude that the existence of cointegration vector on multilateral basis and absence in a bilateral long-run analysis is possibly due to common global factors that can only be captured in multilateral cases that point towards integration.

In conclusion, the existing literature provides conflicting evidence with regard to the existence of the long-run relations between the emerging European stock markets and the mature markets of Europe and the US. Specifically, research is lacking on the integration of stock markets for the former Yugoslav countries.

3. BACKGROUND OF THE SELECTED FORMER YUGOSLAV COUNTRIES

3.1. Bosnia and Herzegovina

Bosnia is one of the former Yugoslav countries that has been hit the hardest by the Balkan wars. The war (1992-1995) had brought destruction and economic backlash: real GDP plummeted by 80% and more than half the country's population (2 million) became refugees (World Bank). Since the end of the war Bosnia went through a major transition from war to peace and from a centrally planned to market economy. Bosnia had gone through more than a decade of continued strengthening of its economic and political institutions within an exceedingly complex political structure whose grounds were laid in the 1995 Dayton Peace Agreement.

The 1995 Dayton Agreement created a multi-layered structure with two political entities: the Federation of Bosnia and Herzegovina (the federation) and the Republica Srpska (RS). Each entity exercises considerable power at a local level with its own government, president and administration. The country is further subdivided into 10 cantons.

<u>Economy</u>

The complex duplicative governmental structure and domination of nationalist parties in government at all levels makes collaboration amongst the major players difficult. This hampers economic development and creates economic disparity between the two major entities.

Bosnia is the third poorest country in Europe, after Albania and Kosovo. GDP per capita is US$6,500 in 2006 (the most recent available data) compared to US$14,300 of Croatia, US$4,444 of Serbia and US$24,400 of Slovenia. Economic growth was on average 5.4% per annum during 2002 to 2007, which was in line with growth figures of other former Yugoslav countries, but below the new EU member states, Bulgaria and Romania (Orchard et al. 2008, 2). The economy is relatively undiversified and primarily focused on a small number of mining and base metals producers, machinery and wood products. With only 4 million inhabitants, the economy is estimated at €12 billion in value.

As of 1 January 2005, the new fiscal administration was created which began with its policies of indirect taxation such as the implementation of a value-added tax (VAT), which are to be collected by the state rather than one of the political entities. The improvements of the fiscal policies has led to a significant decrease in expenditure from 60.3% of GDP in 1999 to 40.9% in 2007, Table 1.

On the other hand, GDP could increase by as much as 20% if underground economy was to be taken into account (O'Donnel et al. 2006, 2). Private sector generates only half of the country's GDP, which is substantially smaller than in other countries in the region.

As a result of the Dayton's Agreement, the Central Bank was established which operates as a currency board. The new currency, the convertible marka (KM) officially designated BAM, is pegged to euro at the fixed exchange rate of 1KM = €0.51129. Convertible marka is freely convertible throughout Bosnia and Herzegovina and is well received and widely used by the Bosnian people. Pegged currency has brought inflation under control.

Long-term unemployment has been one of the country's major challenges. Official unemployment rate has come down considerably but still remains high at 29% in 2007 (45% in 2006). Nevertheless, Bosnia's gray economy is very large and the actual unemployment figure could be as much as by 10 percentage points lower.

Table 1 Economic indicators – Bosnia and Herzegovina (Source: Moody's 2008)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008F	2009F
Economic Structure and Performance												
Nominal GDP (US$ Bil.) [1]	4,7	5,3	5	5,3	6,2	8,4	10,6	11,6	13,6	18,1	19,5	19,7
Population (Mil.)	3,6	3,7	3,8	3,8	3,9	3,9	3,9	3,9	3,9	3,9	3,9	3,9
GDP per capita (US$) [1]	1 318	1 438	1 332	1 380	1 591	2 147	2 712	2 952	3 455	4 601	4 980	5 020
GDP per capita (PPP basis, US$)	3 785	4 073	4 282	4 508	4 787	5 064	5 513	5 949	6 488	--	--	--
Real GDP (% change)	9,9	10	5,5	4,5	5,5	3	6,3	3,9	6,7	6,8	3,7	-0,7
Inflation (CPI, % change Dec/Dec)	21,2	3,3	7,5	0,9	0,2	0,6	0,5	4,3	4,6	4,9	9	3
Gross Investment/GDP [1]	--	--	20,6	18,8	20,1	20,4	27,1	27	21,6	26,1	24,9	22,9
Openness of the Economy [2][3]	109,8	107,5	113,7	112,9	103,5	98,2	94,8	98,9	93,6	89,1	96,9	97,8
Government Finance												
Gen. Gov. Revenue/GDP [1]	--	51,9	50,4	46,6	44,3	50,4	41,8	42,5	43	40,4	40,2	39,6
Gen. Gov. Expenditures/GDP [1]	--	60,3	57	50,1	48,8	52,2	42,3	41,7	41	40,9	41,7	42,5
Gen. Gov. Debt (US$ Bil.)	--	1,92	1,93	1,99	2,3	2,59	2,81	2,62	2,74	2,98	3,47	4,69
Gen. Gov. Debt/GDP	--	38,4	37,9	38,1	33,4	27,7	24,2	23,9	19,2	15,3	18	24,1
External Payments and Debt												
Nominal Exchange Rate (local currency per US$, Dec)	1,7	1,9	2,1	2,2	1,9	1,5	1,4	1,7	1,5	1,3	1,5	1,5
Current Account Balance (US$ Bil.)	-0,35	-0,5	-0,4	-0,74	-1,19	-1,63	-1,64	-1,91	-1,04	-1,94	-2,68	-1,69
Current Account Balance/GDP [1]	-7,3	-9,4	-7,8	-14	-19,3	-19,5	-15,5	-16,6	-7,7	-10,7	-13,7	-8,6
External Debt (US$ Bil.)	--	--	3,01	2,92	3,89	4,99	5,62	5,37	6,18	7,9	6,55	6,35
External Debt/GDP [1]	--	--	59	55,8	56,6	53,3	48,4	49	43,4	40,7	34	32,6
Net Foreign Direct Investment/GDP [1]	1,4	3,3	2,9	2,2	4,3	4,6	6,7	5,1	5,2	11,2	4,6	4,3

Notes:
[1] Series break in 2004
[2] Sum of Exports and Imports of Goods and Services/GDP
[3] Balance of Payments; Series break in 2004

Banking sector

Banking sector is probably the most developed part of the economy with harmonized laws between the two entities. State had in particular put its efforts in privatizing its banking sector to foreign investors which had resulted in greater financial stability. However, foreign bank ownership can potentially have a negative impact on the economy if banks, due to current financial crises, decide not to have exposure in the country.

Foreign investments

Privatizing large and strategic firms had shown to be difficult which had resulted in foreign investors being rather risk averse to Balkans. According to latest available data of 2005, around US$500 million of foreign direct investment was recorded, resulting in a total of US$ 2.3 billion since 1994, primarily in privatized state firms (Lindow et al. 2006, 2).

Economic integration

Bosnia has recently signed the Central European Free Trade Agreement (CEFTA), which enables free trade with the EU and other Western Balkan countries by 2011. CEFTA is expected to strengthen Bosnian economy by providing investment links to the wider European community. However, regional trade is hindered by poor infrastructure links, which despite investments by the international community are still a way behind the European standards.

While political entities may find it difficult to come to a consensus on many issues, EU accession seems to be widely popular and welcome among the population irrespective of ethnical background. In June 2008 Bosnia had signed the Stabilization and Association Agreement (SAA) with the EU, which is a first step towards eventual EU membership. However, while this may be a landmark in the Bosnian efforts to wider European economic integration, adopting a body of EU law which countries are required to adopt prior to EU membership requires a significant overhaul of current laws and regulations. This in itself will be a major test to ethnic-based political parties to come to agreement when faced with the EU accession.

Stock market

Bosnia has two stock exchanges:

- the Sarajevo Stock Exchange, SASE (founded in September 2001 and commenced trading in April 2002)
- the Banja Luka Stock Exchange, BLSE (founded in May 2001 and commenced trading in March 2002)

As the total turnover of SASE was KM1,274m (€649m) in 2007 compared to KM580m (€296m) of BLSE, it is the SASE that has been taken to represent the Bosnian stock market in this study.

The market of Sarajevo Stock Exchange is divided into two major segments:

- The official market ("Kotacija")
- Free market ("Slobodno trziste)

The official market is the market place where the trading of the "blue-chip" companies takes place. Listing on the official market is subject to certain requirements in terms of transparency and size. The official market has a subsection that enables trading of investment funds (fund quotation).

Sarajevo Stock Exchange currently only offers trading in equity shares (common, ordinary and preferred). The lack of trading in other instruments is due to the fact that capital markets in Bosnia are very young and capital raising is primarily focused around banks. Therefore, the main trading instruments are shares from the privatization process and to a far lesser extent shares from secondary public offerings. Trading is done via the electronic trading system, BTS. In the beginning trading took place only once a week, but it increased gradually and since Jan 2007 trading takes place Monday to Friday.

In 2006, the SASX-10 index was developed which tracks the performance of the top 10 companies on the market. The caped weight of an issuer in index is 20% since January 3, 2007 and before that was as far as 40.21% for JP "Elektroprivreda BIH" d.d Sarajevo which is a utility company. SASX-10 index is heavily driven by the performance of top

3 firms: JP "Elektroprivreda BIH" d.d Sarajevo, "BH-Telecom" d.d. Sarajeco, and JP "Elektroprivreda HZHB" d.d. Mostar.

The first sale of state owned capital, the package of "Intersped d.d. Sarajevo" shares, took place in August 2007. This was a successful process that helped the Federation of Bosnia and Herzegovina raise KM851,499 (€434,264) instead of anticipated KM412,493 (€210,371).

In May 2006, SASE signed a memorandum of understanding with Wiener Börse which is meant to lay grounds for closer cooperation between Sarajevo and Vienna. The first major project is expected to be an index.

In November 2007, Sarajevo Stock Exchange became a member of the Federation of European Stock Exchanges (FESE). This membership will enable SASE to have exchange of experience with European stock markets and thus help integrate the capital markets of Bosnia with those of Europe.

3.2. Croatia

The Balkan wars (1991-1995) have left scars on Croatia as well. The challenge for the country was not only the post war era of reconstruction but also the move from a planned to market economy. Croatia has made significant economic progress over the past 15 years: incomes doubled, economic and social opportunities have significantly improved and the country was awarded an investment-grade rating. Furthermore, Croatia is currently undergoing accession negotiations with the EU.

<u>Economy</u>

Real GDP growth in Croatia has risen rapidly in the last few years due to gains in competitiveness and productivity as well as access to external liquidity. Growth in 2007 was 5.6% due to a strong domestic demand. GDP per capita is the highest among its peers, alongside Hungary.

The main driver of the economic growth are the public sector companies with the government sector accounting to about half of the country's GDP. Government related investments outpace those made by the private sector. Sales of shares of INA (national oil company), several steel mills, and possible future sales of some loss-making shipyards have created positive implications. Shipyards are a critical sector of the economy accounting for about 6% of manufacturing employment and 12.5% of exports (Cailleteau et al. 2008, 2).

Yet, the privatization process has been uneven and state ownership impedes private sector activity in the economy. A number of large assets are still in the hands of the state, such as the power utility Hrvatska Elektroprivreda d.d., oil and gas company Industrija Nafte (part-privatized in 2003 and 2006), the railways, the postal service, and as mentioned above, several shipyards (Cailleteau et al. 2008, 2).

The Croatian government has financed its needs domestically since mid-2004 which has reduced public external debt to GDP. General government debt is currently at 36% of GDP from a recent peak of 43.7% in 2005, Table 2, and is expected to decline to 32% of GDP by 2011 (Mates and Gill 2008, 2). General government expenditures have fallen from 56% of GDP in 1999 to 41% of GDP expected in 2008.

Croatia has a free floating currency, *kuna* (Kn). The Croatina National Bank (HNB) has tried to maintain exchange rate stability in recent years due to in particular high level or euroization and balance sheet exposure in Croatia. About 80% of public sector debt is either linked to foreign currency or denominated in foreign currency, mostly euros.

Table 2 Economic indicators – Croatia (Source. Moody's 2008)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008F	2009F
Economic Structure and Performance												
Nominal GDP (US$ Bil.)	21,6	19,9	18,4	19,9	22,8	29,7	36	38,9	42,9	51,3	63,2	61,2
Population (Mil.)	4,5	4,6	4,5	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4	4,4
GDP per capita (US$)	4 806	4 375	4 093	4 472	5 132	6 681	8 100	8 755	9 661	11 548	14 238	13 783
GDP per capita (PPP basis, US$)	8 679	8 632	9 168	9 942	10 675	11 488	12 315	13 231	14 309	--	--	--
Real GDP (% change)	2,5	-0,9	2,9	4,4	5,6	5,3	4,3	4,3	4,8	5,6	3,5	2
Inflation (CPI, % change Dec/Dec)	5,4	3,9	5,5	2,3	1,8	1,7	2,7	3,7	2,1	5,8	5,9	3,5
Gross Investment/GDP	23,3	23,3	21,8	22,3	24,6	28,5	28,8	28,1	29,8	29,9	30,1	30,6
Openness of the Economy [1]	88,8	90,2	99,4	102,9	102,8	104,7	102,9	102,7	104,6	104	102,8	102
Government Finance												
Gen. Gov. Revenue/GDP [2]	51,1	48,4	46,2	44	46,3	45,1	41,2	39,6	40,1	41,4	38,8	39
Gen. Gov. Expenditures/GDP [2]	53,8	55,5	51,9	50	51,4	50,6	45,3	43,4	42,6	43	41,1	41,4
Gen. Gov. Debt (US$ Bil.) [3]	6,29	6,18	7,47	7,96	9,12	12,14	15,55	17	17,51	19,33	22,63	21,66
Gen. Gov. Debt/GDP [3]	28,6	33,4	39,9	40,1	40	40,9	43,2	43,7	40,8	37,7	35,8	35,4
External Payments and Debt												
Nominal Exchange Rate (local currency per US$, Dec)	6,2	7,6	8,2	8,4	7,1	6,1	5,6	6,2	5,6	5	5,1	5,4
Current Account Balance (US$ Bil.)	-1,45	-1,41	-0,47	-0,73	-1,93	-2,16	-1,87	-2,56	-3,29	-4,44	-5,69	-5,63
Current Account Balance/GDP	-6,7	-7,1	-2,6	-3,7	-8,4	-7,3	-5,2	-6,6	-7,7	-8,7	-9	-9,2
External Debt (US$ Bil.)	10,74	10,14	11,27	11,86	15,88	25,11	31,24	30,37	38,55	48,86	46,53	49,36
External Debt/GDP	42,4	50,7	65,7	60,6	62,5	75,3	78,7	82,3	85,6	88,8	74,6	81,7
Net Foreign Direct Investment/GDP	3,9	7	5,9	7	2,4	6,5	2	4	7,5	9,1	8,6	6,9

Notes:
[1] Sum of Exports and Imports of Goods and Services/GDP
[2] Series break in 2005
[3] Official National Source and Moodys; Series break in 2001

Banking sector

Croatia has fully privatized and restructured its banking sector which is now predominantly controlled by foreign banks. The banking sector is about 90% foreign owned, mostly Austrian and Italian banks. This has enabled a rather quick corporate borrowing as many firms had direct access to external financing through local banks' foreign parents. Due to global crisis in financial markets and the lack of capital, corporate borrowing had substantially decreased in August 2008.

Concerns over the health of the local banks' foreign parents have caused a short deposit run in September 2008. This was counteracted by the government's announcement of an expended deposit guarantee scheme of up to Kn400,000 (EUR 56,000), which effectively covered 90% of deposits (Cailleteau et al. 2008, 6).

Foreign investments

As part of the SAA with the EU, government is making progress in terms of modernizing legal and institutional environment and is moving forward in restructuring of the remaining loss making state owned enterprises. This is expected to have a positive effect on foreign direct investment (FDI) which has been picking up recent years, and on per capita basis is especially strong, Table 2.

Economic integration

Croatia is designated as an EU candidate in 2004 with negotiations expected to conclude early next decade. Thus, this EU membership is the main driver of Croatia's economic policy making today. EU related reforms carry positive implications: economic strength, institutional strength, and government financial strength. In compliance with the EU accession, Croatia will have to reduce subsidies, restructure loss making public sector companies and implement measures that would enhance competitiveness of the economy (Cailleteau et al. 2008, 4).

Furthermore, Croatia has opened the economy to global markets through WTO and CEFTA memberships and re-established cooperation with its Southeast European neighbors.

External economic environment is a challenge for Croatia as current turmoil in the financial sector has resulted in higher financing costs and higher inflationary pressures.

<u>Stock market</u>

The Zagreb Stock Exchange or ZSE trades shares of Croatian companies, bonds and commercial bills. ZSE was established in 1991 and in March 2007 it merged with Varazdin Stock Exchange creating a single Croatian capital market. Among the exchanges of former Yugoslav countries, the Zagreb Stock Exchange accounts for 39% of total regional trade and more than 52% or the regional market capitalization (in 2007).

CROBEX is the official Zagreb Stock Exchange share index. CROBEX is a price index weighted by free float adjusted market capitalization. The weight of any individual issuer in the index is limited to 15% of the index capitalization. Based on the selection criteria ordinary shares from 24 companies were included in the index as of March 2009.

In 2007 Zagreb Stock Exchange had seven Initial Public Offerings of Croatian company shares with a market cap of €1.23bn. The number of IPOs as well as the offering value are comparable to those of more developed stock exchanges: Swiss Exchange, Irish Stock Exchange and Vienna Stock Exchange had ten, ten and seven IPOs respectively with offering value of €1.98bn, €1.67bn and €1.43bn respectively. The IPO success had attracted many retail investors and helped improve the investment climate in the country.

The Zagreb Stock Exchange is very active on an international level and is a member of the Federation of Euro-Asian Stock Exchanges and a member of the Federation of European Stock Exchanges - FESE. ZST has also worked with the Organization for Economic Cooperation and Development (OECD) on drafting the principles of corporate governance. Cooperation between Zagreb Stock Exchange and Ljubljana and Belgrade Stock Exchanges intensified in particular in 2007. The exchanges worked together on development of a blue chip index, designed in cooperation with Dow Jones. Zagreb Stock Exchange is also a co-signatory of a partnership agreement with the Ljubljana, Belgrade and Macedonian Stock Exchange.

3.3. Serbia

During the Balkan wars, Serbia was exposed to war related expenditures and economic sanctions by global community. Since the end of wars, the country had made a wide range of democratic and economic reforms.

Economy

Serbia has a potential for fast economic development, as the country is rich in natural and mineral resources and fertile and arable agricultural land. Due to its strategic location in Southeast Europe and good access to EU markets, Serbia is also well positioned for development of a transportation hub.

Official GDP per capita, estimated at $4,444 in 2006, has reached $4,959 in 2007. During the same time period, poverty has fallen from 14 percent of the population to about 6.6 percent (The World Bank 2008). GDP is projected to grow by an average of 5%-6% per annum in medium term.

Serbia's economic base is reasonably diversified. Most economic activity is concentrated in services (about 65% of GDP), industry (24%), and agriculture (11%). In the service sector, construction and consumer demand are the main drivers of economic growth.

The country's major concern right now are its external imbalances: the current account deficit nearly doubled to around 18% of GDP in 2008 from 10% of GDP in 2005 due to surging imports caused by a strong domestic demand (Tepic & Kraemer 2008, 2).

The general government debt is forecast to fall to 30% of GDP in 2008 from 34% in 2007, due to receipts from privatization which are used for debt reduction. Privatization of the banking system is complete, but state still has a monopoly over strategic assets such as the oil and power industry.

Serbia's currency is Serbian *dinar* (RSD), yet people widely use euros. High levels of euro usage in the Serbian banks had left banks exposed to a very volatile exchange rate risk.

The official unemployment rate is estimated at 27% in 2006, mainly due to company restructuring and redundancies. The real unemployment rate is probably lower due to the jobs created by the underground economy.

<u>Banking sector</u>

Majority of the country's banking system is the hands of Western European banks. This poses a problem as given current state of the financial markets some of these banks may wish not to extend its exposure to Serbia, therefore depriving the country of the capital necessary for economic growth.

Serbia's external vulnerabilities have led authorities to close a 15-month precautionary standby agreement with the IMF, which in return required adoption of a restrictive fiscal stand and continuous progress on structural reforms (Tepic & Kraemer 2008, 2).

<u>Foreign investments</u>

Serbia has good prospects in attracting FDI due to its richness in natural and mineral resources, skilled labor force, as well as its strategic position that connects major routes in Southeast Europe. Most FDI is related to privatization (mainly in banking and telecommunications).

Net foreign investments financed 25% of the deficit in 2007, but this is expected to increase to 50% in the medium term as more privatizations of large assets take place. Privatization and the sale of UMTS license had raised net FDI inflows in 2006 to a record level of 13% of GDP.

Economic integration

Serbia has made a major progress with the signing of a Stabilization and Association Agreement (SAA) in May 2008. European integration is priority of the Government. However, the political situation and the EU accession process in Serbia remain influenced by Serbia's involvement in a war in Bosnia. Even though the SAA has been signed, EU has halted the negotiations unless Serbia demonstrates closer with the International Criminal Tribunal for the former Yugoslavia (ICTY).

Stock market

Belgrade Stock Exchange was first founded on November 21, 1894 and it functioned until the breakout of World War II in Yugoslavia; reopened in 1989 as Yugoslavian Capital Market, but after the breakup of the country it was renamed back to Belgrade Stock Exchange.

BELEXline is a benchmark index for Belgrade Stock Exchange that was established with a purpose to describe movements of the broader Serbian capital market. BELEXline is free-float market capitalization weighted index, which is not adjusted for paid out dividends. The index consists common shares traded on the BELEX. In order to limit the influence of issuers with larger market capitalization, the number of shares of certain issuers is limited in the index so that the influence of each constituent is limited to a max. 10% of index capitalization.

The total turnover in 2007 at the BSE amounted to RSD 165bn, or about €2bn, 64% up on the year before. Just like in the previous years, shares accounted for the largest part of the turnover on the Exchange with the participation of shares amounting to c.90% (53% came from the trading in companies' shares and 37% from trading in shares from the banking sector) and bonds of Republic of Serbia the remaining part of c.10%. It is worth noting that corporate bonds are not traded on the Belgrade Stock Exchange.

Foreign investors have increasingly participated in trading at the Belgrade Stock Exchange since 2004, but their participation slowed down in the beginning of 2007 due to increasing inflow of new domestic investors. The average daily participation of foreign investors in annual share trading accounted for 42%. Foreign investors' participation in trading is primarily evolved around trading in foreign currency savings bonds while trading in shares is relatively lower. Net inflow of foreign investments (total sales less total purchase) at the BSE was about EUR500 million in 2007.

Belgrade Stock Exchange has increasingly been involved in international cooperation. In order to promote the regional market and development of regional products, BSE signed the Memorandum of Partnership with Macedonian, Ljubljana and Zagreb stock exchanges in December 2007. This initiative is a major step towards promoting the region as a unified investment environment.

3.4. Slovenia

Slovenia is the most developed country out of all former Yugoslav countries. By some it is one of the most successful transition economies and possibly the most developed of all new EU members. Slovenia joined EU in 2004 and adopted euro as its currency in 2007. Probably due to is already advanced stage of development, Slovenia had not gone through the rapid economic restructuring, extensive privatization, and strong FDI inflows compared to Bosnia, Croatia and Serbia. Slovenia enjoys consensus-based political environment.

<u>Economy</u>

Slovenia is a small open economy. Its main determinant of macroeconomic performance is export performance. The focus is laid on the export of high value added goods to the niche markets in the EU, and therefore the dependability on the demand in West Europe. This is unlike the exports of some other recent EU joiners such as Hungary who exports intermediate products which are subsequently bundled into exports to either other EU member states, or countries outside the EU.

Exports to the EU countries have increased in recent years in particular in autos and pharmaceuticals in 2007. Although the share of exports to the countries of former

Yugoslavia is still high, there has been some decline in investments Slovenian firms had made in these markets (Mates and Mrsnik 2008, 10).

Slovenia is a high-income country with an estimated GDP per capita of $26,400 in 2008. Slovenia had a very steady economic performance with GDP growth rates of around 3.5% - 4% per annum. Growth was primarily due to exports which have contributed over 2% to GDP growth totals on average (Shiffer et al. 2007, 1).

In 2007 Slovenia went through an “investment boom” in non-residential (civil engineering) construction, upgrade of infrastructure (highways and railroads) due to the governmental move to take advantage of the EU available funding.

The general government expenditure to GDP declined from 49.0% in 2001 to 46.3% in 2006. The key expenditure areas remain public sector wages and pensions.

Inflation in Slovenia has been lower than in other former Yugoslav countries. The unemployment rates have been below the average of the region staying at around 6-7 percent since 1997.

Slovenia was the first among the new EU member states of Central and Eastern Europe and the Baltics to adopt the euro in January 2007. Adoption of euro has eliminated risk of foreign exchange exposure.

Table 3 Economic indicators – Slovenia (Source: Moody's 2008)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008F	2009F
Economic Structure and Performance												
Nominal GDP (US$ Bil.)	21,3	21,7	19,5	20,1	22,7	28,6	33,2	35,1	38,2	46	49	50,7
Population (Mil.)	2	2	2	2	2	2	2	2	2	2	2	2
GDP per capita (US$)	10 760	10 952	9 785	10 073	11 390	14 324	16 625	17 563	19 038	22 864	24 298	25 121
GDP per capita (PPP basis, US$)	14 951	15 966	16 953	17 795	18 713	19 602	21 037	22 506	24 356	--	--	--
Nominal GDP (% change, local currency)	7,8	7,3	3,5	6,1	7,6	4,9	5,6	5,7	7,8	10,1	8,9	7
Real GDP (% change)	3,6	5,3	4,1	2,8	4	2,8	4,3	4,3	5,9	6,8	4,4	2,9
Inflation (CPI, % change Dec/Dec)	6,5	8	8,9	7,1	7,2	4,6	3,2	2,3	2,8	5,6	5	4,8
Unemployment Rate (%)	7,4	7,3	6,7	6,2	6,3	6,7	6,3	6,5	6	4,9	4,5	4,8
Gross Investment/GDP	25	27	26,2	24,9	23,4	24,1	25,4	25,5	26,1	28,7	28,6	28,3
Openness of the Economy [1]	105,8	100,8	113	113,2	111,1	109,9	119	126,6	135,7	144,6	149,5	154,3
Government Finance												
Gen. Gov. Revenue/GDP	43,9	44,1	43	43,6	43,9	43,7	43,6	43,8	43,3	42,9	42,2	41,6
Gen. Gov. Expenditures/GDP	46,3	46,1	46,8	47,7	46,3	46,4	45,8	45,3	44,5	42,4	42,4	42,4
Gen. Gov. Debt (US$ Bil.) [2]	5,07	4,9	5,13	5,39	7,04	8,74	10,23	9,16	10,71	11,55	10,43	10,64
Gen. Gov. Debt/GDP [2]	21,8	24,3	26,8	27,4	28,1	27,5	27,2	27	26,7	23,4	21,8	21,1
External Payments and Debt												
Nominal Exchange Rate (local currency per US$, Dec) [3]	161,2	196,8	227,4	250,9	221,1	189,4	176,2	202,4	181,9	0,7	0,8	0,8
Current Account Balance (US$ Bil.)	-0,23	-0,83	-0,62	-0,08	0,2	-0,26	-0,86	-0,63	-0,92	-1,84	-3,08	-3,2
Current Account Balance/GDP	-1,1	-3,8	-3,2	-0,4	0,9	-0,9	-2,6	-1,8	-2,4	-4	-6,3	-6,3
Net Foreign Direct Investment/GDP	1	0,3	0,4	1,8	6,6	-0,6	0,8	-0,3	-0,7	-1,3	-0,8	-0,6

Notes:
[1] Sum of Exports and Imports of Goods and Services/GDP
[2] Eurostat and Moodys

Banking sector

Banking system in Slovenia has experienced rapid growth over the last 10 years or so with banking assets growing threefold since 2000 to around €42.5m in 2007 with a ratio of average assets to GDP growing from 69% in 2006 to 117% in 2007 (Haladjian et al. 2008, 2). This however is still relatively low compared to other EU countries who have a ratio of average assets to GDP of 318%, but serve as an indictor of where Slovenian banking sector could be heading to.

Slovenian banks are still predominantly domestically owned with a relatively high state ownership. This has often been named as the key reason for the banks' low efficiency and less dynamic competition. The banking system is highly concentrated with the three largest banks Nova Ljubljanska Banka (NLB), Nova Kreditna Banka Maribor (NKBM) and Abanka (government directly or indirectly owns 45%, 51% and 42% respectively) controlling more than half of the banking system's assets as at end of 2007.

Foreign direct investment

Slovenia's location at the crossroad between Eastern and Western Europe as well as its highly skilled work force are great enticement to FDI. However, reluctance toward foreign participation in key areas has resulted in low FDI, with the average net FDI equivalent to about 1.2% of GDP in 1997-2005. The exception was year 2002 when the net FDI to GDP reached almost 7% (The World Bank 2008). Thus, comparing these figures to those of Bosnia, Croatia and Serbia, net FDI to GDP in Slovenia is small.

Moreover, given that the domestic financial system is relatively underdeveloped there is a tendency of large outflow of domestically saved funds to foreign investments (such as Croatia and Bosnia) leaving less money available for domestic investments.

Economic integration

Slovenia has become EU Member State on May 1, 2004. Subsequently the country managed to successfully reduce inflation to within the Maastricht Treaty target for European Economic and Monetary Union (EMU) entry and thus was the first of the new EU Member States to adopt euro which became effective on January 1, 2007.

Integration of the banking sector with the EU markets is currently at an early stage due probably to the fact that capital markets of Slovenia are at a relatively young stage. Although exports to the countries of the former Yugoslavia have declined recently they are still at a relatively high level. Slovenian firms however continue to move its production activities to higher risk but higher reward countries of Southeast Europe.

Stock market

After the purchase in June 2008, the major owner of the Ljubljana Stock Exchange (LJSE) is Wiener Börse (Austarian stock exchange) which holds 81.013% of LJSE.

LJSE is a regulated market of the European Union. Adoption of Euro in Januray 2007 was important for transactions on the capital market as it eliminates foreign exchange risks and thus helps simplify foreign investments in Slovenian companies.

LJSE indices offer a concise update on the performance of the Slovenian capital markets. The SBI 20 (or SVSM index as indicated in this study) measures the performance of the entire Slovenian equity market. The SBI 20 is price index, weighted by free-float market capitalization with individual shares not being allowed to exceed 15 percent of index capitalization on the day of the review.

The equity market capitalization (excluding investment funds) was €19.74bn on 31 December 2007, an increase of 71.5% on the year before. This was due to the 2007 boom market and listing of Nova Kreditna Banka Maribor bank (Nova KBM) on the official market. The LJSE market cap was 58.9% of Slovenia's 2007 GDP. During 2007 over €2.23bn worth of trades were executed, an increase of 123.5% on the year before.

As of June 2008, the Exchange had launched a new securities market segmentation, which is based on the types of listed securities. The new divisions include: equity market, bond market, fund market, closed-end fund market and structured products market. The quity market is further divided into sub-segments according to the quality of the listed shares: highest quality – Prime Market, mid quality – Standard Market, basic equity market quality – Entry Market. Prime Market is the most prestigious market segment which lists larger companies known for their liquid track record and transparency.

The listings of telecommunications operator Telecom Slovenije and later of Nova KBM bank in 2007 have resulted in the exchange being even more representative of the Slovenian economy. In particular, the privatization of Nova KBM in an Initial Public Offering at the end of 2007 was an important event for the development of the Slovenian capital market. It was a clear demonstration that Slovenian stock market had achieved the level of sophistication comparable to the developed stock markets of other EU counterparts. At the same time this event demonstrated to other listed companies that the market for new public offerings had improved significantly.

LJSE is a full member of the World Federation of Exchanges – WFE, which is the international institution that includes the most developed world capital markets, and a member of the Federation of European Securities Exchanges – FESE. Through its membership with FESE, LJSE has an opportunity to actively participate in the decision-making on all important issues relating to the EU capital markets.

Furthermore, LJSE also entered into cooperative agreement with markets of South East Eur0pe. On 20 December 2007, LJSE signed the Memorandum of Partnership together with the Belgrade, Macedonia, and Zagreb Stock Exchange. Later also other stock exchanges from the region joined: Banja Luka, Sarajevo, Montenegro, Nex. The exchanges thus agreed to closer cooperation with a goal of promoting the regional market and regional issuers to international investors as well as jointly developing regional products and services.

4. METHODOLOGY

The degree of price comovement model has widely been used in recent studies as a way of estimating long-term linkages between markets. In this study the model will be examined through the utilization of non-asset pricing models: correlation, cointegration and Granger causality. Cointegration makes it possible to examine different levels of data to find comparable long-run properties and, as seen earlier, has been used in many equity market integration studies. Granger causality helps determine the direction of interaction between markets.

This chapter looks at the relevant econometric techniques that will be used in this paper to investigate for market integration as well as presents some important statistical concepts around time series analysis.

4.1. Correlation

There are many possible measure of comovement, and correlation is a standardized measure of a closeness of a linear relationship between two variables.

Correlation is computed into what is known as the correlation coefficient, which ranges between -1 and +1. Two variables that are perfectly positively correlated (a correlation coefficient of +1) move in tandem in the same direction, either up or down. In contrast, perfect negative correlation means that if one variable moves in one direction the other variable that is perfectly negatively correlated will move by an equal amount in the opposite direction. Finding perfect positive or perfect negative correlations is rather unusual; most variables are correlated along the spectrum between more than -1 and less than 1. Two variables that have correlations coefficient of 0 are said to be uncorrelated.

In terms of portfolio theory, the concept of correlation is useful in that the returns on negatively correlated assets tend to be offsetting which stabilizes portfolio returns.

4.1.1. **Stationary and non stationary time series**

Granger and Newbold (1974) argued that economic time series data in general exhibit trend-like behavior and have considerable persistence, that is, they do not have a constant mean and constant variance. The classical regression techniques applied to highly persistent, unrelated series lead to false results because they perform a regression between variables that are independent. Such regressions produce large correlations and could have a high R^2 even if the two series are totally unrelated (Yule 1927, Granger and Newbold 1974). Thus, when standard regression techniques applied to non-stationary data result in a regression that "looks" good but is really valueless we obtain what is termed a "spurious regression". In order to deal with this problem and in the cases when the time series data being used is not stationary, test of long-run relationships require the use of various cointegration techniques.

a) Stationary

A time series sequence (y_t) having a finite mean and variance, and satisfying (4.1) - (4.3) for t = 1, 2, … ∞, is said to be weakly or covariance stationary

1. $E(y_t) = \mu$ (4.1)
2. $E(y_t - \mu)(y_t - \mu) = \sigma^2 < \infty$ (4.2)
3. $E(y_{t_1} - \mu)(y_{t_2} - \mu) = \gamma_{t_2 - t_1} \forall t_1, t_2$ (4.3)

These three equations state that a stationary process should have a constant mean, a constant variance and a constant autocovariance structure, respectively. The autocovariances determine how y is related to its previous values, and for a stationary series they depend only on the difference between t_1 and t_2, so that the covariance between y_t and y_{t-1} is the same as covariance between y_{t-9} and y_{t-10}, etc. In the literature, a covariance stationary process is also referred to as a weakly stationary, second-order stationary, or wide-sense stationary process (Enders 1995, 69).

For a covariance stationary series, we can define the autocorrelation between y_t and y_{t-s} as

$$\tau_s = \frac{\gamma_s}{\gamma_0}, \qquad s = 0, 1, 2, \ldots$$

where γ_0 and γ_s are defined by (4.3). In the case that s = 0, the autocorrelation at lag zero is obtained, i.e. the correlation of y_t and with y_t, which is obviously 1. If τ_s is plotted against s = 0, 1, 2… a graph known as the autocorrelation function (acf) or correlogram is obtained.

b) Non-stationary

Non-stationarity is a commonly observed problem in the analysis of time series. It stems from the fact that the time series is not independent of time. When a variable is not stationary, its mean and variance are not consistent over time, and an observation is correlated with its more recent lags. Thus, a non-stationary series will exhibit a time varying mean and we cannot use the term "mean" properly without referring to some particular time period.

There are two models that have frequently been used in the academic papers to characterise non-stationarity: the *random walk model with drift* and *the trend-stationary process*, each discussed in turn below.

Random walk with drift is given by the following model:

$$y_t = \mu + y_{t-1} + u_t \qquad (4.4)$$

and the *trend-stationary process* – whose name is due to it being stationary around a linear trend:

$$y_t = \alpha + \beta t + u_t \qquad (4.5)$$

where u_t is a white noise disturbance term in both cases.

The model (4.4) could be generalized to describe y_t as an explosive process

$$y_t = \mu + \phi y_{t-1} + u_t \qquad (4.6)$$

where $\phi > 1$. In general, this case is ignored and $\phi = 1$ is used to characterize the non-stationarity because $\phi > 1$ does not describe many data series in economics and finance and $\phi = 1$ has been found to describe many economic and financial series (Brooks 2002, 370). Moreover, the case with $\phi > 1$ has an unappealing property: the effect of any shock to the system are not only persistent through time, they are propagated so that a given shock will have an increasingly large influence. That is, the effect of a shock during time t will have a larger effect in time t+1, an even larger effect in time t+2, and so on. To see this, let us examine the equation (4.4) with no drift

$$y_t = \phi y_{t-1} + u_t \qquad (4.7)$$

and lag it by one and two periods

$$y_{t-1} = \phi y_{t-2} + u_{t-1} \qquad (4.8)$$

$$y_{t-2} = \phi y_{t-3} + u_{t-2} \qquad (4.9)$$

Substituting into (4.7) from (4.8) for y_{t-1} yields

$$y_t = \phi(\phi y_{t-2} + u_{t-1}) + u_t$$

$$y_t = \phi^2 \phi y_{t-2} + \phi u_{t-1} + u_t$$

Substituting again for y_{t-2} from (4.9)

$$y_t = \phi^2 (\phi y_{t-3} + u_{t-2}) + \phi u_{t-1} + u_t$$

$$y_t = \phi^3 \phi y_{t-3} + \phi^2 u_{t-2} + \phi u_{t-1} + u_t$$

T successive substitutions of this type lead to

$$y_t = \phi^T \phi y_{t-T} + \phi u_{t-1} + \phi^2 u_{t-2} + \phi^3 u_{t-3} + \ldots + \phi^T u_{t-T} + u_t$$

Therefore, the effect of shock is permanent and increasing over time.

To sum, there are three possible cases:

$$\phi < 1 \Rightarrow \phi^T \to 0 \text{ as } T \to \infty$$

The shocks to the system gradually die away. This is the *stationary* case.

$$\phi = 1 \Rightarrow \phi^T = 1 \ \forall \ T$$

in which case the shock persist and never die away. The following model is obtained:

$$y_t = y_0 + \sum_{t=0}^{\infty} u_t \text{ as } T \to \infty$$

Thus, the current value of y is the sum of some starting value y_0 and an infinite sum of past shocks. This is known as the *unit root case*.

$$\phi > 1$$

in this case the given shocks become more influential as time progresses, since if $\phi > 1$, $\phi^3 > \phi^2 > \phi$, and so on. This is the *explosive case*, which as described above will be taken as implausible.

Many refer to non-stationary series as integrated series. Stock and Watson (1988) further proved that two or more integrated series may eventually achieve equilibrium, that is, they can eventually share common properties and thus be cointegrated. The linear combination of this series, they argue, is stationary.

Cointegrated processes carry characteristics of a short-term dynamics and a long-run equilibrium. Having a long-run equilibrium does not mean that cointegrated processes tend to a long-run equilibrium. The long-run equilibrium is the static regression function which describes the relationship between the processes after eliminating for the short-term dynamics (Rachev et al 2007, 375).

The order of integration depends on the number of differencing the original series required to reach a stationary series. For each differencing the number of observations is reduced by one. Theoretically, any number of such differencing can be carried out to achieve stationarity, but to do so more than twice is rare in the case of business and economic data time series (Nazem 1988, 200).

The two characterisations of non-stationarity mentioned earlier: the random walk with drift and the trend-stationarity process, both require different treatments to induce stationarity. The first is known as stochastic non-stationarity as the data contains a stochastic trend. The second case is known as deterministic non-stationarity and detrending is required. Nevertheless, stochastic stationarity model (random walk with drift) is the model that has been found to best describe most non-stationary financial and economic time series (Brooks 2002, 372) and thus the following discussion will focus alone on inducing stationarity with such series.

4.2. Testing for cointegration

To determine whether there is cointegration between two or more data series, two tests must be performed. First, it is necessary to test data series for non-stationarity, that is to determine the order of integration in order to induce stationarity. Second, data is examined for the evidence of a long-run relationship between the variables in question.

4.2.1. **Unit roots**

Time series data reflect a process that involves trend, cycle, and seasonality. We obtain stationary data by removing these deterministic patterns. Currently, the most widely used test for stationarity is a unit root test: the existence of unit roots in a series is an indicator of non-stationarity.

Testing for unit roots has been the most important topic in econometrics over the last 20 years with the early and pioneering work on testing for a unit root in time series being done by Dickey and Fuller. The basic objective of the test is to examine the null hypothesis that $\phi = 1$ in

$$y_t = \phi y_{t-1} + u_t \qquad (4.10)$$

against the one-sided alternative $\phi < 1$ (where u_t is a white noise disturbance term that has constant mean and variance). Thus, we have the following hypothesis:

H_0: series contains a unit root ($\phi = 1$)

H_1: series is stationary ($\phi < 1$)

For ease of computation and interpretation the following regression is used in practice

$$\Delta y_t = \psi y_{t-1} + u_t \qquad (4.11)$$

so that a test of $\phi = 1$ becomes a test of $\psi = 0$ (as $\phi - 1 = \psi$). Equation (4.11) is a first-order, or AR(1) regression in that the value of y is regressed at time t on its value at time t-1. If the regression is run and it is found that $\phi=1$, then the stochastic variable has a unit root. In the time series econometrics, a time series that has a unit root is also known as a random walk, examined earlier.

The Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips Perron test can be used to find out the order of integration of the time series. If the series were found to be non-stationary and integrated of order I(1), the series is made stationary by taking the first difference of the series. An I(2) series contains two unit roots and so would require differencing twice to induce stationarity. In general, if a non-stationary series y_t must be differenced d times before it becomes stationary, then the series y_t is said to be integrated of order d. The majority of financial and economic time series, however, is found to contain a single unit root, while some have been argued to contain two unit roots (i.e. nominal consumer prices series) (Brooks 2002, 376).

4.2.2. **Dickey – Fuller and augmented Dickey – Fuller tests**

Dickey – Fuller (DF) tests are also known as τ, τ_μ, τ_τ. The models under the null (H_0) and alternative (H_1) hypotheses in the three cases are:

(i) Without any constant (drift) and trend

H_0: $y_t = y_{t-1} + u_t$, where

H_1: $y_t = \psi y_{t-1} + u_t$

(ii) With constant but no trend

H_0: $y_t = y_{t-1} + u_t$,

H_1: $y_t = \psi y_{t-1} + \mu + u_t$

(iii) With constant and with trend

H_0: $y_t = y_{t-1} + u_t$,

H_1: $y_t = \psi y_{t-1} + \mu + \lambda t + u_t$

Where $\Delta y_t = y_t - y_{t-1}$, $\psi = \phi - 1$ for all three cases, and u_t is white noise. The parameter of interest in all the regressions is $\psi = 0$, meaning that the y_t contains a unit root. Thus, the null hypothesis is a presence of a unit root. The test is basically about estimating one or more of the equations above using OLS in order to obtain the estimated value of ψ and associated standard error. Comparing the resulting test statistic with the appropriate critical value reported in the DF tables enables one to determine whether to accept or reject the null hypothesis.

The methodology for all three models (i, ii, and iii above) is the same. However, Dickey and Fuller (1979) have in their Monte Carlo study found that the critical values for $\psi = 0$ depend on the form of the data-generating process and the sample size. More concretely, the critical values of the t-statistics do depend on whether a constant and/or trend are included in the regression model.

The test statistics for the DF tests are defined as:

$$test\_statistic = \frac{\hat{\psi}}{S\hat{E}(\hat{\psi})}$$

Under non-stationarity, the test statistics computed does not follow a standard t-distribution but a non-standard Dickey-Fuller distribution. As can be seen from the Table 4 below, the failure to apply the DF (τ-distribution) would lead on average to over-rejection of the null hypothesis (Harris 1995, 29) as the DF critical values are much bigger in absolute terms (i.e. more negative). In order words, more evidence against the null hypothesis is needed in the context of unit root tests than under standard t-tests. The statistics labels τ, τ_{μ}, and τ_{τ} are critical values for equations (i, ii, and iii) respectively.

Table 4 Critical values for the DF-test

Sample size	Critical values for τ level of significance			Critical values for τ_{μ} level of significance			Critical values for τ_{τ} level of significance		
	0.01	0.05	0.10	0.01	0.05	0.10	0.01	0.05	0.10
Dickey-Fuller distribution									
25	-2.66	-1.95	-1.60	-3.75	-3.00	-2.63	-4.38	-3.60	-3.24
50	-2.62	-1.95	-1.61	-3.58	-2.93	-2.60	-4.15	-3.50	-3.18
100	-2.60	-1.95	-1.61	-3.51	-2.89	-2.58	-4.04	-3.45	-3.15
t-distribution									
°	-2.33	-1.65	-1.28	-2.33	-1.65	-1.28	-2.33	-1.65	-1.28

Source: Fuller (1976)

The tests above are valid only if u_t is white noise. However, a practical problem with the AR(1)[1] (stationary process) based unit-root test is that the residuals obtained in the regression tend to be autocorrelated. To avoid this problem one can add sufficiently many lagged Δy_{t-i} on the right hand side of the equation in the case (i) until the residuals appear white. Thus the alternative model for the case (i) becomes

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + u_t$$

and one refers to this test as the *augmented Dickey-Fuller (ADF) test.* ADF test is still conducted on ψ and relies on the same critical test statistic values as the DF test. According to Rachev et al. (2007, 250), ADF test is the most widely used unit-root test.

The problem that arises now is in determining the optimal number of lags of the dependent variable. The problem can be solved in two ways. First is through the use of the *frequency of the data* (e.g. if the data is monthly 12 lags are used, if the data is quarterly 4 lags are used, etc.). However, when we have a case with higher frequency data, such as daily data, this technique does not give us any apparent choice. Second is through the use of a technique called *information criteria*. Information criteria is based on two factors: a term which is a function of the residual sum of squares (RSS), and

[1] The model where the current value of a variable y is taken to depend only upon the values that the variable took in previous periods plus an error term is called an autoregressive model. An autoregressive model of order p is denoted as AR(p) and can be expressed as

$$y_t = \mu + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \ldots + \phi_p y_{t-p} + u_t$$

where u_t is a white noise disturbance term.

A moving average model, on the other hand, is simply a linear combination of white noise processes, so that y_t depends on the current and previous values of a white noise disturbance term. A moving average model of order q is denoted as MA (q) and can be expressed as

$$y_t = \mu + u_t + \theta_1 u_{t-1} + \theta_2 u_{t-2} + \ldots + \theta_q u_{t-q}$$

where u_t with t = 1, 2, 3, … is a sequence of independently and identically distributed (iid) random variables with $E(u_t) = 0$, and $var(u_t) = \sigma^2$.

some penalty for the loss of degrees of freedom due to adding extra parameters. Thus, adding an additional lag to a model will have two opposite effects: the residual sum of squares will fall but the value of the penalty term will increase. The objective in this technique is to choose a number of parameters which minimize the value of the information criteria. The three most popular information criteria are:

(i) Akaike Information Criterion (AIC)

$$AIC = \ln(\hat{\sigma}^2) + \frac{2k}{T}$$

(ii) Schwarz's Bayesian Information Criterion (SBIC)

$$SBIC = \ln(\hat{\sigma}^2) + \frac{k}{T}\ln T$$

(iii) Hannah-Quinn Criterion (HQIC)

$$HQIC = \ln(\hat{\sigma}^2) + \frac{2k}{T}\ln(\ln T)$$

where $\hat{\sigma}^2$ is the residual variance (also equal to the residual sum of squares divided by the number of degrees of freedom, T-k), whereas k = p + q + 1 is the total number of parameters estimated by the regression and T is the sample size. Hereby, p refers to the number of lags of the variable y used in the model, and q refers to the number of independently and identically distributed (iid) random variables u_t. (Brooks 2002, 257-58)

It should be noted that the AIC may give more than one minimum and despite the penalty term, the AIC tends to overparameterize. The BIC imposes a more sever penalty for each additional parameter and thus tends to select the lower-order models than the AIC, while the HQIC imposes a penalty that is somewhere in between that of the AIC and BIC.

4.3. Cointegration

Behind the concept of cointegration is the idea that variables hypothesized to be linked by some theoretical economic relationship should not diverge from each other in the long run. Such variables may drift apart in the short run or due to seasonal effects, but for an equilibrium relationship among such variables to exist, the variables must not diverge without bound. Thus, "cointegration" is a statistical expression describing the nature of an equilibrium relationship where the divergence from a stable equilibrium is stochastically bounded and, when it does occur, it is diminishing over time (Banerjee, Dolado, Galbraith and Hendry 1993, 132).

Cointegration allows us to describe the existence of an equilibrium, or stationary, relationship among two or more time-series, each of which is individually non-stationary. In other words, while the component time-series may have moments such as means, variances, and covariances shifting over time, some linear combination of these series, which defines the equilibrium relationship, has linear properties independent of time.

4.3.1. The Engle-Granger (EG) approach

If the two time series y_t and x_t are both I(d) then any linear combination of the two series will also be I(d). If, however, the variables with differing orders are combined, the combination will have an order of integration equal to the largest. By the same token, if we have time series such as $y_t \sim I(d)$ and $x_t \sim I(b)$ and a parameter β so that the disturbance term from the regression ($y_t = \beta x_t + u_t$) is of a lower order of integration, I(d-b), where b > 0, then according to Engle and Granger (1987) the series y_t and x_t are cointegrated of order (d, b). Thus, if the residuals are distributed I(0), we reject the null hypothesis of no cointegration, whereas if we have residuals of I(1) we do not reject the null hypothesis, meaning that the series under examination are not cointegrated. (Harris 1995)

When studying the relationship between variable one cannot independently take the first difference of each of the I(1) variables and then use these first differences in a modeling procedure. The reason is that the pure first difference models have no long-run relationship. However, Granger was able to show that a multivariate integrated process is cointegrated if and only if it can be represented in *the error correction model (ECM)* or an *equilibrium correction model* form with appropriate restrictions:

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 (y_{t-1} - \gamma x_{t-1}) + u_t$$

where $y_{t-1} - \gamma x_{t-1}$ is known as the *error correction term*. If y_t and x_t are cointegrated with cointegrating coefficient γ, then $(y_{t-1} - \gamma x_{t-1})$ will be I(0) even though the constituents are I(1). Thus, γ defines the long-run relationship between x and y, and β_1 describes the short-term relationship between changes in x and changes in y. More generally, β_1 describes the speed of adjustment back to equilibrium.

An error correction form can be estimated for more than two variables. In the case of three cointegrated variables, x_t, w_t and y_t , a possible error correction model would be:

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 \Delta w_t + \beta_3 (y_{t-1} - \gamma_1 x_{t-1} - \gamma_2 w_{t-1}) + u_t$$

4.3.2. Engle-Granger methodology

Previous descriptions of statistical concepts around time series will allow us now to fully understand the process behind the Engle-Granger methodology for testing for cointegration.

Examination of the existence of the equilibrium relationship between, e.g. time series y_t and x_t, which are believed to be integrated of order 1, will according to Engle and Granger be conducted in the following way.

- Step 1.

In this step one needs to make sure that all the individual variables are of I(1). Then cointegrated regression needs to be estimated using OLS. Nothing can be inferred on the coefficient estimates, but the residuals, $\hat{u}_t$ have to saved and tested to ensure that they are I(0). If they are I(0) then one needs to move to the Step 2. If, on the other hand, they are I(1) then a model containing only first differences must be estimated.

- Step 2.

Residuals in the Step 1 need to be used as a variable in the error correction model, e.g.

$$\Delta y_t = \beta_1 \Delta x_t + \beta_2 (\hat{u}_{t-1}) + v_t$$

where $\hat{u}_{t-1} = y_{t-1} - \hat{\tau}x_{t-1}$. The linear combination of non-stationary variables that is stationary is also referred to as the *cointegrating vector*. The cointegrating vector, in our case, is denoted by $[1 - \hat{\tau}]$.

The Engl-Granger approach is easy to use, but it has some drawbacks. Firstly, it is not possible to perform any hypothesis tests about the cointegrating relationship estimated in Stage 1. Secondly, the single equation approach requires that the researchers specifies one variable as dependent variable and the other as independent variable even if the causality between the x and y variables runs in both directions. Thirdly, the Engle-Granger 2-step method can estimate only up to one cointegrating relationship between the variables. In the case of stock markets of former Yugoslav countries under examination in this study there could potentially be up to six linearly independent cointegrating relationships. Thus, it is more appropriate to examine the issue of cointegration within the Johansen VAR (Vector Autoregressive) framework.

4.3.3. Johansen cointegration

The Johansen procedure is based on the maximum likelihood estimation in a VAR model. If we have a set of *g* variables (*g* ≥ 2) which are integrated of first order I(1) and thought to be cointegrated, a VAR model with *k* lags containing these variables could be set up:

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_k y_{t-k} + u_t$$

For Johansen test to be used, the above VAR needs to be transformed into a vector error correction model (VECM) of the following form:

$$\Delta y_t = \prod y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \ldots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t$$

where $\prod = (\sum_{i=1}^{k} \beta_i) - I_g$ and $\Gamma_i = (\sum_{j=1}^{i} \beta_j) - I_g$

This VAR model contains *g* variables in first differenced form on the LHS, and *k* – 1 lags of the dependent variables (differences) on the RHS, with a Γ coefficient matrix.

As Johansen test can be affected by the lag length used in the VECM, it is important to select an optimal lag length.

Johansen test centres around an examination of the Π matrix. In equilibrium, all the Δy_{t-i} will be zero and assuming error terms, u_t, to be at its expected value of zero, we will have $\Gamma y_{t-k} = 0$. From this follows interpretation of Π as a long-run coefficient matrix. The test of cointegration between the *y*s is calculated by looking at the rank of the Π matrix through its eigenvalues (characteristic roots). The number of eigenvalues that are different from zero determines the rank of a matrix. (Brooks 2002, 403-4)

In simplified terms, Johansen test is a multivariate approach which allows for estimation of several cointegrating relationships at once and this characteristic has made it a rather popular method for testing of long run cointegrating relationship in literature. Since likelihood estimators can work with more than two variables which are integrated of the same order, Johansen methodology can capture all of the cointegrating relationships among the selected set of variables and idenfity a number of cointegrating vectors via its test statistics.

There are two test statistics for cointegration under Johansen methodology: trace statistic (λ_{trace}) and the Max-Eigenvalue statistic (λ_{max}). The test statistics are formulated in the following way:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1+\hat{\lambda}_i) \text{ , and}$$

$$\lambda_{\max}(r, r+1) = -T \ln(1-\hat{\lambda}_{r+1})$$

Where *r* is the number of cointegrating vectors under the null hypothesis (*r*=0, 1, k-1), *k* represents number of variables in the system, T is number of observations, and $\hat{\lambda}_i$ is the estimated value for the i^{th} ordered eigenvalue (characteristic root) obtained from the estimated Π matrix.

λ_{trace} is a joint test where the null hypothesis is that the number of cointegrating vectors is less than or equal to *r* against the alternative hypothesis that there are more than *r*.

λ_{max} conducts separate tests on every eigenvalue and the null hypothesis is that the number of cointegrating vectors is less is *r* against the alternative hypothesis that there are *r* + 1.

Johansen and Juselius provide critical values for the two test statistics (Johansen and Juselius 1990). If the test statistic is greater than the critical value from Johansen's tables, the null hypothesis that there are *r* cointegrating vectors is rejected against the alternative hypothesis that there are more than *r* (for λ_{trace}) or that there are *r* + 1 (for λ_{max}).

4.3.4. Granger causality

The Granger causality test is a better approach to a correlation analysis as it is more efficient. Unlike Johansen cointegration analysis which is able to estimate whether the long-run equilibrium exists between two variables, the Granger causality test helps determine the direction of causation. The test however does not imply causation between correlated variables in any significant way as the name would imply. The Granger test seeks to find out whether the current value of variable y-y_t can be explained by past values of the same variable, y_{t-k}, and whether adding lagged values of another variable x-x_{t-k} can give more insight on y_t. In that way, the variable y is said to be "Granger caused" by x if x helps predict y, which is determined by an F-test (Gilmore and McManus 2002, 77-78 on Granger 1969).

It should be noted though that the term "Granger causality" is somewhat of a misnomer since finding "causality" does not mean that movements in one variable causes movement in the other, but rather causality implies a chronological ordering of movements of the series (Brooks 2002, 355).

5. STOCK MARKETS INTEGRATION OF THE FORMER YUGOSLAV COUNTRIES

This chapter contains the empirical results of the study. First, data used in the analysis is described and data source given. Second, data is analyzed according to the statistical methods deployed in the study and results are given.

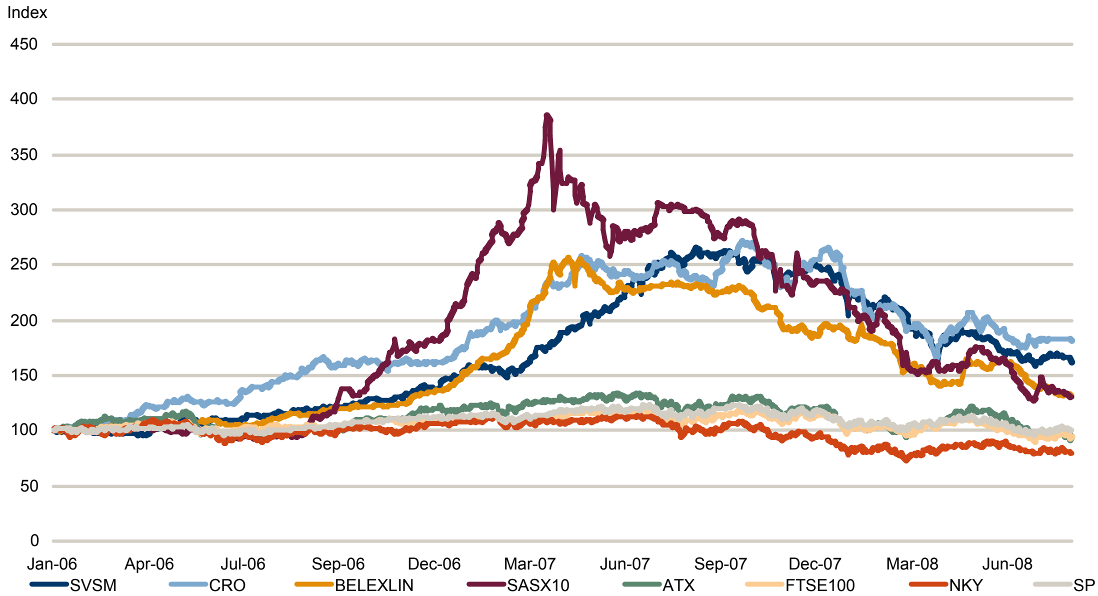
5.1. Description of data

The study covers the time period 03 January 2006 – 20 August 2008 (687 observations). The database consists of daily closing prices for eight financial series: SASX-10 (Sarajevo Stock Exchange), SBI20 (Ljubljana Stock Exchange), CROBEX (Zagreb Stock Exchange), BELEXline (Belgrade Stock Exchange), ATX (Vienna Stock Exchange), S&P 500 (New York Stock Exchange), FTSE 100 (London Stock Exchange), and Nikkei 225 (Tokyo Stock Exchange). Data was retrieved from Bloomberg, data provider. Local currencies were used in order to avoid the impact of foreign exchange on the level of security prices. This is in accordance with the approach used by Jochum et al (1999) and Voronkova (2004), in their study on the long-run relationship between Eastern European stock markets. In the event of stock exchanges being closed on certain dates due to holidays, the price for indices from the last trading day was used.

According to the literature (Perron 1989 in Jochum et al 1999) the power of cointegration tests depends more on the length of the data series and less on the frequency used in the analysis. However, the choice of using high frequency market data is due to two reasons. Firstly, the stock markets of former Yugoslavia are relatively young and therefore using low frequency figures such as weekly or monthly data would result in a limited number of observations. Scheicher (2001) in his study of regional and global cointegration of stock markets of Hungary, Poland and the Czech Republic uses daily data (723 observations) in order to achieve larger number of observations. Secondly, Eun and Shim (1989, 242) state that daily return data is better suited to capture potential interactions as weekly or higher frequency data may miss on interactions that last for only few days.

The Figure 3 below presents the development of stock markets in their respective local currencies and standardized to January 01, 2006 = 100.

Figure 3 Stock market development



The research objective was directed towards the identification of significant interactions between the stock exchange indices among the selected former Yugoslav countries and between the developed international markets, either on a bilateral or multilateral basis. Two types of analysis used are: a Granger causality test and a cointegration test.

The focus in this chapter is on the cointegration analysis among the stock markets of former Yugoslav countries. The markets analyzed in this chapter are:

- Belgrade Stock Exchange (BELEXline index) in Serbia
- Croatian Stock Exchange (CROBEX index) in Croatia
- Sarajevo Stock Exchnage (SASX-10 index) in Bosnia and Herzegovina
- Slovenian Stock Exchange (SBI20 index) in Slovenia

Shorter names will be used for the above indices (BELEXLIN, CRO, SASX and SVSM). Returns on the index levels are denoted by capital "R" in front of the index name (e.g. RCRO), and capital "L" is used to refer to log values of index levels (e.g. LCRO).

Statistical analysis undertaken in this chapter were the analysis of:

- Correlation: correlation relationship is calculated for each of the 6 bilateral pairs of the former Yugoslav countries
- Cointegration analysis: Engle-Granger and Johansen cointegration tests were performed for each of the 6 bilateral pairs among the four analysed markets of the former Yugoslav countries
- Granger causality test: Granger causality test is performed for each of the 6 bilateral pairs among the stock markets of the former Yugoslav countries.

5.2. Analysis

5.2.1. Descriptive statistics and correlation analysis

Descriptive statistics for the daily index returns are given in the Table 5 below. The means lie between 0.04% (Belgrade Stock Exchange) and 0.09% (Zagreb Stock Exchange). Of the four markets, Sarajevo Stock Exchange exhibits the highest volatility as seen in its standard deviation of 1.70%; Belgrade Stock Exchange has the lowest standard deviation of 0.9%. Indices of BELEXline and SASX-10 are positively skewed to the right, while the indices CROBEX and SVSM are negatively skewed to the left. All indices exhibit a relatively high kurtosis. The distributions for all indices are able to reject the null hypothesis of normality according to the Jarque Bera χ^2 - statistic with two degrees of freedom. In addition, the p-value at the bottom of the normality test screen (Table 5 below and Appendix 1) should be bigger than 0.05 to not reject the null of normality at the 5% level. Appendix 2 shows the graphs for index returns.

Table 5 Descriptive statistics for logarithmic equity index returns. Daily data for the period 03.01.2006 – 20.08.2008

	RBEL	RCRO	RSASX	RSVSM
Mean	0.000399	0.000867	0.000383	0.000705
Median	1.14E-05	0.00059	0	0.000142
Maximum	0.098708	0.048397	0.081976	0.064466
Minimum	-0.053791	-0.058585	-0.088401	-0.063509
Std. Dev.	0.009478	0.011413	0.016661	0.010732
Skewness	1.772781	-0.417158	0.026064	-0.24605
Kurtosis	25.44532	6.070389	7.80676	9.385656
Jarque-Bera	14759.39**	289.3596**	660.494**	1172.453**
Probability	0	0	0	0
Sum	0.273529	0.595094	0.262728	0.483609
Sum Sq. Dev	0.061539	0.089232	0.190154	0.078893
Observations	686	686	686	686

The normality follows the χ^2 - distribution and the test uses the significance levels 5% with a critical value of 5.991 (*), and 1% with a critical value of 9,210 (**).

Correlation is a measure how two random variables move in relation to each other. The table below presents correlation coefficients for both the index returns and index levels for the 6 bilateral pairs of the selected markets of the former Yugoslav countries.

Table 6 Correlation matrix between return and the index levels

		BELEXLIN	CRO	SASX10	SVSM
		Levels			
BELEXLIN	Returns	-	0.936349	0.944656	0.879819
CRO		0.149951	-	0.866217	0.945718
SASX10		0.101684	0.086492	-	0.772227
SVSM		0.090039	0.222071	0.091606	-

The correlation matrix shows positive relationship between indices indicating that indices tend to move in the same direction as the markets move. However, the correlation matrix shows that returns of former Yugoslav countries are weakly correlated to each other. The highest correlation of 0.22 exists between the SVSM (Slovenian stock market) and CROBEX (Croatian stock market); the smallest correlation of only 0.08 is between the SASX10 and CRO index (Bosnian and Croatian stock markets). However, this correlation is relatively small[2].

5.2.2. Cointegration Analysis

This section looks at the long-run relationship and causality between the stock markets of the former Yugoslav countries. The existence of cointegration between the stock market indices of the markets in the study is tested using two methodologies: Engle-Granger methodology and the one developed by Johansen.

5.2.3. Unit Root Test

In order to perform a cointegration test, the nonstationarity of the data series has to be established. Here, each market is tested for unit roots using the Augmented Dickey-Fuller test (ADF). Assuming the series have non-zero mean, a constant is included in the regression. The null hypothesis H_0: $\psi = 0$ is that the variable under study contains a unit root, against the alternative that it does not.

Therefore, the failure to reject the null hypothesis means that the variable is nonstationary, I(1), while the rejection of the null hypothesis means that there are no unit root problems, the variable is stationary, I(0). The test is about estimating the above equations using Ordinary Least Square (OLS) in order to obtain the estimated value of ψ and the associated standard error, and then comparing the resulting t-statistic with the critical values reported in the Dickey-Fuller table to determine whether to accept or reject the null hypothesis.

In this study the ADF of the unit root test was done for each data series for each stock markets included in the study. Table 7 below summarizes the results of the ADF test.

[2] Cohen (1988) has suggested $0.1<\rho<0.29$ to be a small correlation, $0.30<\rho<0.49$ to be a medium correlation and $0.5<\rho<1$ to be a large correlation. The same benchmark is taken for negative values of ρ (Pallant 2005, 126)

The critical values of the tests are MacKinnon (1996) one-sided p-values. Lag lengths were chosen according to Akaike Information Criterion.

Table 7 ADF Unit Root tests for indices of four former Yugoslav countries

Market index	ADF t-value	Critical value of t (1%)	Critical value of t (5%)	Lag length	Result
LBEL	-1.490076	-3.439852	-2.865624	14	Non-stationary
LCRO	-2.385809	-3.439696	-2.865555	3	Non-stationary
LSASX	-1.07877	-3.439682	-2.865549	2	Non-stationary
LSVSM	-1.693205	-3.439724	-2.865567	5	Non-stationary

As can be seen from the table, all unit root tests for the stock markets under the study have shown test statistics to be less negative than the critical values and hence the null hypothesis of a unit root in the returns cannot be rejected at any level of significance. In other words, all variables are non-stationary.

Table 8 ADF Unit Root tests for first difference for indices of four former Yugoslav countries

Market index	ADF t-value	Critical value of t (1%)	Critical value of t (5%)	Lag length	Result
LBEL	-4.401936	-3.439852	-2.865624	13	I(1)**
LCRO	-12.97692	-3.439696	-2.865555	2	I(1)**
LSASX	-16.89054	-3.439682	-2.865549	1	I(1)**
LSVSM	-12.08297	-3.439724	-2.865567	4	I(1)**

However, for the first difference series the null hypothesis of a unit root is rejected for all market indices at both the 1 percent and 5 percent levels of significance, Table 8. Rejection of the null hypothesis indicates that the data series are stationary in the first difference and all market indices are individually integrated of order one, I(1). The next step in cointegration analysis is to check for unit-roots in the residuals obtained from 6 pair-wise regressions between markets of the countries under analysis.

5.2.4. Engle-Granger cointegration

Since we had series in our analysis of the same order of integration, the next step is to estimate the long run equilibrium relationship among different markets. Cointegration is evaluated using the Engle-Granger cointegration technique according to which the residuals of a regression of one market index levels on the other are examined. The ADF test is performed on residuals in order to ensure that they are I(0).

If a cointegration relationship exists between the variables this implies that long-run relationship exists between the variables. Again, for lag length (p) selection the Akaike (1974) Information Criteria (AIC) and the model with a linear trend and intercept in the cointegrating equations (CE) is used. This alternative is more suitable for the data as we have trending series with stochastic trends (Alsuhaibani 2004, 99).

Table 9 Performing the ADF test on the residual series of the pair-wise regression analysis (Engle-Granger cointegration technique)

Pair cointegration	ADF t-value	Critical value of t (1%)	Critical value of t (5%)	Lag length	Result
LBEL and LCRO	-2.179515	-3.971507	-3.416391	1	Non-stationary
LBEL and LSASX	-2.013451	-3.971546	-3.41641	3	Non-stationary
LBEL and LSVSM	-1.663798	-3.971546	-3.41641	3	Non-stationary
LCRO and LSASX	-2.191345	-3.971526	-3.416401	2	Non-stationary
LCRO and LSVSM	-2.827459	-3.971526	-3.416401	2	Non-stationary
LSASX and LSVSM	-1.286966	-3.971526	-3.416401	2	Non-stationary

Table 9 shows results of ADF tests on the residuals of the pair-wise evaluations for all combinations of the selected former Yugoslav countries. Residuals are not stationary and thus all the 6 pairs of the series are not cointegrated. The test for cointegration between the Croatian (LCRO) and the Slovenian stock market (LSVSM) is marginal as the residual plot LCROLSVSM in Appendix 3. suggests. However, as the residuals of the regressions are non-stationary an error correction model (second step in Engle-Granger methodology) cannot be estimated since there are no linear combinations of market indices that would be stationary.

Since Engle-Granger cointegration methodology had produced somewhat, for this author, unexpected results we have to see whether these results are confirmed by Johansen methodology.

5.2.5. Johansen cointegration

The Johansen test methodology is used to estimate both the bilateral and multilateral long run equilibrium relationship among the market indices. Since the unit root tests have determined the data series to be cointegrated of the same order I(1), Johansen cointegration test can be applied. As the series in the study appear to have stochastic trends, a model that allows for a deterministic trend in data – with intercept and trend in the cointegrating equation (CE) – was used. The Akaike information criterion (AIC) was used to determine appropriate lag interval. Determination of cointegration rank (r) is concluded by using two test statistics, and the Max-Eigenvalue test statistics (λ_{max}) (the trace statistic (λ_{trace}) is reported in the Appendix 6).

Bilateral analysis

Johansen methodology was applied to all 6 bilateral pairs among the four analysed markets of the former Yugoslav countries. Max-Eigen test statistics for the existence of a cointegrating rank of 0 or 1 were compared against the corresponding critical values at 5 percent and 1 percent. If the calculated test statistics exceed the critical values at 5 percent and 1 percent, the null hypothesis of no cointegrating vectors (r = 0) is rejected and the variables are determined to be cointegrated. Table 10 summarizes the results of the Johansen cointegration test.

Table 10 Johansen cointegration test results.

Series	Hypothesised Number of Cointegrated Equations	Max-Eigen Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LBEL and LCRO	r = 0	9.918139	14.07	19	0
	r = 1	0.887205	3.76	7	
LBEL and LSASX	r = 0	29.78399	14.07	19	1**
	r = 1	2.378851	3.76	7	
LBEL and LSVSM	r = 0	20.08701	14.07	19	1**
	r = 1	2.367332	3.76	7	
LCRO and LSASX	r = 0	12.59931	14.07	19	0
	r = 1	0.494206	3.76	7	
LCRO and LSVSM	r = 0	13.09726	14.07	19	0
	r = 1	5.595803	3.76	7	
LSASX and LSVSM	r = 0	24.13984	14.07	19	1**
	r = 1	2.495693	3.76	7	

In the case of relationship between the Belgrade Stock Exchange and Zagreb Stock Exchange, Johansen cointegration test statistic (9.92) is less than the 5 percent critical value (14.07) and 1 percent critical value (19). Thus, the null hypothesis of $r = 0$ cannot be rejected and therefore no long run relationship exists between the Serbian and Croatian stock markets.

Similar conclusion as the above can be made for the relationship between the Zagreb Stock Exchange and Sarajevo Stock Exchange: Johansen cointegration test statistics point towards lack of cointegration between the Bosnian and Croatian markets.

Table 10 above shows that one cointegration equation exists between the Belgrade Stock Exchange and Sarajevo Stock Exchange, and Belgrade Stock Exchange and Ljubljana Stock Exchange at both 5 and 1 percent of levels of significance.

Furthermore, cointegration exists between the Sarajevo Stock Exchange and Ljubljana Stock Exchange. For r = 0, Max-Eigen statistic (24.14) is higher than critical value at the both 5 percent (14.07) and 1 percent (19) levels of significance. This result can be explained by relatively strong FDI flows from Slovenia into Bosnian markets.

Finally, the Max-Eigen statistics indicate no cointegrating vector between the Croatian and Bosnian stock markets, and Croatia and Slovenia. The lack of integration between the Croatian and stock markets of other former Yugoslav countries can perhaps be explained by a scale of Croatian stock market development that outpaces those of the other countries in the region (Croatian stock market accounts for 39% of the total regional trade and more than 52% of the regional market capitalization). With its economy in transition and a view set at finding ways to comply with the EU accession policies, it seems that the Croatian market is more driven by domestic factors.

In sum, the Johansen bilateral cointegration analysis indicates three long-run relationships between the selected former Yugoslav countries. Findings show that the following financial markets are integrated:

- Belgrade Stock Exchange and Sarajevo Stock Exchange,

- Belgrade Stock Exchange and Ljubljana Stock Exchange,
- Ljubljana Stock Exchange and Sarajevo Stock Exchange.

Multilateral Analysis

The Johansen test statistics show rejection for the null hypothesis that there are no cointegrating vectors between variables tested.

Table 11 Multilateral cointegration among stock markets of former Yugoslav countries

Series	Hypothesised Number of Cointegrated Equations	Max-Eigen Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LBEL-LCRO-LSASX-LSVSM	r = 0	36.08395	27.07	32	1**
	r ≤ 1	14.69229	20.97	26	
	r ≤ 2	10.14231	14.07	19	
	r ≤ 3	2.979565	3.76	7	

The Table 11 shows the Max-Eigen statistics, trace statistics are reported in Appendix 6. Max-Eigen statistic of 36.08 for no cointegrating vector is larger than the 5 percent critical value of 27.07 and the 1 percent critical value of 32 leading us to conclude that null hypothesis of no cointegrating vector is rejected at the 1 percent level of significance.

Testing the null hypothesis of at most one cointegrating vectors the test statistic is lower than both the 5 percent and 1 percent critical values, thus suggesting that null hypothesis should not be rejected.

Since only one cointegrating vector was found among the selected markets of former Yugoslav countries, it can be concluded that the level of integration between these markets is low. The Johansen multilateral cointegration analysis among the four Yugoslav countries supports the results obtained through the bilateral cointegration analysis as only three long-run relationships were found. This is consistent with previous studies on emerging markets that conclude that development of markets in transition economies is driven by domestic factors.

5.2.6. Granger causality test

In order to examine the issue of causation, the standard Granger causality tests were used. Firstly, the time series properties of the historical data of the stock exchanges were tested. According to Enders (2004) causality tests cannot be performed using F-tests if the variables under study are cointegrated. However, one can apply F-tests if the variables are individually integrated of order one, I(1), and are not cointegrated (Alkhuzaim, 2005, 112).

The Granger causality test was applied to log values of the index series whereas pairwise causation is examined. Table 12 below shows the results of the analysis with reported F-statistic and probability for each pair of variables. As the test is highly sensitive to the lag order, the Akaike Information Criterion was used to determine the optimal lag length. The hypothesis of non causality can be rejected if the probability of non causation is below 10 percent, meaning that the causality relationship exists.

Table 12 Granger – causality test of the relationship between the stock markets of former Yugoslav countries.

Null Hypothesis:	Obs	AIC	F-Statistic	Prob.
LCRO does not Granger Cause LBEL	685	1	0.4247	0.5148
LBEL does not Granger Cause LCRO			5.4679*	0.0197
LSASX does not Granger Cause LBEL	684	3	12.9640*	0.0048
LBEL does not Granger Cause LSASX			4.3491*	0.0000
LSVSM does not Granger Cause LBEL	684	3	1.9089	0.1268
LBEL does not Granger Cause LSVSM			7.1853*	0.0001
LSASX does not Granger Cause LCRO	685	2	7.8503*	0.0004
LCRO does not Granger Cause LSASX			2.1350	0.1190
LSVSM does not Granger Cause LCRO	685	2	0.1944	0.8233
LCRO does not Granger Cause LSVSM			17.3714*	0.0000
LSVSM does not Granger Cause LSASX	685	2	3.8835*	0.0210
LSASX does not Granger Cause LSVSM			7.3636*	0.0007

* significance at 5% level

The results of the Granger causality test suggest that Granger causality runs from Serbia to Croatia. As shown in the Table 12 above, probability for accepting the null hypothesis is 2% while there is probability of 98% to reject the hypothesis with F-statistic of 5.47 which is significant at 5% critical value. This relationship was not documented in the Johansen cointegration analysis.

Furthermore, the one-directional causality with 100 percent of probability exists between the following pairs of markets:

- from Serbian to Slovenian market,
- from Bosnian to Croatian market, and
- from Croatian to Slovenian.

Given that the Johansen bilateral cointegration analysis suggests that the Belgrade Stock Exchange is cointegerated with the Ljubljana Stock Exchange, the Granger causality supports this result by finding at least one-directional causal relationship between these markets. Perhaps this can be explained by development and competitiveness of the Serbian banking sector which is completely privatized and owned by Western European banks. Slovenian banks are predominantly domestically owned, have high state ownership and are known to be less efficient and non competitive. Knowing that banking sector plays a major part in financial markets and are significant players in emerging countries , perhaps this one-directional causality that flows from Serbian to Slovenian market is an indirect way in which the causality is passed from the developed world onto the Slovenian stock market.

The results indicate that bilateral causal relationship exists between the Bosnian and Serbian market. There is an almost 100 percent probability that the Granger causality runs either from Bosnia to Serbia or Serbia to Bosnia. Bidirectional Granger causality is registered also between the Slovenian and Bosnian markets. These results support the Johansen bilateral cointegration analysis that found cointegrating vector to exist between Bosnian and Serbian, and Bosnian and Slovenian markets. Perhaps these bidirectional casualties can be explained by investments that flow between these markets.

6. STOCK MARKETS INTEGRATION OF THE FORMER YUGOSLAV COUNTRIES AND MAJOR INTERNATIONAL MARKETS

This chapter will focus on studying integration between the stock markets of the selected four former Yugoslav countries and major international markets. In particular the following indices from the developed markets have been chosen:

- ATX index (to represent Austrian stock market)
- FTSE 100 (the UK)
- Nikkei 225 (Japan)
- S&P 500 (the US)

Statistical analysis done in this chapter are the following:

- Correlation: correlation relationship between the index returns of former Yugoslav countries to those of developed markets are examined
- Cointegration: Johansen cointegration tests were performed on a bilateral basis between each of the four former Yugoslav countries and developed international markets
- Granger causality test: Granger causality is investigated on each of the 16 bilateral relationships

6.1. Correlation analysis

Correlation between two variables indicates the level to which those variables move together. Lack of correlation between the markets of developed countries to those of emerging markets indicate diversification potential from a portfolio perspective.

The correlation between the returns of the stock markets of Belgrade, Zagreb, Sarajevo and Ljubljana stock exchanges and the developed markets are found in Table 13.

Table 13 Correlation matrix between returns of market indices of former Yugoslav countries and developed markets

	RATX	RFTSE	RNKY	RSP
RBEL	0.01025	0.02051	0.07950	0.02141
RCRO	0.30666	0.31440	0.27660	0.08912
RSASX	0.01066	-0.01088	0.03031	-0.04207
RSVSM	0.13655	0.07091	0.26512	0.03905

Table 13 shows very low correlations between the returns on the Belgrade Stock Exchange and returns of the stock markets of developed countries. Thus, it seems that Serbian markets is independent of the movements in the markets of advanced economies.

The highest correlations are between the returns on the Croatian stock exchange and the exchanges of the UK (0.31), Austria (0.31) and Japan (0.27). Croatia does not seem to be significantly correlated with the US stock market thus offering diversification benefits to the US investor.

Returns on the Sarajevo Stock Exchange do not exhibit any correlation with the return on advanced stock markets. Moreover, there is a negative correlation with the returns on the UK's FTSE index (-0.01) and the US' S&P 500 index (-0.04). As the level of integration of emerging markets into those of industrialized economies is ever increasing, finding a market with negatively correlated assets is in particular appealing to a portfolio manager who can stabilize its portfolio returns through international diversification of its investments.

Returns on Slovenian stock market show some correlation with the returns on the Austrian market (0.27). Given the proximity of these two markets and the consistent interest of the Austrian investors in the Slovenian market this is a no surprising outcome.

6.2. Unit root test

The first step in the Johansen cointegration analysis is to test each index series for the presence of unit roots, which shows whether the series are nonstationary. In this study the ADF of the unit root test was done for each data series and the results are summarized in the Table 14 below. Lag lengths were chosen according to Akaike Information Criterion.

Table 14 ADF Unit Root tests for indices of four developed markets

Market index	ADF t-value	Critical value of t (1%)	Critical value of t (5%)	Lag length	Result
LATX	-1.618201	-3.439682	-2.865549	2	Non-stationary
LFTSE	-1.079457	-3.439668	-2.865542	1	Non-stationary
LNKY	-1.752306	-3.439668	-2.865542	1	Non-stationary
LSP	-1.709555	-3.439668	-2.865542	1	Non-stationary

Stationarity is a precondition for cointegration. Additionally, all series must be integrated of the same order since cointegration only exists among the series of the same order of integration. Null hypothesis is rejected if the test statistics are greater in absolute value than the critical values. As the ADF test values are smaller than critical values we can conclude that null hypothesis cannot be rejected and all series are non-stationary in level.

The ADF unit root test for first difference series of the developed markets produce t-statistics that are greater than critical values at both the 5 percent and 1 percent level of significance. The null hypothesis of a unit root is rejected and all series are stationary, Table 15.

Table 15 ADF Unit Root tests for first difference for four developed markets

Market index	ADF t-value	Critical value of t (1%)	Critical value of t (5%)	Lag length	Result
LATX	-17.6584	-3.439682	-2.865549	1	I(1)**
LFTSE	-30.71858	-3.439668	-2.865542	0	I(1)**
LNKY	-27.50564	-3.439668	-2.865542	0	I(1)**
LSP	-29.9375	-3.439668	-2.865542	0	I(1)**

As the series are integrated of the same order one, I(1), there is a possibility that cointegrating relationship exists between the four former Yugoslav countries and the developed markets. This is examined in the next section.

6.3. Cointegration analysis

The Johansen test methodology was applied to test for the bilateral long-run equilibrium relationship between market indices of the former Yugoslav countries and the indices of developed markets. Similar Johansen model as in the Section 5.2.5 was used – with intercept and trend in the cointegrating equation. An appropriate lag interval was determined by the Akaike Information Criterion. Although both the Max-Eigenvalue test statistics and the trace statistics can be used to determine cointegration rank, only trace statistics have been shown in this study. Null hypothesis that no cointegration exists ($r=0$) is tested against the alternative hypothesis that cointegration exists ($r\leq1$). If the test statistics exceed the corresponding critical values at 5 percent and 1 percent, the null hypothesis of no cointegrating relationship is rejected and the variables are determined to be cointegrated.

The trace statistics for each former Yugoslav market and their developed counterparts are presented in the Tables 16-19 below. In the case of Belgrade Stock Exchange the table shows trace statistics are higher than critical values at 5 percent level for each pair wise analysis, therefore implying the existence of one cointegrating relationship. The hypothesis of no cointegration is rejected even at the 1 percent level in the case of BELEXline and the ATX as the trace statistics are higher (20.73) than the critical values (20). This can perhaps be explained by heavy presence of Austrian banks in the Serbian market.

Table 16 Bilateral cointegration analysis for BELEXlin and the developed stock markets

Series	Hypothesised Number of Cointegrated Equations	Trace Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LBEL and LATX	r = 0	20.73363	15.41	20	1**
	r ≤ 1	1.474379	3.76	7	
LBEL and LFTSE	r = 0	17.69942	15.41	20	1*
	r ≤ 1	1.379582	3.76	7	
LBEL and LNKY	r = 0	17.76153	15.41	20	1*
	r ≤ 1	1.521569	3.76	7	
LBEL and LSP	r = 0	17.59832	15.41	20	1*
	r ≤ 1	1.404827	3.76	7	

In the case of the Croatian stock market, the null hypothesis of no cointegration cannot be rejected in the bilateral analysis of the CROBEX and the ATX as the trace statistics (14.62) are lower than the critical values at 5 percent (15.41) and the 1 percent (20) levels. This is in line with our previous results that showed no bilateral cointegration between Croatia and its neighboring countries as Croatian market seems to act in isolation from its nearby peers. However, at least one cointegrating relationship exists between the CROBEX and the FTSE, NKY and SP on the bilateral basis.

Table 17 Bilateral cointegration analysis for CROBEX and the developed stock markets

Series	Hypothesised Number of Cointegrated Equations	Trace Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LCRO and LATX	r = 0	14.61751	15.41	20	0
	r ≤ 1	2.571389	3.76	7	
LCRO and LFTSE	r = 0	18.55307	15.41	20	1*
	r ≤ 1	2.778167	3.76	7	
LCRO and LNKY	r = 0	17.49738	15.41	20	1*
	r ≤ 1	2.764097	3.76	7	
LCRO and LSP	r = 0	18.63549	15.41	20	1*
	r ≤ 1	2.221499	3.76	7	

The findings of the Johansen test in the Table 18 below show that null hypothesis of no cointegrating relationship can be rejected only in the case of the SASX-10 and the SP at the 5 percent level. Cointegration does not exist between the Sarajevo Stock Exchange and other major international markets included in the study. Bosnian market seems to be primarily driven by domestic factors.

Table 18 Bilateral cointegration analysis for SASX-10 and developed stock markets

Series	Hypothesised Number of Cointegrated Equations	Trace Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LSASX and LATX	r = 0	11.08141	15.41	20	0
	r ≤ 1	1.068646	3.76	7	
LSASX and LFTSE	r = 0	13.4152	15.41	20	0
	r ≤ 1	1.018913	3.76	7	
LSASX and LNKY	r = 0	13.73418	15.41	20	0
	r ≤ 1	0.98884	3.76	7	
LSASX and LSP	r = 0	16.09344	15.41	20	1*
	r ≤ 1	1.077336	3.76	7	

Finally, the Table 19 below presents the findings on the bilateral cointegration analysis for the Ljubljana Stock Exchange and the selected international stock markets. As the null hypothesis of no cointegration cannot be rejected at the 1 percent level, the results imply the existence of at least one cointegrating vector between the SVSM and each one of the selected developed markets. These results are not surprising as Slovenia had to adjust its fiscal and monetary policies as well as adjust its political and legal framework in order to become an EU member. This closer cooperation with the developed markets had resulted in the closer integration of its stock market to those of the more advanced counterparts.

Table 19 Bilateral cointegration analysis for SVSM and developed stock markets

Series	Hypothesised Number of Cointegrated Equations	Trace Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LSVSM and LATX	r = 0	20.24568	15.41	20	1**
	r ≤ 1	2.212149	3.76	7	
LSVSM and LFTSE	r = 0	20.63052	15.41	20	1**
	r ≤ 1	2.23195	3.76	7	
LSVSM and LNKY	r = 0	27.33441	15.41	20	1**
	r ≤ 1	2.655669	3.76	7	
LSVSM and LSP	r = 0	22.11917	15.41	20	1**
	r ≤ 1	2.083081	3.76	7	

6.4. Ganger causality

Johansen cointegration analysis is able to determine whether the long-run relationship exists between two variables, whereas the Granger causality test helps determine the direction of causation. Although causation can run in both ways, the comments below will focus only on the findings of causality running from developed markets to markets of former Yugoslav countries.

The results of the Granger causality test suggest that Granger causality indeed does run from each selected international market to each selected former Yugoslav country, Table 20-23. This however, does not mean that the former Yugoslav markets shift as a direct result of, or because of, movements in the developed markets. Rather, it means that the movements in the former Yugoslav markets appear to lag those of the more advanced counterparts.

Table 20 Findings of Granger causality test for BELEXline and developed markets

Null Hypothesis:	Obs	F-Statistic	Prob.
LATX does not Granger Cause LBEL	685	10.724000	0.000030
LBEL does not Granger Cause LATX		0.806920	0.446700
LFTSE does not Granger Cause LBEL	685	8.444200	0.000200
LBEL does not Granger Cause LFTSE		0.677390	0.508300
LNKY does not Granger Cause LBEL	685	7.798390	0.000400
LBEL does not Granger Cause LNKY		1.513050	0.221000
LSP does not Granger Cause LBEL	685	8.608570	0.000200
LBEL does not Granger Cause LSP		1.993900	0.137000

Table 21 Findings of Granger causality test for CROBEX and developed markets

Null Hypothesis:	Obs	F-Statistic	Prob.
LATX does not Granger Cause LCRO	685	4.108800	0.016800
LCRO does not Granger Cause LATX		0.139580	0.869700
LFTSE does not Granger Cause LCRO	685	5.356750	0.004900
LCRO does not Granger Cause LFTSE		0.389610	0.677500
LNKY does not Granger Cause LCRO	685	4.256490	0.014600
LCRO does not Granger Cause LNKY		4.982730	0.007100
LSP does not Granger Cause LCRO	685	23.753300	0.000000
LCRO does not Granger Cause LSP		0.219110	0.803300

Table 22 Findings of Granger causality test for SASX-10 and developed markets

Null Hypothesis:	Obs	F-Statistic	Prob.
LATX does not Granger Cause LSASX	685	5.712940	0.003500
LSASX does not Granger Cause LATX		1.357690	0.258000
LFTSE does not Granger Cause LSASX	685	5.484350	0.004300
LSASX does not Granger Cause LFTSE		1.062670	0.346100
LNKY does not Granger Cause LSASX	685	4.557390	0.010800
LSASX does not Granger Cause LNKY		0.124530	0.882900
LSP does not Granger Cause LSASX	685	6.219290	0.002100
LSASX does not Granger Cause LSP		4.161220	0.016000

Table 23 Findings of Granger causality test for SVSM and developed markets

LATX does not Granger Cause LSVSM	685	14.865700	0.000001
LSVSM does not Granger Cause LATX		1.557980	0.211300
LFTSE does not Granger Cause LSVSM	685	20.707500	0.000000
LSVSM does not Granger Cause LFTSE		1.623930	0.197900
LNKY does not Granger Cause LSVSM	685	5.294290	0.005200
LSVSM does not Granger Cause LNKY		1.980270	0.138800
LSP does not Granger Cause LSVSM	685	29.377800	0.000000
LSVSM does not Granger Cause LSP		0.197890	0.820500

While some of the implications of the Granger causality were documented in the Johansen cointegration analysis (in particular in the case of the Slovenian market), the findings reported below do not support the cointegration analysis for the Bosnian stock market which showed the existence of only one cointegrating vector between the Sarajevo Stock Exchange and the US.

7. SUMMARY AND CONCLUSIONS

7.1. Summary

The purpose of this study was to establish the level of integration between the stock markets of the selected former Yugoslav countries (Bosnia, Croatia, Serbia and Slovenia) and major international markets (Austria, the US, the UK, and Japan) as a way of exploring possible diversification benefits for investors. Chapter One introduces the reader to the topic, outlines the statement of the problem, motivation for the study and organization of the study. The market integration is defined here as a co-movement of stock prices. Markets are considered to be integrated if national stock prices share a common long-run relationship. Given that many researchers link financial intergration with the economic growth, and given different level of stock development of the selected former Yugoslav countries, this study also took a view that integration of the markets would promote economic growth of the region.

Chapter Two provides a literature overview on the studies of long-run comovements between stock markets as a way of identifying diversification benefits to an investor. Many studies examined cointegration within the context of market crashes and the shock waves these had sent out across the stock markets around the world. Overall, studies on the long-run comovements between stock markets have traditionally been focused on the mature markets of the United States and Western Europe and the emerging markets of Asia and Latin America. Much less attention had been given to the markets of Central and Eastern Europe. Even in those few studies evidence of links between emerging markets within the region and globally have been different between studies.

Chapter Three provides some background information on the selected countries in terms of their economies, banking sector, foreign investment activities in the region, economic integration and stock markets. Slovenia and to a much lesser degree Croatia are the most developed countries in the region. The official GDP per capita in 2006 were estimated at US$4,444 in Serbia, US$6,500 in Bosnia, US$14,300 in Croatia and

US$24,356 in Slovenia. Stock markets of these countries vary in the degree of development from one another. Some of the markets are much more efficient in generating the capital and have a way greater market capitalization than the others. Among the exchanges of former Yugoslav countries in 2007, the Zagreb Stock Exchange accounts for 39% of total regional trade and more than 52% or the regional market capitalization.

Chapter Five gives a review on the methodology employed in the study. It looks at the econometric techniques which are used in the paper to study for the market integration as well as presents some statistical concepts around time series analysis. The integration between the markets in the former Yugoslav countries and those in developed countries is studied through the analysis of correlation, Granger causality tests and the application of Johansen cointegration analysis. The concept of correlation is useful in terms of portfolio theory in that the returns on negatively correlated assets tend to be offsetting which stabilizes portfolio returns. Cointegration is referred to a statistical relationship where the variables hypothesized to be linked by some theoretical economic relationship should not diverge from each other in the long run. To test for cointegration between two or more data series, two tests need to be performed. Firstly, it is necessary to test data series for non-stationarity: when a variable is not stationary, it means that its mean and variance are not consistent over time, and an observation is correlated to its most recent lags. Here, Augmented Dickey-Fuller (ADF) test with intercept was used to determine the order of integration of the time series in order to induce stationarity. Secondly, data is examined for the evidence of a long-run relationship between the variables in question. The Engle and Granger theory of cointegration states that if the two time series y_t and x_t are both I(d) then the residuals from the regression of those series will also be I(d). More specifically, if the residuals are distributed I(0), we reject the null hypothesis of no cointegration, whereas if we have residuals of I(1) we do not reject the null hypothesis, meaning that the series under examination are not cointegrated. As the Engle-Granger method can estimate only up to one cointegrating relationship between the variables, it is more appropriate to use Johansen methodology when testing for several cointegrating relationships at once. Finally, the Granger causality test helps determine the direction of causation. The Granger test seeks to find out whether the current value of variable y-y_t can be explained by past values of the same variable, y_{t-k}.

Chapter Five presents the empirical results of the cointegration analysis of the former Yugoslav countries. The data used was for the period 03 Jan 2006-20 Aug 2008 (687 observations). The correlation analysis showed positive relationship between indices, indicating that indices tend to move in the same direction as the markets move albeit the correlations on returns are relatively small (the highest correlation of 0.22 exists between the Slovenian and Croatian stock market, and the lowest correlation of 0.08 is between the Bosnian and Croatian stock market). In order to determine existence of cointegrating relationships between stock markets, non-stationarity of the data series was established. All series were individually integrated of the same order one, I(1). Applying Engle-Granger methodology bilateral tests were performed on the long-run relationships between former Yugoslav markets. ADF tests on the residuals of the six pair-wise evaluations were not stationary, and thus it was concluded that there are no pair-wise cointegrating relationships between stock markets of the former Yugoslav countries.

However, Johansen bilateral cointegrating analysis showed the existence of three long-run relationships between: Serbian and Bosnian stock market, Serbian and Slovenian stock market, and Bosnian and Slovenian stock market. Applying Johansen methodology in order to test for cointegration on multilateral basis indicated the existence of one coinegrating vector, which suggests low long-run relationship between former Yugoslav countries. Finally, Granger causality test indicated that causal relationships exist between markets and bilateral causal relationship exist between the Bosnian and Serbain market and Bosnian and Slovenian market.

The empirical results of the cointegration analysis between the former Yugoslav countries and major international markets are presented in Chapter Six. All correlation coefficients between returns of market time series are low, thus indicating potential for diversification benefits to international investors. Moreover, returns on Sarajevo's SASX-10 index exhibit negative correlation with the returns on the UK's FTSE 100 and the US' S&P 500. Inducing stationarity is a step towards integration. The ADF unit root test on stock price series of developed markets showed that series are stationary in the first difference. Bilateral cointegration analysis between Serbian and international markets reveals the existence of one cointegrating relationship in all four pairs. Further findings showed that there is at least one cointegrating relation between the Croatian and the UK, the US and Japanese market. With the exception of the US, no cointegrating vector was found between the Bosnian and other international markets. At least one cointegrating vector was found between the Slovenian and each one of the selected developed markets. The results of the Granger causality test suggest that Granger causality runs from each selected international market to each market of the selected former Yugoslav countries.

7.2. Conclusions

Integration of financial markets prospers economic growth by enhancing stability and allowing companies to access capital by reaching to investors in other countries. Four selected former Yugoslav countries have taken different steps towards opening their economies to the industrial world in order to increase capital and trade flows. Privatization of the state owned companies is at different stages with the banking sector being still heavily controlled by the state (Slovenia) or completely in the hands of foreign owners (Croatia). All of the former Yugoslav countries examines in this study share a common situation in which bank lending is a predominant form of funding. Capital markets offer very limited equity financing.

The procedures used in the cointegration analysis offer contradictory results. The application of the Engle-Granger methodology indicates no cointegration between the stock markets of the former Yugoslav countries, while the use of the Johansen procedure suggests the presence of cointegration between Bosnia and Serbia, Bosnia and Slovenia, and Serbia and Slovenia. The lack of cointegration indicated by the Engle-Granger procedure may be due to the lower power of the test as is often indicated in the literature.

The observed long-run relationship between the Slovenian and Bosnian stock markets could be due to direct foreign investments from Slovenian investors into Bosnian economy. Integration between Serbia and Bosnia is documented implying that investors may perceive the stock markets in Belgrade and Sarajevo as one investment opportunity rather than two separate asset classes.

Interestingly, Croatia does not exhibit any long-run relationship with other markets of former Yugoslav countries. Although they conducted a study on examining cointegration in international bond markets, Clare, Maras and Thomas (1995) suggest that lack of long-run equilibrium between markets may be due to "institutional idiosyncrasies", such as heterogeneous maturity and taxation structures. Furthermore, they propose that different investment cultures, issuance patterns and macroeconomic policies between countries could explain as to why markets mainly operate independently of one another.

With the exception of Bosnia, the results of the analysis showed the existence of bilateral cointegrating relationship between Croatia, Serbia and Slovenia (much stronger link) and developed markets. Equilibrium relationship could possibly be caused by the growing capital inflows from developed markets into these countries. Moreover, it seems that economic reforms and liberalization efforts undertaken in the case of Slovenia (an EU Member State) have resulted in greater level of integration with stock markets of developed countries.

The results of this study indicate that Bosnian stock markets can yield substantial diversification benefits and suggest inclusion of Bosnian equities in a global portfolio. The absence of long-run relationships between Bosnia and developed markets can be due to national stock markets reflecting idiosyncrasies of their country's industrial structure. Bekaert (1995) identifies country characteristics that could act as a barrier towards integration with global equity markets. Factors such as poor credit ratings, high and variable inflation, exchange rate controls, lack of high-quality regulatory and accounting framework, lack of sufficient country funds, lack of cross-listed securities and limitations related to the size of the stock markets, could partially explain the absence of the long-run relationship between developing markets and the stock market of Bosnia.

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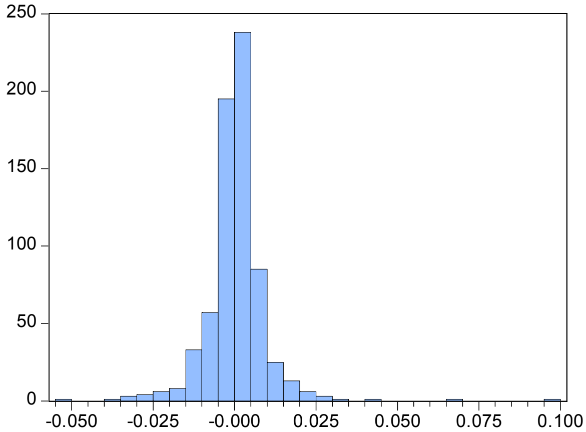
Appendices

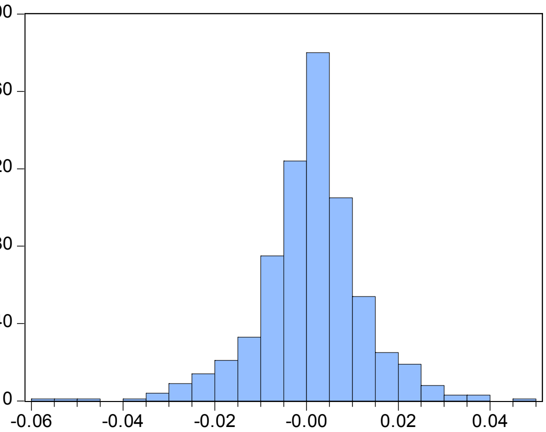
Appendix 1. Non-normality test results

Stock markets of former Yugoslav countries



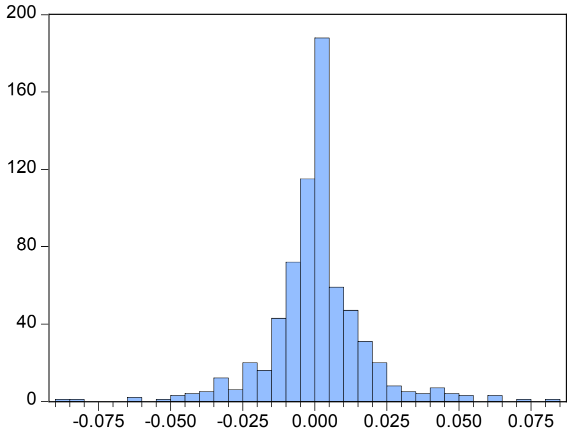
Series: RBEL
Sample 1/03/2006 8/20/2008
Observations 682

Mean	0.000401
Median	0.000000
Maximum	0.098708
Minimum	-0.053791
Std. Dev.	0.009499
Skewness	1.770738
Kurtosis	25.36624
Jarque-Bera	14571.80
Probability	0.000000



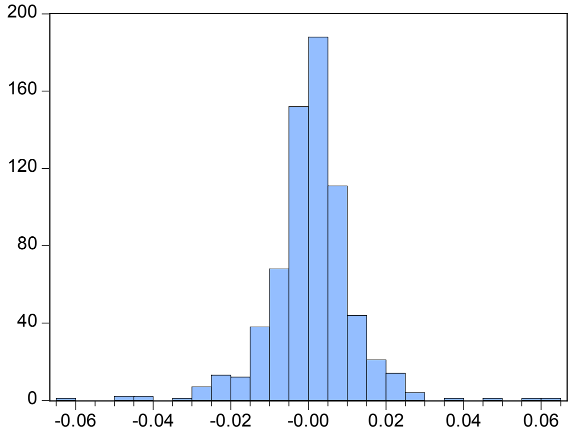
Series: RCRO
Sample 1/03/2006 8/20/2008
Observations 682

Mean	0.000855
Median	0.000560
Maximum	0.048397
Minimum	-0.058585
Std. Dev.	0.011439
Skewness	-0.414243
Kurtosis	6.048894
Jarque-Bera	283.6592
Probability	0.000000



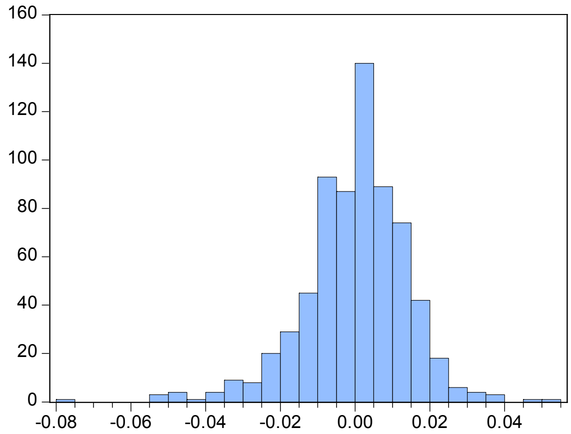
Series: RSASX
Sample 1/03/2006 8/20/2008
Observations 682

Mean	0.000404
Median	0.000000
Maximum	0.081976
Minimum	-0.088401
Std. Dev.	0.016675
Skewness	0.023774
Kurtosis	7.823269
Jarque-Bera	661.1475
Probability	0.000000

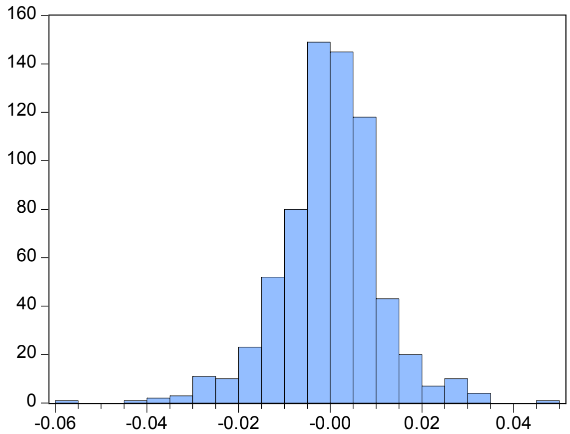


Series: RSVSM	
Sample 1/03/2006 8/20/2008	
Observations 682	
Mean	0.000709
Median	0.000211
Maximum	0.064466
Minimum	-0.063509
Std. Dev.	0.010763
Skewness	-0.246492
Kurtosis	9.331780
Jarque-Bera	1146.171
Probability	0.000000

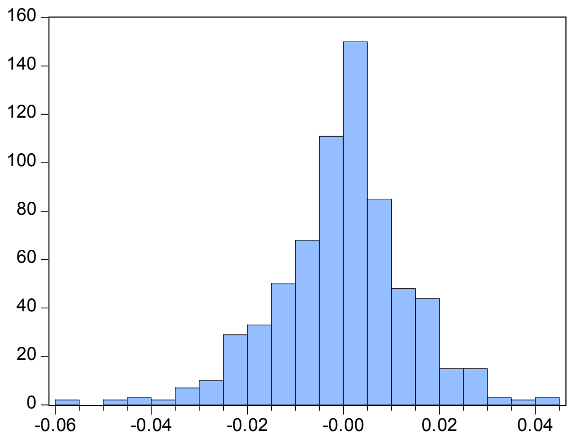
International stock markets



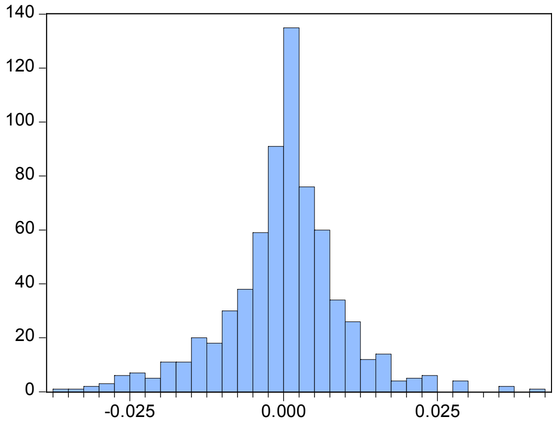
Series: RATX	
Sample 1/03/2006 8/20/2008	
Observations 682	
Mean	-9.03e-05
Median	0.000145
Maximum	0.053585
Minimum	-0.077676
Std. Dev.	0.014038
Skewness	-0.657239
Kurtosis	5.733094
Jarque-Bera	261.3667
Probability	0.000000



Series: RFTSE	
Sample 1/03/2006 8/20/2008	
Observations 680	
Mean	-0.000103
Median	0.000000
Maximum	0.046416
Minimum	-0.056374
Std. Dev.	0.011004
Skewness	-0.247983
Kurtosis	5.408912
Jarque-Bera	171.3837
Probability	0.000000

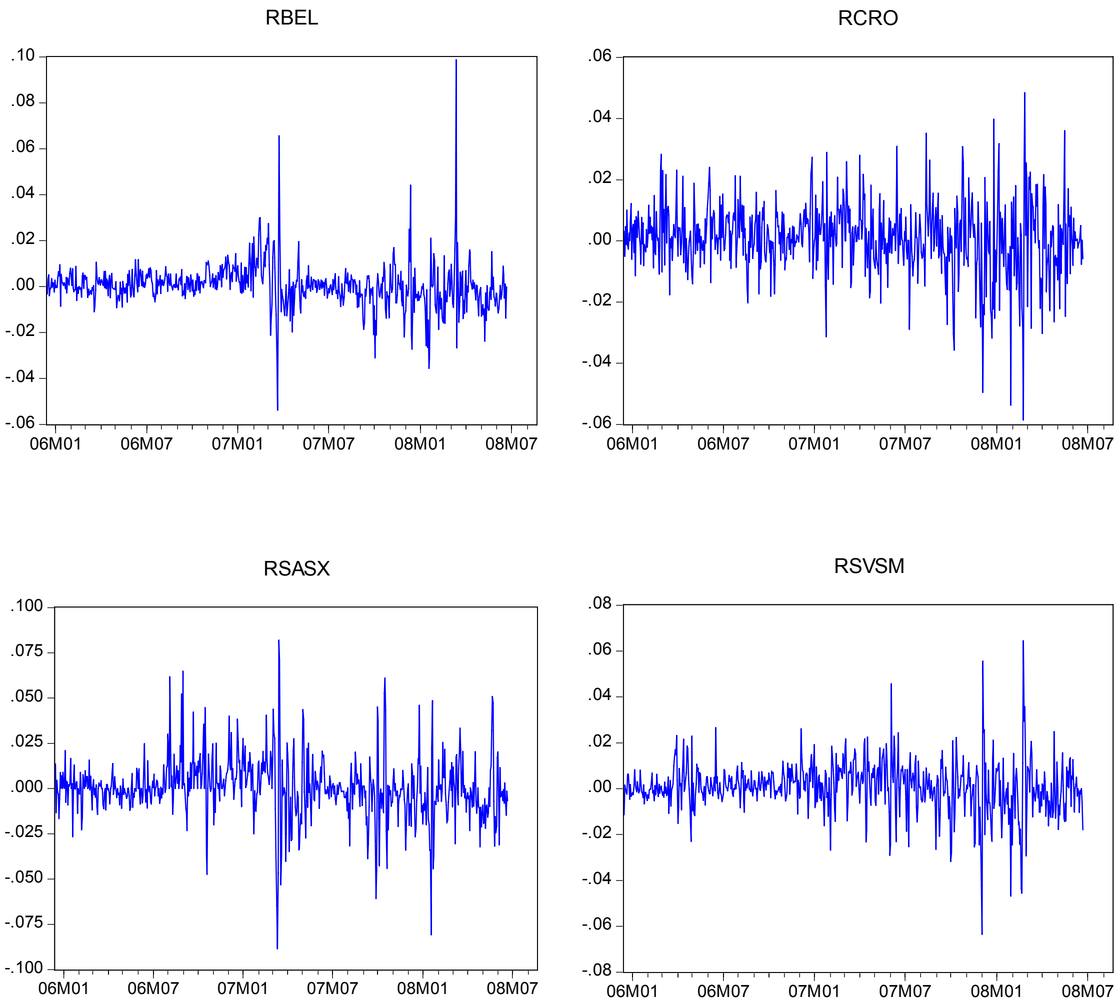


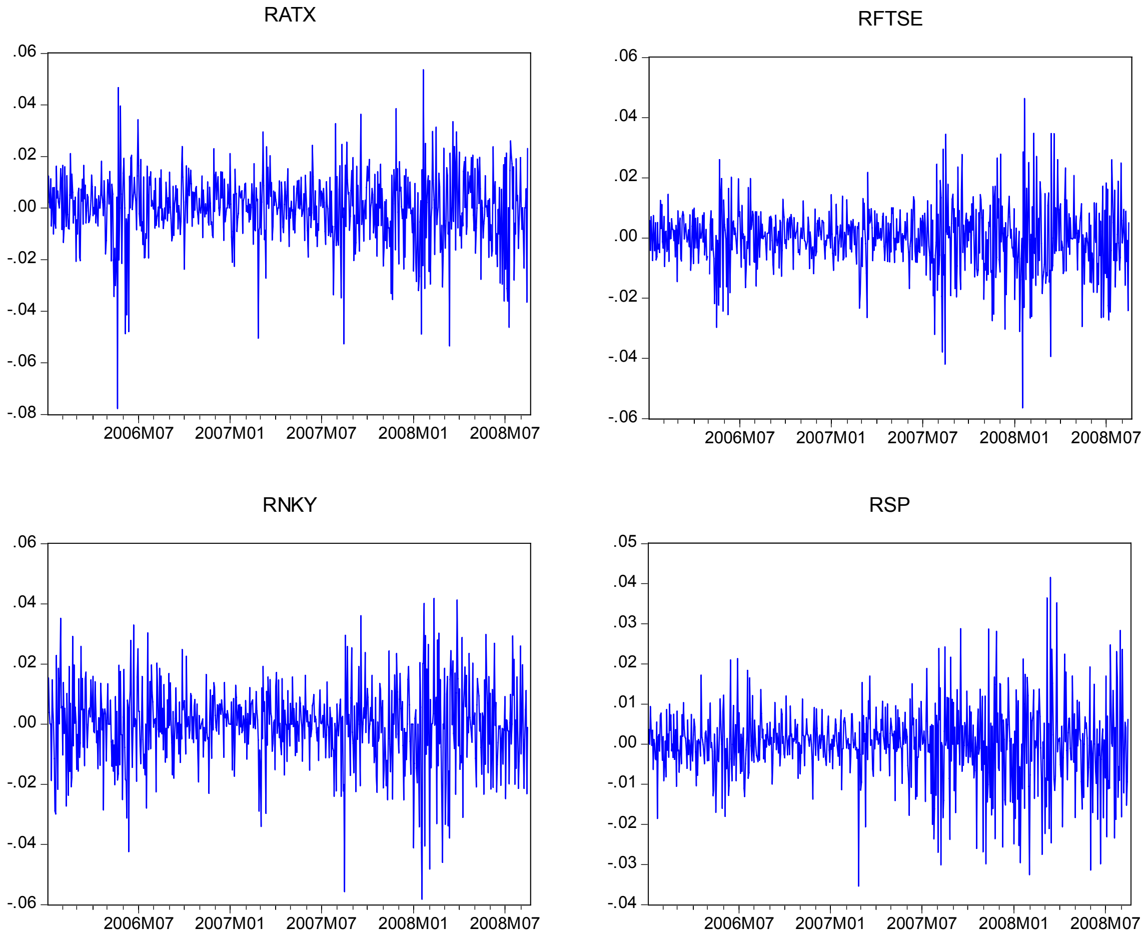
Series: RNKY	
Sample 1/03/2006 8/20/2008	
Observations 682	
Mean	-0.000331
Median	0.000000
Maximum	0.041823
Minimum	-0.058157
Std. Dev.	0.013592
Skewness	-0.371219
Kurtosis	4.388649
Jarque-Bera	70.46080
Probability	0.000000



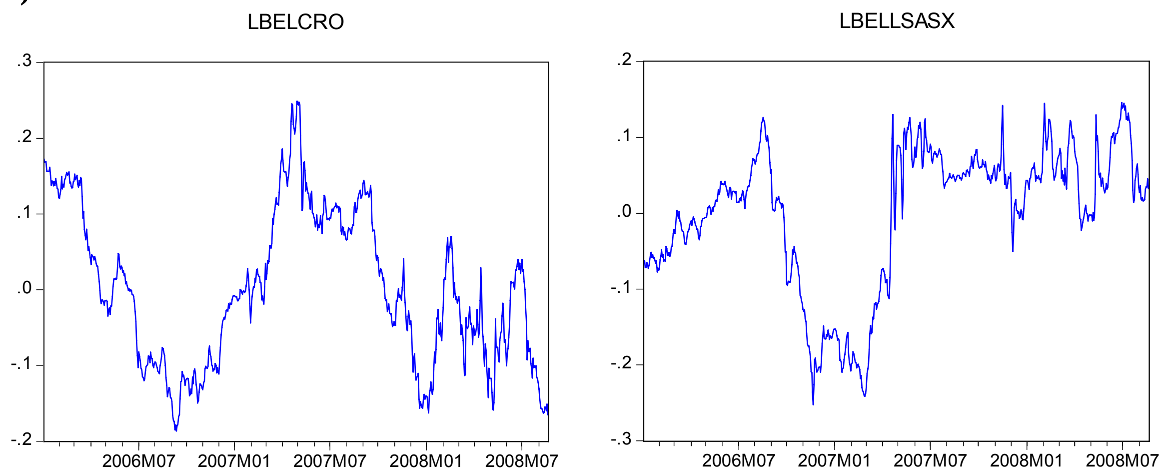
Series: RSP	
Sample 1/03/2006 8/20/2008	
Observations 682	
Mean	6.62e-06
Median	0.000561
Maximum	0.041535
Minimum	-0.035343
Std. Dev.	0.009733
Skewness	-0.164224
Kurtosis	5.038289
Jarque-Bera	121.1261
Probability	0.000000

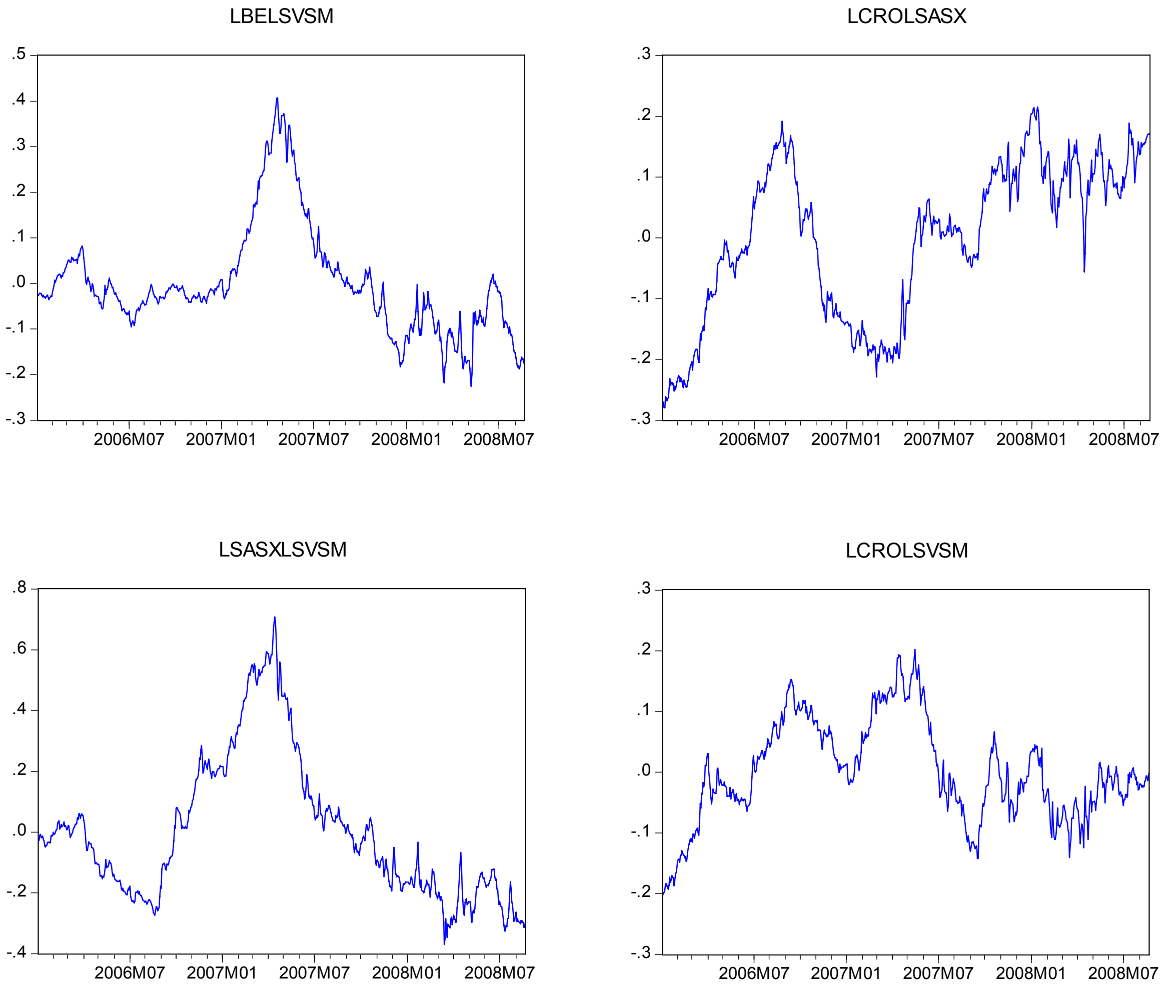
Appendix 2 Logarithmic equity index returns





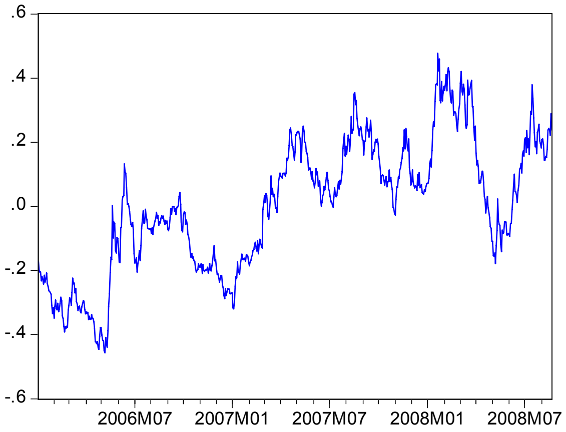
Appendix 3 Residual plot to check for stationarity (Engle-Granger cointegration test)



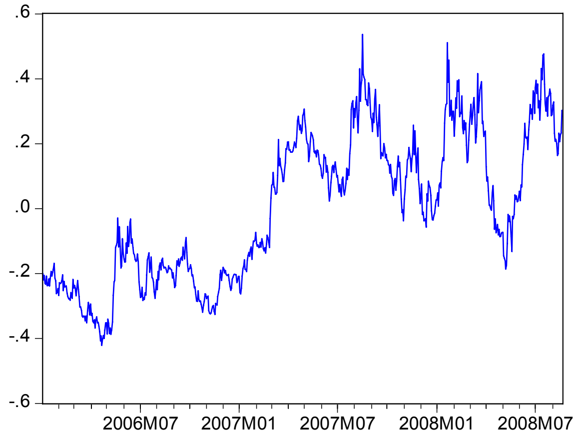

LBELSVSM
.5
.4
.3
.2
.1
.0
-.1
-.2
-.3
2006M07
2007M01
2007M07
2008M01
2008M07
LCROLSASX
.3
.2
.1
.0
-.1
-.2
-.3
2006M07
2007M01
2007M07
2008M01
2008M07
LSASXLSVSM
.8
.6
.4
.2
.0
-.2
-.4
2006M07
2007M01
2007M07
2008M01
2008M07
LCROLSVSM
.3
.2
.1
.0
-.1
-.2
-.3
2006M07
2007M01
2007M07
2008M01
2008M07

BELEXline and developed markets

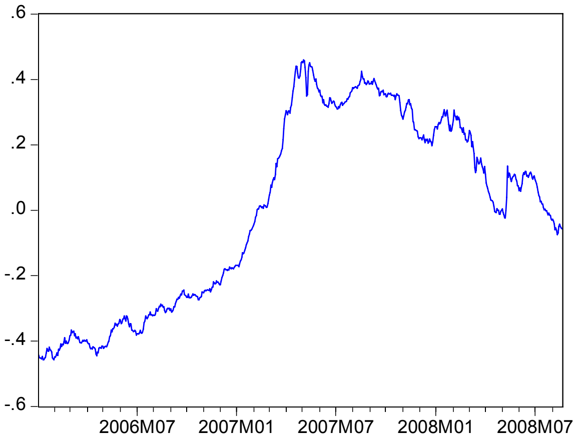
LBELLATX



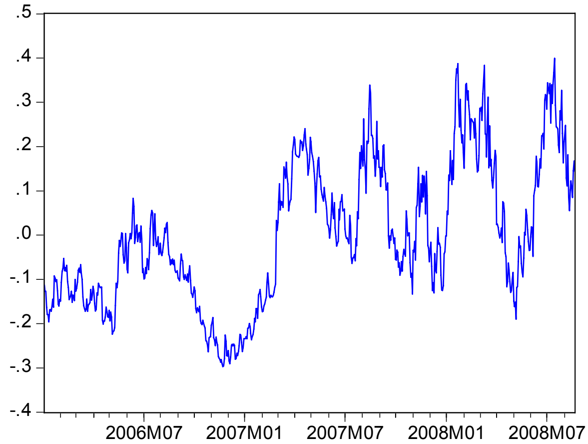
LBELLFTSE



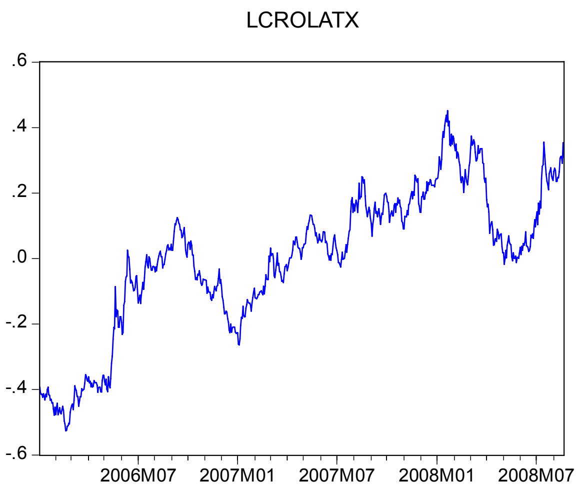
LBELLNKY

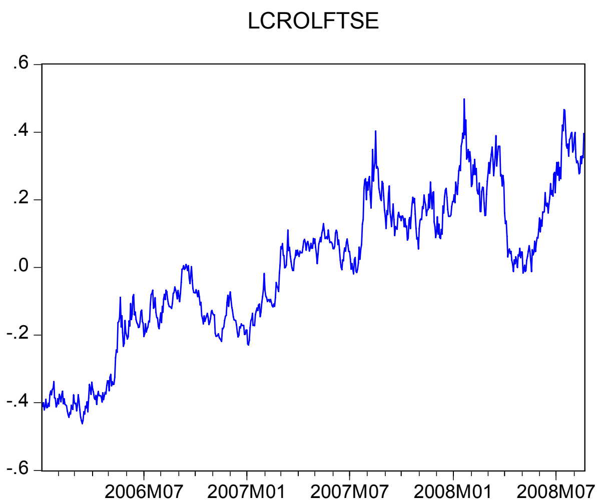


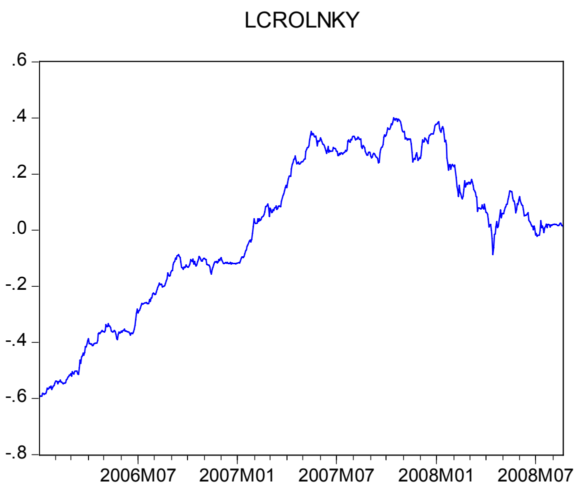
LBELSP

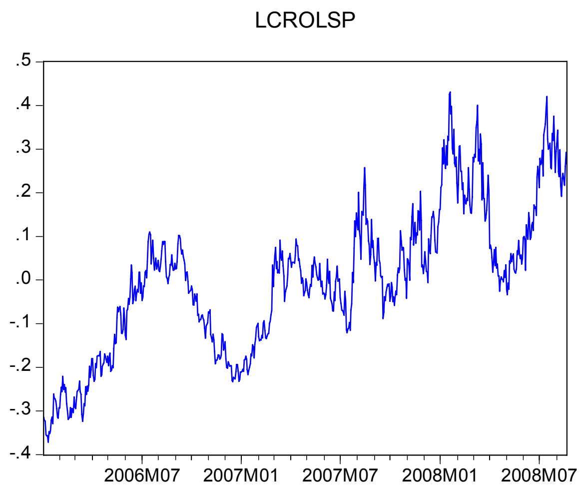


CROBEX and developed markets

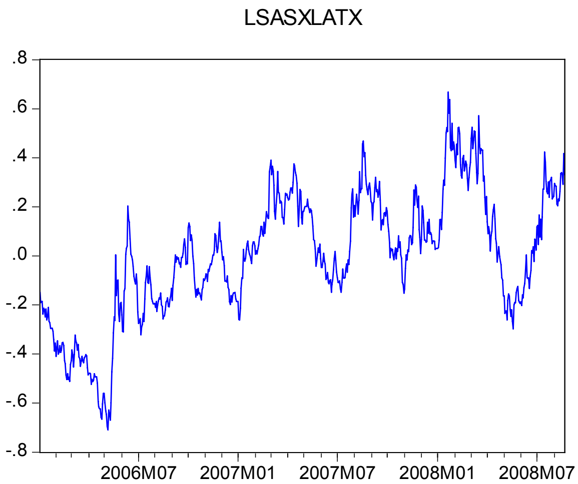


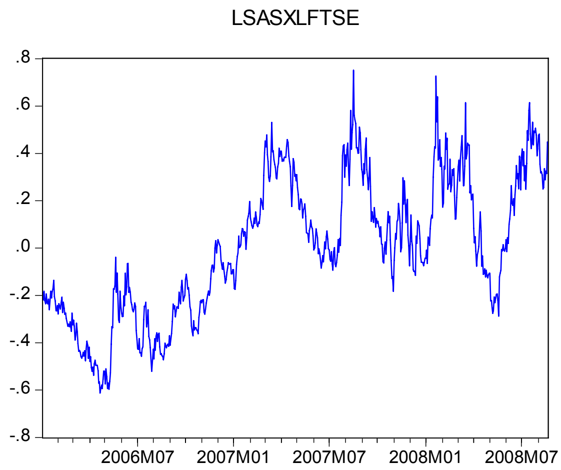


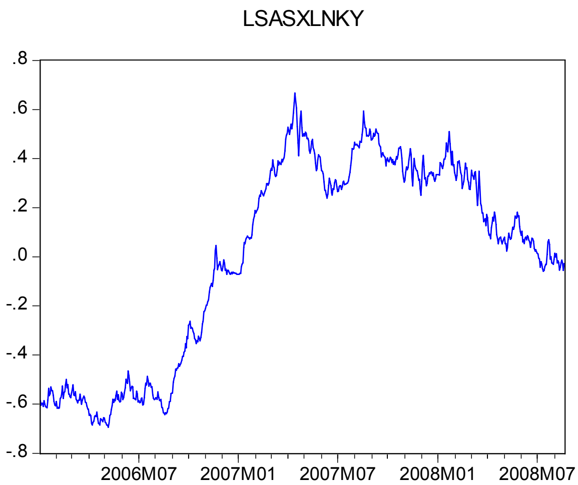


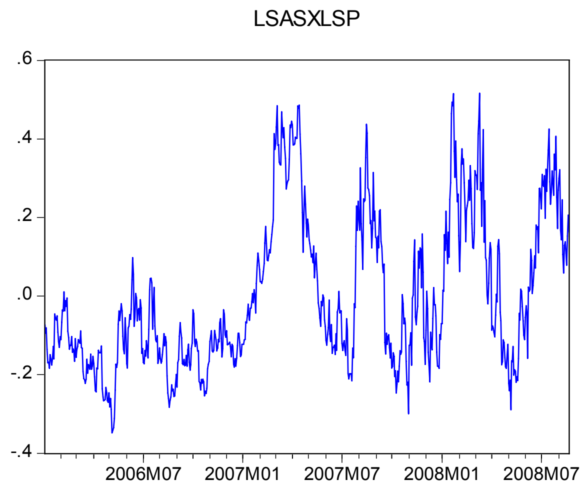


SASX-10 and developed markets

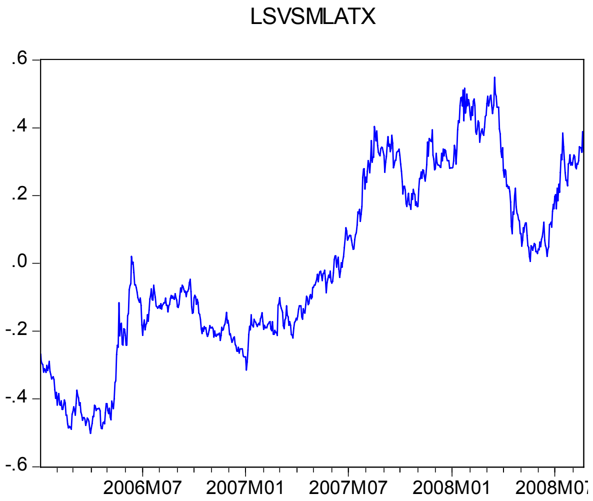


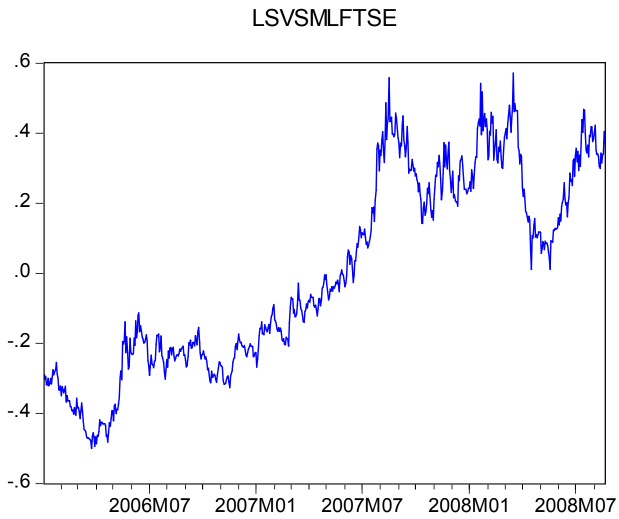


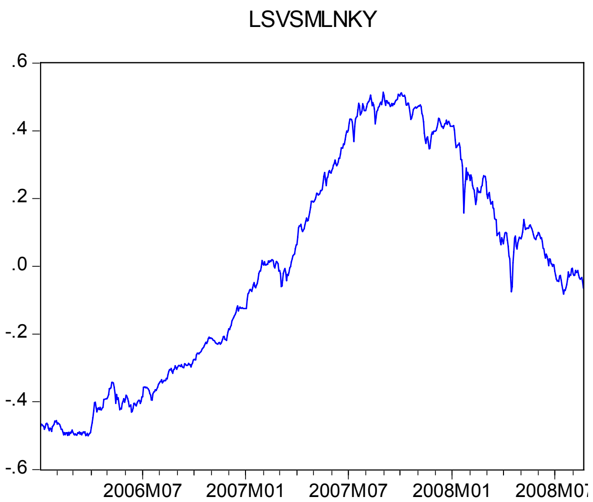


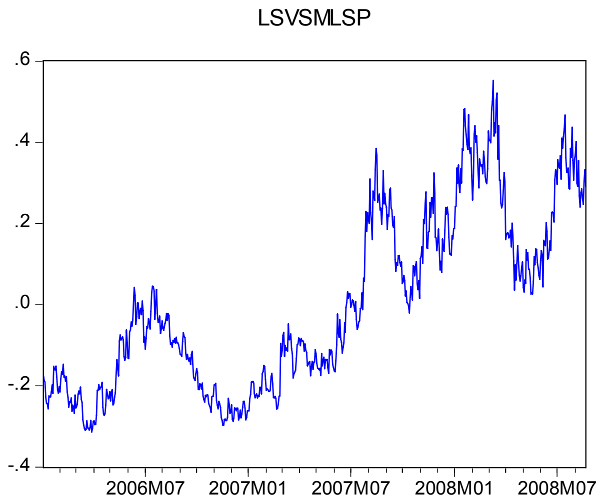


SBI20 and developed markets









Appendix 4 ADF Tests in First Difference

Appendix 4a) **ADF test in first difference for BELEXline index**

Null Hypothesis: D(LBEL) has a unit root				
Exogenous: Constant				
Lag Length: 13 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4,401936	0,0003
Test critical values:	1% level		-3,439852	
	5% level		-2,865624	
	10% level		-2,569002	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBEL,2)				
Method: Least Squares				
Sample (adjusted): 1/24/2006 8/20/2008				
Included observations: 672 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LBEL(-1))	-0,35082	0,079697	-4,401936	0
D(LBEL(-1),2)	-0,339232	0,081725	-4,150916	0
D(LBEL(-2),2)	-0,220168	0,080629	-2,730637	0,0065
D(LBEL(-3),2)	-0,284412	0,079286	-3,587145	0,0004
D(LBEL(-4),2)	-0,310635	0,077929	-3,986138	0,0001
D(LBEL(-5),2)	-0,270014	0,076232	-3,54201	0,0004
D(LBEL(-6),2)	-0,196345	0,07261	-2,704126	0,007
D(LBEL(-7),2)	-0,283916	0,068708	-4,132216	0
D(LBEL(-8),2)	-0,305953	0,066247	-4,618396	0
D(LBEL(-9),2)	-0,165967	0,062754	-2,644716	0,0084
D(LBEL(-10),2)	-0,115514	0,057567	-2,00661	0,0452
D(LBEL(-11),2)	-0,083161	0,052137	-1,595053	0,1112
D(LBEL(-12),2)	-0,125312	0,047178	-2,656179	0,0081
D(LBEL(-13),2)	-0,10461	0,03896	-2,685096	0,0074
C	0,00013	0,000338	0,383611	0,7014
R-squared	0,365476	Mean dependent var		-2,79E-06
Adjusted R-squared	0,351955	S.D. dependent var		0,010827
S.E. of regression	0,008716	Akaike info criterion		-6,625266
Sum squared resid	0,04991	Schwarz criterion		-6,524591
Log likelihood	2,24E+03	Hannan-Quinn criter.		-6,586276
F-statistic	27,03018	Durbin-Watson stat		1,992981
Prob(F-statistic)	0			

Appendix 4b) **ADF test in first difference for CROBEX index**

Null Hypothesis: D(LCRO) has a unit root				
Exogenous: Constant				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-12,97692	0
Test critical values:	1% level		-3,439696	
	5% level		-2,865555	
	10% level		-2,568965	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LCRO,2)				
Method: Least Squares				
Sample (adjusted): 1/09/2006 8/20/2008				
Included observations: 683 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCRO(-1))	-0,76591	0,059021	-12,97692	0
D(LCRO(-1),2)	-0,07448	0,049963	-1,490752	0,1365
D(LCRO(-2),2)	-0,08463	0,03826	-2,212053	0,0273
C	0,00066	0,000434	1,519227	0,1292
R-squared	0,423845	Mean dependent var		-8,50E-06
Adjusted R-squared	0,4213	S.D. dependent var		0,01482
S.E. of regression	0,011274	Akaike info criterion		-6,12687
Sum squared resid	0,086297	Schwarz criterion		-6,10036
Log likelihood	2096,325	Hannan-Quinn criter.		-6,11661
F-statistic	166,5009	Durbin-Watson stat		2,000096
Prob(F-statistic)	0			

Appendix 4c) **ADF test in first difference for SASX-10 index**

Null Hypothesis: D(LSASX) has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-16,89054	0
Test critical values:	1% level		-3,439682	
	5% level		-2,865549	
	10% level		-2,568961	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSASX,2)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSASX(-1))	-0,69044	0,040877	-16,89054	0
D(LSASX(-1),2)	0,175319	0,03771	4,649151	0
C	0,000243	0,000573	0,423399	0,6721
R-squared	0,315602	Mean dependent var		-2,98E-05
Adjusted R-squared	0,313592	S.D. dependent var		0,018078
S.E. of regression	0,014978	Akaike info criterion		-5,56012
Sum squared resid	0,152771	Schwarz criterion		-5,54026
Log likelihood	1904,561	Hannan-Quinn criter.		-5,55244
F-statistic	157,0174	Durbin-Watson stat		2,010565
Prob(F-statistic)	0			

Appendix 4d) **ADF test in first difference for SBI20 index**

Null Hypothesis: D(LSVSM) has a unit root				
Exogenous: Constant				
Lag Length: 4 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-12,08297	0
Test critical values:	1% level		-3,439724	
	5% level		-2,865567	
	10% level		-2,568971	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSVSM,2)				
Method: Least Squares				
Sample (adjusted): 1/11/2006 8/20/2008				
Included observations: 681 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSVSM(-1))	-0,832982	0,068938	-12,08297	0
D(LSVSM(-1),2)	0,222742	0,062749	3,549723	0,0004
D(LSVSM(-2),2)	0,051619	0,054235	0,951763	0,3416
D(LSVSM(-3),2)	-0,013833	0,045112	-0,306629	0,7592
D(LSVSM(-4),2)	0,0762	0,038456	1,98146	0,0479
C	0,0006	0,000386	1,554656	0,1205
R-squared	0,36562	Mean dependent var		-2,25E-05
Adjusted R-squared	0,360921	S.D. dependent var		0,012483
S.E. of regression	0,00998	Akaike info criterion		-6,367784
Sum squared resid	0,067224	Schwarz criterion		-6,327929
Log likelihood	2174,231	Hannan-Quinn criter.		-6,352358
F-statistic	77,8061	Durbin-Watson stat		1,989856
Prob(F-statistic)	0			

Appendix 4e) **ADF test in first difference for ATX index**

Null Hypothesis: D(LATX) has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-17,6584	0
Test critical values:	1% level		-3,439682	
	5% level		-2,865549	
	10% level		-2,568961	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LATX,2)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LATX(-1))	-0,98147	0,055581	-17,6584	0
D(LATX(-1),2)	-0,07035	0,038459	-1,829241	0,0678
C	-0,00011	0,000534	-0,21323	0,8312
R-squared	0,528937	Mean dependent var		3,04E-05
Adjusted R-squared	0,527554	S.D. dependent var		0,02033
S.E. of regression	0,013974	Akaike info criterion		-5,69887
Sum squared resid	0,132979	Schwarz criterion		-5,67901
Log likelihood	1952,013	Hannan-Quinn criter.		-5,69118
F-statistic	382,334	Durbin-Watson stat		2,00078
Prob(F-statistic)	0			

Appendix 4f) **ADF test in first difference for NKY index**

Null Hypothesis: D(LNKY) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-27,50564	0
Test critical values:	1% level		-3,439668	
	5% level		-2,865542	
	10% level		-2,568958	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LNKY,2)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNKY(-1))	-1,05012	0,038178	-27,50564	0
C	-0,00037	0,000518	-0,712873	0,4762
R-squared	0,525549	Mean dependent var		-2,40E-05
Adjusted R-squared	0,524855	S.D. dependent var		0,019646
S.E. of regression	0,013542	Akaike info criterion		-5,76314
Sum squared resid	0,125251	Schwarz criterion		-5,74992
Log likelihood	1975,876	Hannan-Quinn criter.		-5,75802
F-statistic	756,5601	Durbin-Watson stat		2,002996
Prob(F-statistic)	0			

Appendix 4g) **ADF test in first difference for FTSE index**

Null Hypothesis: D(LFTSE) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-30,71858	0
Test critical values:	1% level		-3,439668	
	5% level		-2,865542	
	10% level		-2,568958	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LFTSE,2)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFTSE(-1))	-1,16018	0,037768	-30,71858	0
C	-0,00011	0,000414	-0,271167	0,7863
R-squared	0,580114	Mean dependent var		-1,04E-06
Adjusted R-squared	0,579499	S.D. dependent var		0,016708
S.E. of regression	0,010834	Akaike info criterion		-6,2093
Sum squared resid	0,080171	Schwarz criterion		-6,19607
Log likelihood	2128,684	Hannan-Quinn criter.		-6,20418
F-statistic	943,631	Durbin-Watson stat		1,995161
Prob(F-statistic)	0			

Appendix 4h) **ADF test in first difference for S&P500 index**

Null Hypothesis: D(LSP) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-29,9375	0
Test critical values:	1% level		-3,439668	
	5% level		-2,865542	
	10% level		-2,568958	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSP,2)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LSP(-1))	-1,135226	0,03792	-29,9375	0
C	9,09E-07	0,000368	0,002471	0,998
R-squared	0,567517	Mean dependent var		3,67E-06
Adjusted R-squared	0,566884	S.D. dependent var		0,01463
S.E. of regression	0,009628	Akaike info criterion		-6,445328
Sum squared resid	0,063315	Schwarz criterion		-6,432104
Log likelihood	2209,525	Hannan-Quinn criter.		-6,440211
F-statistic	896,2541	Durbin-Watson stat		2,009828
Prob(F-statistic)	0			

Appendix 5 Engle Granger causality analysis

Appendix 5a) **Bilateral cointegration for BELEXline and CROBEX**

Null Hypothesis: LBELCRO has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,179515	0,4998
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELCRO)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELCRO(-1)	-0,01178	0,005405	-2,179515	0,0296
D(LBELCRO(-1))	0,143861	0,037918	3,793981	0,0002
C	3,32E-05	0,001074	0,030939	0,9753
0,000166168	-1,28E-06	2,72E-06	-0,470127	0,6384
R-squared	0,025854	Mean dependent var		-0,00048
Adjusted R-squared	0,021563	S.D. dependent var		0,013856
S.E. of regression	0,013706	Akaike info criterion		-5,73611
Sum squared resid	0,127933	Schwarz criterion		-5,70966
Log likelihood	1968,617	Hannan-Quinn criter.		-5,72588
F-statistic	6,024658	Durbin-Watson stat		1,985691
Prob(F-statistic)	0,000472			

Appendix 5b) **Bilateral cointegration for BELEXline and SASX-10**

Null Hypothesis: LBELLSASX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,132743	0,526
Test critical values:	1% level		-3,971546	
	5% level		-3,41641	
	10% level		-3,13052	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELLSASX)				
Method: Least Squares				
Sample (adjusted): 1/09/2006 8/20/2008				
Included observations: 683 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELLSASX(-1)	-0,01248	0,005851	-2,132743	0,0333
D(LBELLSASX(-1))	0,328484	0,037589	8,738822	0
D(LBELLSASX(-2))	-0,0442	0,039629	-1,115415	0,2651
D(LBELLSASX(-3))	-0,19416	0,03777	-5,140545	0
C	-0,00058	0,001064	-0,541791	0,5881
0,000166168	2,09E-06	2,74E-06	0,764603	0,4448
R-squared	0,152016	Mean dependent var		0,000158
Adjusted R-squared	0,145753	S.D. dependent var		0,013837
S.E. of regression	0,012789	Akaike info criterion		-5,87175
Sum squared resid	0,110726	Schwarz criterion		-5,83198
Log likelihood	2011,201	Hannan-Quinn criter.		-5,85636
F-statistic	24,27284	Durbin-Watson stat		1,995849
Prob(F-statistic)	0			

Appendix 5c) **Bilateral cointegration for BELEXline and SBI20**

Null Hypothesis: LBELLSVSM has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1,663798	0,7663
Test critical values:	1% level		-3,971546	
	5% level		-3,41641	
	10% level		-3,13052	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELLSVSM)				
Method: Least Squares				
Sample (adjusted): 1/09/2006 8/20/2008				
Included observations: 683 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELLSVSM(-1)	-0,00664	0,003989	-1,663798	0,0966
D(LBELLSVSM(-1))	0,325129	0,038297	8,489698	0
D(LBELLSVSM(-2))	-0,02607	0,040298	-0,646948	0,5179
D(LBELLSVSM(-3))	-0,08451	0,03839	-2,201255	0,0281
C	0,00084	0,000943	0,890692	0,3734
0,000166168	-2,87E-06	2,39E-06	-1,19962	0,2307
R-squared	0,110881	Mean dependent var		-0,0002
Adjusted R-squared	0,104314	S.D. dependent var		0,012534
S.E. of regression	0,011862	Akaike info criterion		-6,02222
Sum squared resid	0,095257	Schwarz criterion		-5,98246
Log likelihood	2062,589	Hannan-Quinn criter.		-6,00683
F-statistic	16,88551	Durbin-Watson stat		2,00381
Prob(F-statistic)	0			

Appendix 5d) **Bilateral cointegration for CROBEX and SASX-10**

Null Hypothesis: LCROLSASX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,191345	0,4932
Test critical values:	1% level		-3,971526	
	5% level		-3,416401	
	10% level		-3,130514	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LCROLSASX)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCROLSASX(-1)	-0,01174	0,005357	-2,191345	0,0288
D(LCROLSASX(-1))	0,200771	0,037843	5,305421	0
D(LCROLSASX(-2))	-0,14284	0,037909	-3,767935	0,0002
C	-0,0005	0,001294	-0,387773	0,6983
0,000166168	3,27E-06	3,42E-06	0,956217	0,3393
R-squared	0,058008	Mean dependent var		0,000656
Adjusted R-squared	0,052459	S.D. dependent var		0,014252
S.E. of regression	0,013873	Akaike info criterion		-5,71043
Sum squared resid	0,130685	Schwarz criterion		-5,67733
Log likelihood	1957,966	Hannan-Quinn criter.		-5,69762
F-statistic	10,45325	Durbin-Watson stat		2,002642
Prob(F-statistic)	0			

Appendix 5e) **Bilateral cointegration for CROBEX and SBI20**

Null Hypothesis: LCROLSVSM has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,827459	0,1878
Test critical values:	1% level		-3,971526	
	5% level		-3,416401	
	10% level		-3,130514	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LCROLSVSM)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCROLSVSM(-1)	-0,01655	0,005854	-2,827459	0,0048
D(LCROLSVSM(-1))	0,117322	0,038014	3,086315	0,0021
D(LCROLSVSM(-2))	-0,09197	0,03805	-2,417153	0,0159
C	0,001296	0,00097	1,336194	0,1819
0,000166168	-2,92E-06	2,44E-06	-1,194173	0,2328
R-squared	0,033032	Mean dependent var		0,000289
Adjusted R-squared	0,027335	S.D. dependent var		0,012749
S.E. of regression	0,012574	Akaike info criterion		-5,90713
Sum squared resid	0,107349	Schwarz criterion		-5,87403
Log likelihood	2025,238	Hannan-Quinn criter.		-5,89432
F-statistic	5,798691	Durbin-Watson stat		2,007138
Prob(F-statistic)	0,000136			

Appendix 5f) **Bilateral cointegration for SASX-10 and SBI20**

Null Hypothesis: LSASXLSVSM has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1,286966	0,89
Test critical values:	1% level		-3,971526	
	5% level		-3,416401	
	10% level		-3,130514	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSASXLSVSM)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSASXLSVSM(-1)	-0,00396	0,003077	-1,286966	0,1985
D(LSASXLSVSM(-1))	0,400528	0,037763	10,60623	0
D(LSASXLSVSM(-2))	-0,16765	0,037837	-4,430813	0
C	0,001129	0,001434	0,787344	0,4314
0,000166168	-4,21E-06	3,65E-06	-1,154266	0,2488
R-squared	0,145715	Mean dependent var		-0,00042
Adjusted R-squared	0,140682	S.D. dependent var		0,019538
S.E. of regression	0,018111	Akaike info criterion		-5,17729
Sum squared resid	0,222722	Schwarz criterion		-5,14419
Log likelihood	1775,634	Hannan-Quinn criter.		-5,16449
F-statistic	28,95413	Durbin-Watson stat		2,006579
Prob(F-statistic)	0			

Appendix 5f) **Bilateral cointegration for BELEXline and ATX**

Null Hypothesis: LBELLATX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,106419	0,1056
Test critical values:	1% level		-3,971487	
	5% level		-3,416382	
	10% level		-3,130503	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELLATX)				
Method: Least Squares				
Sample (adjusted): 1/04/2006 8/20/2008				
Included observations: 686 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELLATX(-1)	-0,027562	0,008872	-3,106419	0,002
C	-0,006992	0,003401	-2,055722	0,0402
0,000166168	2,21E-05	9,23E-06	2,391628	0,017
R-squared	0,013958	Mean dependent var		0,000598
Adjusted R-squared	0,011071	S.D. dependent var		0,032345
S.E. of regression	0,032166	Akaike info criterion		-4,031457
Sum squared resid	0,706662	Schwarz criterion		-4,011643
Log likelihood	1385,79	Hannan-Quinn criter.		-4,023791
F-statistic	4,834205	Durbin-Watson stat		2,062654
Prob(F-statistic)	0,008227			

Appendix 5g) **Bilateral cointegration for BELEXline and FTSE**

Null Hypothesis: LBELLFTSE has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,173037	0,0908
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELLFTSE)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELLFTSE(-1)	-0,033181	0,010457	-3,173037	0,0016
D(LBELLFTSE(-1))	-0,132859	0,037967	-3,499335	0,0005
C	-0,009645	0,004354	-2,215082	0,0271
0,000166168	3,05E-05	1,19E-05	2,559213	1,07E-02
R-squared	0,036546	Mean dependent var		0,000737
Adjusted R-squared	0,032302	S.D. dependent var		0,039212
S.E. of regression	0,038573	Akaike info criterion		-3,666691
Sum squared resid	1,013259	Schwarz criterion		-3,640242
Log likelihood	1259,842	Hannan-Quinn criter.		-3,656457
F-statistic	8,610589	Durbin-Watson stat		1,993192
Prob(F-statistic)	0,000013			

Appendix 5h) **Bilateral cointegration for BELEXline and NKY**

Null Hypothesis: LBELLNKY has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 10 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0,274272	0,9912
Test critical values:	1% level		-3,971687	
	5% level		-3,416479	
	10% level		-3,13056	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELLNKY)				
Method: Least Squares				
Sample (adjusted): 1/18/2006 8/20/2008				
Included observations: 676 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELLNKY(-1)	-0,000585	0,002132	-0,274272	0,784
D(LBELLNKY(-1))	0,164937	0,038485	4,285705	0
D(LBELLNKY(-2))	0,099136	0,038883	2,549617	0,011
D(LBELLNKY(-3))	-0,055084	0,03905	-1,410602	1,59E-01
D(LBELLNKY(-4))	-0,027457	0,0391	-0,702227	0,4828
D(LBELLNKY(-5))	0,061955	0,039077	1,585431	0,1133
D(LBELLNKY(-6))	-0,012574	0,039197	-0,32079	0,7485
D(LBELLNKY(-7))	-0,026913	0,039175	-0,686987	0,4923
D(LBELLNKY(-8))	-0,02742	0,039163	-0,700141	0,4841
D(LBELLNKY(-9))	0,09026	0,038981	2,31547	0,0209
D(LBELLNKY(-10))	0,141393	0,038686	3,654858	0,0003
C	0,001483	0,001239	1,196279	0,232
0,000166168	-3,30E-06	3,31E-06	-0,99684	0,3192
R-squared	0,093322	Mean dependent var		0,000564
Adjusted R-squared	0,076912	S.D. dependent var		0,011262
S.E. of regression	0,01082	Akaike info criterion		-6,195739
Sum squared resid	0,077624	Schwarz criterion		-6,108889
Log likelihood	2107,16	Hannan-Quinn criter.		-6,162112
F-statistic	5,68676	Durbin-Watson stat		1,996122
Prob(F-statistic)	0			

Appendix 5i) **Bilateral cointegration for BELEXline and S&P 500**

Null Hypothesis: LBELSP has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,553988	0,0346
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LBELSP)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LBELSP(-1)	-0,040857	0,011496	-3,553988	0,0004
D(LBELSP(-1))	-0,103454	0,038118	-2,714039	0,0068
C	-0,006608	0,003496	-1,889983	0,0592
0,000166168	2,05E-05	9,25E-06	2,213165	2,72E-02
R-squared	0,033256	Mean dependent var		0,000395
Adjusted R-squared	0,028998	S.D. dependent var		0,038358
S.E. of regression	0,037798	Akaike info criterion		-3,707314
Sum squared resid	0,972922	Schwarz criterion		-3,680865
Log likelihood	1273,755	Hannan-Quinn criter.		-3,69708
F-statistic	7,808902	Durbin-Watson stat		2,003855
Prob(F-statistic)	0,000039			

Appendix 5j) **Bilateral cointegration for CROBEX and ATX**

Null Hypothesis: LCROLATX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,5105	0,3229
Test critical values:	1% level		-3,971526	
	5% level		-3,416401	
	10% level		-3,130514	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LCROLATX)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCROLATX(-1)	-0,017811	0,007095	-2,5105	0,0123
D(LCROLATX(-1))	-0,044924	0,038406	-1,169704	0,2425
D(LCROLATX(-2))	0,063823	0,038563	1,655043	0,0984
C	-0,004038	0,002844	-1,419844	1,56E-01
0,000166168	1,48E-05	7,84E-06	1,886453	0,0597
R-squared	0,015504	Mean dependent var		0,001056
Adjusted R-squared	0,009705	S.D. dependent var		0,023246
S.E. of regression	0,023132	Akaike info criterion		-4,687879
Sum squared resid	0,363339	Schwarz criterion		-4,65478
Log likelihood	1608,255	Hannan-Quinn criter.		-4,675071
F-statistic	2,67331	Durbin-Watson stat		2,001823
Prob(F-statistic)	0,031111			

Appendix 5k) **Bilateral cointegration for CROBEX and NKY**

Null Hypothesis: LCROLNKY has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0,395208	0,9876
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LCROLNKY)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCROLNKY(-1)	-0,000925	0,00234	-0,395208	0,6928
D(LCROLNKY(-1))	0,143831	0,037979	3,787088	0,0002
C	0,002608	0,001206	2,163151	0,0309
0,000166168	-5,40E-06	3,27E-06	-1,649456	9,95E-02
R-squared	0,037369	Mean dependent var		0,000879
Adjusted R-squared	0,033128	S.D. dependent var		0,011259
S.E. of regression	0,011071	Akaike info criterion		-6,163143
Sum squared resid	0,083469	Schwarz criterion		-6,136693
Log likelihood	2114,876	Hannan-Quinn criter.		-6,152908
F-statistic	8,811947	Durbin-Watson stat		1,997589
Prob(F-statistic)	0,00001			

Appendix 5l) **Bilateral cointegration for CROBEX and S&P 500**

Null Hypothesis: LCROLSP has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,415025	0,0502
Test critical values:	1% level		-3,971526	
	5% level		-3,416401	
	10% level		-3,130514	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LCROLSP)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCROLSP(-1)	-0,04219	0,012354	-3,415025	0,0007
D(LCROLSP(-1))	-0,164399	0,03858	-4,261289	0
D(LCROLSP(-2))	-0,065006	0,038309	-1,696881	0,0902
C	-0,008007	0,003744	-2,138543	3,28E-02
0,000166168	2,64E-05	1,02E-05	2,581652	0,01
R-squared	0,053198	Mean dependent var		0,000861
Adjusted R-squared	0,047621	S.D. dependent var		0,033766
S.E. of regression	0,032952	Akaike info criterion		-3,980258
Sum squared resid	0,737273	Schwarz criterion		-3,947159
Log likelihood	1366,248	Hannan-Quinn criter.		-3,96745
F-statistic	9,53782	Durbin-Watson stat		1,997485
Prob(F-statistic)	0			

Appendix 5m) **Bilateral cointegration for SASX-10 and ATX**

Null Hypothesis: LSASXLATX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,495352	0,0406
Test critical values:	1% level		-3,971487	
	5% level		-3,416382	
	10% level		-3,130503	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSASXLATX)				
Method: Least Squares				
Sample (adjusted): 1/04/2006 8/20/2008				
Included observations: 686 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSASXLATX(-1)	-0,034769	0,009947	-3,495352	0,0005
C	-0,010298	0,004873	-2,113293	0,0349
0,000166168	3,20E-05	1,30E-05	2,45991	0,0141
R-squared	0,017653	Mean dependent var		0,000696
Adjusted R-squared	0,014777	S.D. dependent var		0,051458
S.E. of regression	0,051077	Akaike info criterion		-3,10661
Sum squared resid	1,781836	Schwarz criterion		-3,086796
Log likelihood	1068,567	Hannan-Quinn criter.		-3,098944
F-statistic	6,136927	Durbin-Watson stat		2,045461
Prob(F-statistic)	0,002283			

Appendix 5n) **Bilateral cointegration for SASX-10 and FTSE**

Null Hypothesis: LSASXLFTSE has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,528129	0,0372
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSASXLFTSE)				
Method: Least Squares				
Sample (adjusted): 1/04/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSASXLFTSE(-1)	-0,040558	0,011496	-3,528129	0,0004
D(LSASXLFTSE(-1))	-0,118181	0,038042	-3,106568	0,002
C	-0,01443	0,0063	-2,290618	0,0223
0,000166168	4,49E-05	1,69E-05	2,652035	8,20E-03
R-squared	0,036794	Mean dependent var		0,000923
Adjusted R-squared	0,032551	S.D. dependent var		0,063417
S.E. of regression	0,062377	Akaike info criterion		-2,705427
Sum squared resid	2,649673	Schwarz criterion		-2,678978
Log likelihood	930,6087	Hannan-Quinn criter.		-2,695192
F-statistic	8,671272	Durbin-Watson stat		1,997189
Prob(F-statistic)	0,000012			

Appendix 5o) **Bilateral cointegration for SASX-10 and NKY**

Null Hypothesis: LSASXLNKY has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0,186036	0,9933
Test critical values:	1% level		-3,971546	
	5% level		-3,41641	
	10% level		-3,13052	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSASXLNKY)				
Method: Least Squares				
Sample (adjusted): 1/09/2006 8/20/2008				
Included observations: 683 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSASXLNKY(-1)	-0,000596	0,003203	-0,186036	0,8525
D(LSASXLNKY(-1))	0,159398	0,03826	4,166211	0
D(LSASXLNKY(-2))	-0,07096	0,038707	-1,833287	0,0672
D(LSASXLNKY(-3))	-0,116174	0,038347	-3,029529	2,50E-03
C	0,003444	0,00245	1,405955	0,1602
0,000166168	-7,53E-06	6,61E-06	-1,139138	0,255
R-squared	0,049877	Mean dependent var		0,000826
Adjusted R-squared	0,04286	S.D. dependent var		0,023765
S.E. of regression	0,02325	Akaike info criterion		-4,676267
Sum squared resid	0,365965	Schwarz criterion		-4,636503
Log likelihood	1602,945	Hannan-Quinn criter.		-4,660878
F-statistic	7,107836	Durbin-Watson stat		2,013166
Prob(F-statistic)	0,000002			

Appendix 5p) **Bilateral cointegration for SASX-10 and S&P 500**

Null Hypothesis: LSASXLSP has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4,205898	0,0046
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSASXLSP)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSASXLSP(-1)	-0,055954	0,013304	-4,205898	0
D(LSASXLSP(-1))	-0,078942	0,038208	-2,066078	0,0392
C	-0,008489	0,00494	-1,718415	0,0862
0,000166168	2,58E-05	1,28E-05	2,021014	4,37E-02
R-squared	0,036454	Mean dependent var		0,000376
Adjusted R-squared	0,03221	S.D. dependent var		0,059705
S.E. of regression	0,058736	Akaike info criterion		-2,82571
Sum squared resid	2,349383	Schwarz criterion		-2,799261
Log likelihood	971,8057	Hannan-Quinn criter.		-2,815476
F-statistic	8,58818	Durbin-Watson stat		2,002524
Prob(F-statistic)	0,000013			

Appendix 5r) **Bilateral cointegration for SBI 20 and ATX**

Null Hypothesis: LSVSMLATX has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 1 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,265613	0,4518
Test critical values:	1% level		-3,971507	
	5% level		-3,416391	
	10% level		-3,130508	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSVSMLATX)				
Method: Least Squares				
Sample (adjusted): 1/05/2006 8/20/2008				
Included observations: 685 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSVSMLATX(-1)	-0,016067	0,007092	-2,265613	0,0238
D(LSVSMLATX(-1))	-0,088933	0,038285	-2,322936	0,0205
C	-0,005675	0,003481	-1,630606	0,1034
0,000166168	1,94E-05	9,68E-06	1,99962	4,59E-02
R-squared	0,016706	Mean dependent var		0,000901
Adjusted R-squared	0,012374	S.D. dependent var		0,026335
S.E. of regression	0,026172	Akaike info criterion		-4,44246
Sum squared resid	0,466453	Schwarz criterion		-4,416011
Log likelihood	1525,543	Hannan-Quinn criter.		-4,432226
F-statistic	3,856712	Durbin-Watson stat		1,987666
Prob(F-statistic)	0,009388			

Appendix 5s) **Bilateral cointegration for SBI 20 and FTSE**

Null Hypothesis: LSVSMLFTSE has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-2,601427	0,2798
Test critical values:	1% level		-3,971546	
	5% level		-3,41641	
	10% level		-3,13052	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSVSMLFTSE)				
Method: Least Squares				
Sample (adjusted): 1/09/2006 8/20/2008				
Included observations: 683 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSVSMLFTSE(-1)	-0,02572	0,009888	-2,601427	0,0095
D(LSVSMLFTSE(-1))	-0,19128	0,038514	-4,966497	0
D(LSVSMLFTSE(-2))	-0,02703	0,039259	-0,68846	0,4914
D(LSVSMLFTSE(-3))	-0,0787	0,038393	-2,049875	0,0408
C	-1,02E-02	4,98E-03	-2,057903	0,04
0,000166168	3,35E-05	1,40E-05	2,401317	0,0166
R-squared	0,057413	Mean dependent var		0,00101
Adjusted R-squared	0,050452	S.D. dependent var		0,033004
S.E. of regression	0,03216	Akaike info criterion		-4,02742
Sum squared resid	0,700214	Schwarz criterion		-3,98765
Log likelihood	1381,363	Hannan-Quinn criter.		-4,01203
F-statistic	8,247225	Durbin-Watson stat		2,001783
Prob(F-statistic)	0			

Appendix 5t) **Bilateral cointegration for SBI 20 and NKY**

Null Hypothesis: LSVSMLNKY has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 5 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			0,610681	0,9995
Test critical values:	1% level		-3,971586	
	5% level		-3,41643	
	10% level		-3,130531	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSVSMLNKY)				
Method: Least Squares				
Sample (adjusted): 1/11/2006 8/20/2008				
Included observations: 681 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSVSMLNKY(-1)	0,001333	0,002183	0,610681	0,5416
D(LSVSMLNKY(-1))	0,27321	0,03856	7,085233	0
D(LSVSMLNKY(-2))	-0,09826	0,039849	-2,465815	0,0139
D(LSVSMLNKY(-3))	-0,09747	0,039847	-2,446055	0,0147
D(LSVSMLNKY(-4))	0,090494	0,039831	2,271973	2,34E-02
D(LSVSMLNKY(-5))	-0,06589	0,038613	-1,706306	0,0884
C	0,003322	0,001347	2,466414	0,0139
0,000166168	-8,02E-06	3,63E-06	-2,210486	0,0274
R-squared	0,09778	Mean dependent var		0,000611
Adjusted R-squared	0,088396	S.D. dependent var		0,012747
S.E. of regression	0,01217	Akaike info criterion		-5,96795
Sum squared resid	0,099683	Schwarz criterion		-5,91481
Log likelihood	2040,086	Hannan-Quinn criter.		-5,94738
F-statistic	10,41971	Durbin-Watson stat		2,000903
Prob(F-statistic)	0			

Appendix 5u) **Bilateral cointegration for SBI 20 and S&P 500**

Null Hypothesis: LSVSMLSP has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 2 (Automatic based on AIC, MAXLAG=19)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3,076661	0,1127
Test critical values:	1% level		-3,971526	
	5% level		-3,416401	
	10% level		-3,130514	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(LSVSMLSP)				
Method: Least Squares				
Sample (adjusted): 1/06/2006 8/20/2008				
Included observations: 684 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LSVSMLSP(-1)	-0,03405	0,011068	-3,076661	0,0022
D(LSVSMLSP(-1))	-0,16657	0,03853	-4,323088	0
D(LSVSMLSP(-2))	-0,06544	0,038311	-1,708057	0,0881
C	-0,01001	0,004359	-2,29679	0,0219
0,000166168	3,16E-05	1,20E-05	2,639387	8,50E-03
R-squared	0,049042	Mean dependent var		0,000705
Adjusted R-squared	4,34E-02	S.D. dependent var		0,037107
S.E. of regression	0,036293	Akaike info criterion		-3,78713
Sum squared resid	0,894343	Schwarz criterion		-3,75403
Log likelihood	1300,198	Hannan-Quinn criter.		-3,77432
F-statistic	8,754172	Durbin-Watson stat		2,002647
Prob(F-statistic)	0,000001			

Appendix 6 Johansen cointegration test results: Trace Statistics.

Bilateral cointegration

Series	Hypothesised Number of Cointegrated Equations	Trace Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LBEL and LCRO	r = 0	10.80534	15.41	20	0
	r ≤ 1	0.887205	3.76	7	
LBEL and LSASX	r = 0	32.16284	15.41	20	1**
	r ≤ 1	2.378851	3.76	7	
LBEL and LSVSM	r = 0	22.45434	15.41	20	1**
	r ≤ 1	2.367332	3.76	7	
LCRO and LSASX	r = 0	13.09351	15.41	20	0
	r ≤ 1	0.494206	3.76	7	
LCRO and LSVSM	r = 0	18.69306	15.41	20	2*
	r ≤ 1	5.595803	3.76	7	
LSASX and LSVSM	r = 0	26.63553	15.41	20	1**
	r ≤ 1	2.495693	3.76	7	

Multilateral cointegration among stock markets of former Yugoslav countries

Series	Hypothesised Number of Cointegrated Equations	Trace Statistic	5% Critical Value	1% Critical Value	Number of Cointegrating Equations
LBEL-LCRO-LSASX-LSVSM	r = 0	63.89812	47.21	54	1**
	r ≤ 1	27.81417	29.68	36	
	r ≤ 2	13.12187	15.41	20	
	r ≤ 3	2.979565	3.76	7	