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Financial Integration of South Eastern Europe and the European Union

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28.06.2007 Kremena Mihaylova

DECLARATION

I confirm that I have written this master thesis independently and that I have used only the sources indicated.

28.06.2007

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ABSTRACT

In my thesis I lay a stress on the financial integration of several countries in South Eastern Europe (Bulgaria, Romania, Croatia and Slovenia) and the EU. I use the concept of beta and sigma convergence in order to estimate the speed of convergence and the degree of financial integration of the countries in question. I examine the unsecured segment of the money market and the foreign exchange markets. My empirical findings suggest that the speed of financial integration of the examined countries and the EU is high.

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1. Introduction

Recently there have been a number of developments pointing towards the ongoing process of financial and economic integration between the South Eastern European region and the European Union (EU). The financial sector has converged to a universal bank-based system predominantly owned by EU financial institutions. The presence of foreign banks is associated with a more stable lending environment and better government and risk management. This has been supported by the process of bringing domestic supervisory standards in line with the EU regulation framework. Improvements in the institutional environment and financial deepening have preceded the full opening of the capital account which is considered to be the best approach to financial globalization. However, financial deepening and bringing institutional and governance standards in line with the EU practice are still far from being completed. Legislative reforms are still unfinished and important segments of the financial market, such as securities markets, are in several cases missing or underdeveloped. The efficient development of bank and financial intermediation are hampered by a weak judiciary system, weak property rights, ineffective contract enforcement and corruption. (Smaghi, 2006; Trichet, 2004)

The countries from South Eastern Europe are at different stages on their way to the EU. While Slovenia, Bulgaria and Romania are full members of the union, the rest of the countries in the region are still candidates or potential candidates of the EU.

This thesis concentrates on the issue of financial integration between South Eastern Europe and the EU, more precisely, on finding the degree and speed of money market integration and foreign exchange market integration. The thesis is structured in the following manner: Section 2 gives a theoretical review of the definitions of financial integration, the potential costs and benefits for it and the categories of measures of financial integration. This is the section which describes the methodology I employ in the next Section 3 and Section 4 to estimate the speed and degree of convergence of money market and foreign exchange market integration. The overnight, the 3-month and the 1-year segments of the unsecured money market are examined over the period between January, 2001 and the middle of March, 2007. The sample countries from the South Eastern European region include Bulgaria, Romania, Croatia and Slovenia. Due to the unavailability of data other countries from the region, such as Macedonia and Serbia are not included. The Czech Republic is also within the research as a representative Central European country and an EU member since 2004.

The last Section 5 gives some concluding remarks.

2. Theoretical review

2.1. Definition of financial integration

According to George M. Von Furstenberg, (1998), definitions of international financial integration may be divided into two groups. The first one approaches the subject from the side of necessary preconditions for such integration which include removing of capital controls and regulatory, legal and tax obstacles between foreign and domestic suppliers of financial services. In view of this class of definitions financial integration does not arise spontaneously as soon as legal barriers are lifted. Rather it is the possible end result of an organized process aiming at the development and better functioning of the financial markets. Institutional prerequisites for international financial integration can be the introduction of standardized, internationally tradable financial products and of quotation and trading systems, introduction of international conventions and the adoption of mutually recognized regulatory, supervisory, large-value transfer and final-settlement practices.

A definition belonging to this group of definitions of financial integration is given by Baele et al. (2004). It states that market for a given set of financial instruments and/or services is fully integrated if all potential market participants with the same relevant characteristics face a single set of rules when deciding to deal with those financial instruments and/or services; have equal access to the above-mentioned set of financial instruments and/or services; are treated equally when they are active in the market. Baele et al. (2004) point out three important features of their definition of financial integration.

Firstly, it follows that financial integration is independent of the financial structures within regions. Financial structures include all financial intermediaries (institutions or markets) and their relationship with respect to the flow of funds to and from households, governments and corporations. Regions may develop different financial structures before integration takes place and these different structures may remain once regions are integrated. As Hartmann et al. (2003) notices the importance of currency deposits and of loans in different euro area countries has become more heterogeneous over time and even during the period following the introduction of the euro.

Secondly, financial integration is not about removing frictions that impede the optimal allocation of capital but it is concerned with the symmetric or asymmetric effects of existing frictions on different areas. Frictions in the process of intermediation (the access to or investment of capital either through institutions or markets) may persist after financial integration is completed. But even if frictions are present several areas can be financially integrated if frictions affect these regions symmetrically.

Thirdly, full integration implies the same access to banks or trading, clearing and settlement platforms for both investors and firms, regardless of their region of origin. Once access has been granted full integration requires no discrimination among comparable market participants based solely on the location of their origin. An area may not favour the access of domestic investors over foreign ones, but may impose constraints on listings of foreign firms on the domestic exchange. In this case the region is partially financially integrated.

Baele et al. (2004) state that from this definition follows that the law of one price holds. If the law of one price does not hold, then there are arbitrage opportunities. But if the investment of capital is non-discriminatory, then investors will be free to exploit the arbitrage opportunities, which will cease to exist afterwards and by that restoring the validity of the law of one price.

The second class of definitions is closely connected to testable consequences of financial integration. Many authors say that financial markets are integrated when the law of one price holds (Adam et al., 2002; Pauer, 2005). According to it assets generating identical cash flows command the same returns, regardless of where they are transacted.

2.2. Potential benefits and costs of financial integration

2.2.1. Potential benefits of financial integration

According to Freixas et al. (2004) there are two strands of literature evaluating the merits and deficiencies of financial integration. The first is from the macroeconomic point of view and considers the implications of financial integration for capital flows between countries. Four are the effects that are considered: on risk sharing for consumption smoothing, domestic investment and growth, macroeconomic discipline, and efficiency.

The second strand of literature emphasizes on the microeconomic side. It focuses on the effects on portfolio allocations, the opportunities available to savers and borrowers and the impact on individual components of the financial sector.

- Benefits of international risk sharing for consumption smoothing

By allowing a country to borrow in "bad" times (for example, during a recession or a sharp deterioration in the country's terms of trade) and lend in "good" times (for example, in an expansion or following an improvement in the country's terms of trade) access to world capital markets can enable a country to engage in risk sharing and consumption smoothing. (Agenor, 2003) According to Obstfeld (1994) access to world capital markets allows countries to borrow to smooth consumption during times of adverse shocks and the potential growth and welfare gains which result from such international risk sharing may be large and permanent. If shocks have a temporary character this counter-cyclical role of world capital markets is very important.

- The positive impact of capital flows on domestic investment and growth

In countries where the level of income is low net foreign capital inflows may supplement domestic saving, increase physical capital per worker and help the recipient country raise its rate of growth, as long as the marginal return from investment is at least equal to the cost of (borrowed) capital. These potential benefits may be very large for foreign direct investment (FDI) as FDI may have significant indirect long-run effects. (Agenor, 2003). As it was noted by Grossman and Helpman (1991), FDI can facilitate the transfer of diffusion of managerial and technological know-how – especially in the form of new varieties of capital inputs – and improve the skills of the labor force as a result of "learning by doing" effects, investment in formal education, and on-the-job training. According to Markusen and Venables (1999), though the profit of local firms might be reduced by the increased degree of competition in the product and factor markets, induced by FDI, the spillover effects through linkages to supplier industries can reduce input costs, raise profits and stimulate domestic investment.

Levine (2001) states that international financial integration can positively affect the growth rate of a country through its effect on total factor productivity. Firstly, liberalizing restrictions on international portfolio flows tends to enhance stock market liquidity which accelerates economic growth mainly by boosting productivity growth. Secondly, allowing greater foreign bank presence tends to enhance the domestic banking system efficiency which improves the resource allocation, especially accumulation of capital and allocation of risk. A better resource allocation increases the marginal product of capital on average and the increased opportunities for wealth diversification reduce the risk. This leads to a higher return on capital and therefore a higher savings. Increased savings together with an increased total factor productivity due to the improvements in resource allocation result in higher economic growth (Rusek, 2004).

However, some theories predict that international financial integration promotes growth only in countries with sound institutions and good policies. Boyd and Smith (1992) show that international financial integration in countries with weak institutions and policies (weak financial and legal systems) may induce a capital outflow from capital-scarce countries to capital-abundant countries with better institutions. Edison et al. (2002) find that although international financial integration is associated with high level of GDP per capita and strong institutions it does not stimulate economic growth.

- Enhanced macroeconomic discipline

According to Obstfeld (1998) a main potential positive role of the free flow of capital across borders is to discipline policymakers. Unsound policies, such as excessive government borrowing or inadequate bank regulation would induce capital outflows and higher domestic interest rates. This may induce countries to follow more disciplined macroeconomic policies. External financial liberalization may act as a "signal" that a country is willing or ready to adopt "sound" macroeconomic policies, for example by reducing budget deficits and forgoing the use of the inflation tax (Bartoilini and Drazen, 1997). Thus an open capital account can encourage macroeconomic and financial stability, ensuring a more efficient allocation of resources and higher economic growth.

- Increased efficiency and greater stability of the domestic financial system associated with foreign bank penetration

Financial stability is a condition where financial system, i.e. financial markets, financial institutions and financial infrastructures, is directing capital to its most profitable (risk-adjusted) use without major disturbances (ECB's Financial Stability Review, Dec 2004). According to this definition the stability of a liberalized financial system is part of its efficiency, i.e. the capability of allocating capital in the most efficient manner. Therefore increased efficiency brought about by the integration process will provide a higher degree of stability in the long run (Pauer, 2005).

Caprio and Honohan (1999) state that foreign bank penetration may improve the quality and availability of financial services in the domestic market. As a result of the increased bank competition and the application of more sophisticated banking techniques and technology (for example more advanced risk management systems) the cost of acquiring and processing information on potential borrowers may be reduced and the bank-efficiency improved. The foreign bank penetration may enhance a country's access to international capital and improve the domestic bank supervisory and legal framework (in the case when the local foreign banks are supervised on a consolidated basis with their parent). It also improves the stability of the domestic financial system since in periods of financial instability depositors have the opportunity to shift their funds to foreign institutions (which are believed to be more sound than domestically owned banks) in stead of transferring assets abroad in the form of capital flight. (Agenor, 2003)

- Better opportunities available to savers and borrowers

The elimination of barriers to free flow of capital leads to a bigger variety of forms in which savers can invest and firms can borrow. By having access to foreign as well as domestic assets and financial instruments savers can achieve a greater degree of portfolio diversification. A factor, contributing to the existence of the "home-country bias", by which savers prefer to invest in domestic rather than foreign assets, might be regulatory differences. Therefore financial integration allows savers to move closer towards holding the world portfolio.

On the borrowing side, financial integration intensifies the degree of competition in the lending market and broadens the range of sources of finance. Thus borrowers can search across a broader range of lenders for the lowest-cost source of finance.(Freixas et al., 2004)

2.2.2. Potential costs of financial integration

Open financial markets may generate significant potential costs. This part follows strongly Agenor (2003) who classifies them into the following main groups:

- ✓ a high degree of concentration of capital flows and lack of access to financing for small countries, either permanently or when they most need it

Access to capital markets may be pro-cyclical and asymmetric which results in macroeconomic instability.

- ✓ domestic misallocation of capital flows

The impact of capital inflows on long-run growth may be limited if they are used to finance speculative or low-quality domestic investment, such as investment in the real estate sector. Low-productivity investments in the non-tradables sector can decrease over time the economy's capacity to export and lead to external imbalances.

- ✓ Loss of macroeconomic stability

The large capital inflows may induce rapid monetary expansion due to the difficulty and cost of pursuing sterilization policies, inflation resulting from the effect of capital inflows on domestic spending, real exchange appreciation and widening current account deficits.

- ✓ Pro-cyclicality of short-term flows

Access to capital markets may be pro-cyclical and countries may be able to borrow only in “good” times whereas in “bad” times they might face credit constraints. In such conditions countries do not have the possibility to borrow to smooth consumption in the face of temporary adverse shocks. In addition the pro-cyclicality may increase macroeconomic instability as favourable shocks may attract large capital inflows and encourage consumption and spending at unsustainable levels in the longer term, forcing countries to over-adjust at the moment of an adverse shock.

- ✓ Herding, contagion and volatility of capital flows

A high degree of financial openness may be associated with a high degree of volatility in capital movements. The possibility of large reversal of short-term capital flows creates risk of bank runs and financial crises if the level of short-term debt relative to the borrowing country’s international reserves is high.

Herding behaviour often translates into large movements into and out of certain types of assets and causes fluctuations in asset prices and capital movements.

Volatility of capital flows may be due to contagion effects. Financial contagion may be induced when a country suffers large outflows of capital caused by loss of confidence in the country’s economic prospects as a result of developments elsewhere (Dornbusch, Park and Claessens, 2000).

- ✓ Risks, associated with foreign bank penetration

Foreign banks may concentrate their lending only to the most creditworthy corporate borrowers and to a lesser extent households. In this case their presence is less likely to contribute to an overall increase in efficiency in the financial sector.

Entry of foreign banks with lower operational cost may create pressure on local banks to merge and thus create monopoly power that would reduce the overall efficiency of the banking system. High degree of concentration may yield higher interest rate spreads (relative to competitive credit and deposit markets) and a smaller amount of loans than in a more competitive system.

In addition, the entry of foreign banks may not enhance the stability of the banking system. If, for example, the economy undergoes a persistent recession leading to large increase in default rates and a rise in the amount of non-performing loans, foreign banks may tend to cut lines of credit to domestic borrowers.

2.3. Measuring financial integration

Baele et al. (2004) consider three broad categories of measures of financial integration. The first two categories are based on the law of one price: price-based and news-based measures. The third broad group comprises quantity-based measures of integration.

- Price-based measures

They measure discrepancies in prices or returns on assets due to geographic origin of assets and are a direct application of the law of one price (mentioned as a basis for the definition of financial integration given by Adam et al., 2002; Pauer, 2005). For assets with sufficiently similar characteristics these measures constitute direct price or yield comparisons. Otherwise differences in systematic (nondiversifiable) risk factors and other characteristics have to be considered. According to these measures euro area assets generating identical cash flows and having the same risk should be traded at the same price. Hence markets are integrated as long as the rate at which cash flows are discounted is equal across markets. Exchange rate risk (prior to the introduction of the euro in 1999) and some restrictions on the free movement of capital which still exist (such as differences in tax rates and fragmentation in trading, settlement and payment systems across countries) may prevent discount factors from equalising.

- News-based measures

In a financially integrated area portfolios should be well-diversified (thus purely local shocks would be avoided) and new economic information of a regional character would have little impact on prices while global news should be more important. Therefore local shocks should not be a systematic risk and an alternative measure of integration is the proportion of asset price changes which is explained by global factors (relevant news common to assets across all the countries).

- Quantity-based measures

According to Adam et al. (2002) they may be flow measures (for example international capital flows) or stock measures such as the amount of cross-border holdings of equity and debt.

2.3.1. Concept of beta-convergence

Financial integration maybe measured by means of beta convergence test. The concept of beta-convergence originates at the growth literature. Adam et al. (2002) use this approach to determine the speed of convergence. This measure involves running the following regression:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t-1} + \sum_{k=1}^{L} \delta_k \Delta R_{i,t-k} + \varepsilon_{i,t} \ , \qquad (1)$$

where $R_{i,t}$ is the return spread of specific assets between country i and some relevant benchmark rate at time t – here this is the difference in the yields of a specific asset of country i and the yield of the respective Euro area asset. Δ represents the difference operator and α_i is the country specific constant, $\varepsilon_{i,t}$ is the white-noise disturbance. The yields are computed using the following equation:

$$Y_t^x = [\log(A_t^x) - \log(A_{t-1}^x)].100 \, , \qquad (2)$$

where (Y) is the percentage return of the asset, (A) is the value of the relevant index for the asset and (x) is a country index.

A negative β coefficient in regression (1) indicates that yields in countries with relatively high yields have a tendency to decrease more rapidly than in countries with relatively low yields (Baele et al., 2004). Moreover, the size of β provides a direct measure of the speed of convergence. A negative β is a signal that convergence is taking place and the estimated regression tests the null hypothesis, where with β=0 no convergence is observable. The magnitude of β indicates the speed of convergence in that the higher its observed absolute value becomes, the faster the convergence process (Hölscher, 2002).

To analyse whether the speed of convergence is larger in one period relative to another, one can decompose β in $\beta = \beta_1 I + (1 - I)\beta_2$, where I is a dummy variable that takes on the value of 1 in a particular sub-period.

2.3.2. Concept of sigma-convergence

Adam et al. (2002) borrowed also from the growth as a measure of the degree of integration the concept of sigma-convergence. The application to financial markets consists in calculating the cross-sectional dispersion in the return spread of specific assets as a measure of the degree of integration. In the present context, the degree of financial integration increases when the cross-sectional standard deviation of a variable, such as interest rates, is trending downward. Typically one calculates the standard deviation of the log values of the variable of interest according to the following equation:

$$\sigma_t^{\,2} = \left(\frac{1}{N}\right)\sum_{k=1}^{N}\left[\log(y_{kt}) - \mu_t\right]^2 \tag{3}$$

where (y_{kt}) is the return of the asset for country k = 1, 2, …, N and (μ_t) is the log mean value of the data set in time (t). If the cross-sectional distribution collapses to a single point, and the standard deviation converges to zero, full integration is achieved.

It is important to note that the two convergence indicators have different informational contents: beta-convergence does not imply sigma-convergence. The reason is that mean reversion does not imply that the cross sectional variance decreases over time. In fact, beta-convergence could even be associated with sigma-divergence (see Quah (1993) for further details on this issue).

2.3.3. Correlation analysis

For testing the existence of a linear relationship between two time series the standard correlation analysis can be used. The correlation coefficient measures the degree to which two time series vary together or oppositely. The maximum positive correlation is 1.00. Since the correlation is the average product of the standard scores for the cases on two variables, and since the standard deviation of standardized data is 1.00, then if the two standardized variables covary positively and perfectly, the average of their products across the cases will equal 1.00. On the other hand, if the two time series vary oppositely and perfectly, then the correlation will equal -1.00. The measuring of zero or near zero correlation mean that the time series vary separately, that is, when the magnitudes of one of them are high, the other's magnitudes are sometimes high, and sometimes low. (Rummel, 1976). The case of insignificant correlation coefficient does not exclude the existence of a non-linear relationship between the time series.

3. Money market integration

The money market generally refers to the wholesale inter-bank market for low-risk and highly liquid short-term debt instruments. It enables banks and other entities to receive large amounts of money from other banks and liquid entities. The money market comprises several different markets with respect to the specific and distinct instruments used by the agents. The most significant segments of the money market are the unsecured deposit market (where credit institutions exchange short-term liquidity without the guarantee of collateral), the swap market (in which market fixed interest payments are exchanged for floating interest rate payments), the repo market (in which agents exchange short-term liquidity against collateral), the futures markets for short-term instruments and the markets for short-term securities as Treasury bills, commercial paper and other assets (Santillan et al, 2000).

Here, I study the integration of the unsecured money markets in Bulgaria, Romania, Croatia, Slovenia, Czech Republic and the EU. Rates of the type ONIA (OverNight Index Average) for the overnight segment of the market and of the type IBOR for the three-month and one-year maturities have been used. The respective interbank rates for the studied countries are listed in the following table and described underneath.

Table 1 Interbank rates

Country	ONIA	3 Month IBOR	1 Year IBOR
Croatia	ZIBOR Overnight	ZIBOR 3M	ZIBOR1Y
Bulgaria	SOFIBOR Overnight	SOFIBOR 3M	BLSWE1
Romania	BUBOR Overnight	BUBOR3M	BUBOR12M
Slovenia	SITION	SITI3M	SITI1Y
Czech Republic	PRIBOR	PRIBO3M	PRIBOR1Y
Euro area	EONIA	EUROO3M	EURO12M

- ZIBOR (Zagreb Interbank Offered Rate) represents a unique referential offering interest rate for Kuna funds on the Croatia inter-bank money market. ZIBOR maintains the average rate for deposits in Croatian Kuna in the referential banks on Croatian market, with internationally recognized maturities, ranging from overnight loans to six-month placements. The official calculator of the ZIBOR on any given day is infoforum d.o.o., a member of the Infoinvest.hr group. The calculation of the average is conducted based upon values quoted on the web pages of the Financial Service http://biznis.hinet.hr/FS at exactly 11:00 a.m., local time.
- The SOFIBOR (Sofia Interbank Offered Rate) Reference Rate is a fixing of the quotes for unsecured BGN deposits offered in the Bulgarian interbank market. It is produced for a set of maturities at 11:00 a.m. (local time) every business day as an average of the ask quotes provided by a representative panel of banks. Contributor banks also provide the respective bid rates, which are averaged by analogy with the fixing. The resultant value is called SOFIBID (Sofia Interbank Bid Rates) Reference Rate.
- Bucharest Intrabank Bid Rate (BUBID) and Bucharest Inetrbank Offered Rate (BUBOR) are the reference interest rates on the Romanian interbank market. Rates are ordinary arithmetic average of daily quotes for eight maturities provided by ten biggest Romanian banks. Fixings are held at 11 a.m. local time.

- Slovenian interbank rates SITIBID (asked) and SITIBOR (offered) interest rates of unsecured banking deposits with individual maturities are being calculated daily at 11 a.m. as an ordinary arithmetic average of two central quartiles of eight daily quotations by eight Slovenian banks. The rates are being published by 11:30 a.m.
- PRIBOR (The Prague Interbank Offered Rate) is the reference rate of the Czech money market. It is sponsored by the Financial Markets Association of the Czech Republic (formerly Czech Forex Club), which selects a calculation and the reference banks. The reference banks provide the calculation agent with the quotations and the calculation agent (currently MoneyLine Telerate) computes the PRIBOR from the quotations. The PRIBOR is computed as a trimmed mean of available quotations after elimination of the highest and lowest quotations (~ 15-20 % each side). PRIBOR is quoted for spot value (with the exception of O/N maturity) and on act/360 convention. It is disseminated at 11:00 a.m. local time (Prague).
- Effective Overnight Index Average EONIA (Euro Overnight Index Average) is an effective overnight rate computed as a weighted average of all overnight unsecured lending transactions in the interbank market, initiated within the euro area by the contributing panel banks. Daily reports are provided by the same panel of 57 banks as quote for Euribor. It is reported on an act/360 day count and is calculated by the European Central Bank.
- Euribor (Euro Interbank Offered Rate) is the benchmark rate of the large euro money market. It is sponsored by the European Banking Federation which represents 2,800 banks in the twelve member States of the European Union and the EMU division of ACI, the Financial Markets Association. A representative sample of prime banks will provide daily quotes – for thirteen maturities from one week to one year – at which intebank term deposits denominated in euro are being offered within the euro zone between prime banks. The average rate is calculated after elimination of the highest/lowest quotations (15% each side). Euribor is quoted for spot value (T+2) and on an actual/360 day-count

convention, and are distributed from 4 January 1999 to three decimals. It will be disseminated at 11:00 a.m., Brussels time

3.1. Overnight segment of the unsecured money market

3.1.1. Data

In this section I present the data and some descriptive statistics (Table 2). At my disposal, I have the daily data on the ONIA for Bulgaria, Romania, Croatia, Slovenia and the Czech Republic and EU. For Romania, Croatia, the Czech Republic and EU the data is between January, 2001 and the middle of March, 2007. For Bulgaria the available data is between the middle of February, 2003 and the middle of March, 2007 with missing observations between May, 2005 and July, 2005. The available data for Slovenia is over the period from 2002 to 2006.

Table 2 presents the descriptive statistics of the data. For all but the Bulgarian indexes, on the basis of the reported Jarque-Bera statistic the hypothesis of normal distribution of the data can be rejected at 1% significance level. For the Bulgarian ONIA the null hypothesis of normal distribution of the series can be rejected at 10% level of significance.

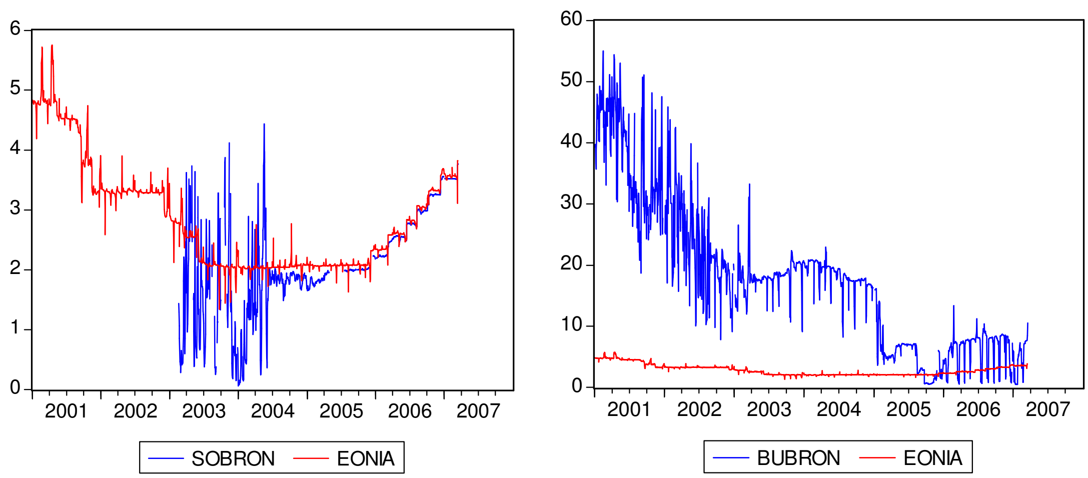
The developments of the ONIA over the studied period are shown in Figure 1. Generally, the overnight indexes for the sample countries from South-Eastern Europe exhibit a different and a very volatile behaviour. An explanation for the high volatility may be the low liquidity of the markets. The Bulgarian ONIA becomes less volatile and converges to the EU ONIA after the year 2004. The volatility of the Croatian and Slovenian ONIA decreases after 2005 and 2003 respectively. The Romanian ONIA exhibits a decreasing trend and is very volatile over the whole studied period. A lower volatility and a similar behaviour show the ONIA for the Czech Republic and the EU.

Table 2: Descriptive statistics for ONIA

	Bulgaria	Romania	Croatia	Slovenia	Cz	EU
Mean	2.09	17.60	3.23	4.41	2.73	2.85
Median	1.99	17.63	2.39	4.06	2.37	2.60
Maximum	4.44	55.00	10.75	7.25	5.82	5.75
Minimum	0.06	0.50	0.50	2.98	0.95	1.34
Std. Dev.	0.85	12.04	2.23	0.86	1.13	0.88
Skewness	-0.15	0.80	1.52	1.10	1.07	0.94
Kurtosis	2.80	3.17	4.70	3.19	2.71	3.07
Jarque-Bera	4.92	170.11	796.91	258.12	313.87	236.66
	[0.09]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	933	1585	1578	1274	1610	1618

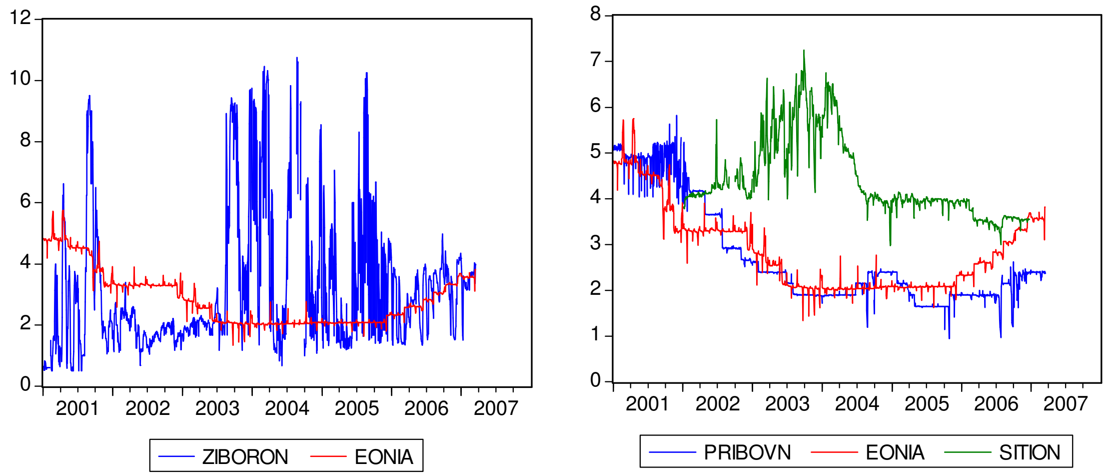
Notes: p-values are reported in the brackets.

Figure 1 Indexes type ONIA



Notes: SOBRON -Bulgaria; BUBRON - Romania; ZIBORON - Croatia; SITION - Slovenia; PRIBOVN - Czech Republic; EONIA - EU
Source: Bloomberg

Figure 1 Indexes type ONIA



Notes: SOBRON -Bulgaria; BUBRON - Romania; ZIBORON - Croatia; SITION - Slovenia; PRIBOVN - Czech Republic; EONIA - EU
Source: Bloomberg

3.1.2. Simple correlation analysis

In this section I study the simple correlation analysis among the logarithmic returns of the ONIA of Bulgaria, Romania, Croatia, Slovenia, the Czech Republic and EU. The logarithmic returns are calculated using equation (2). The results show no significant linear relationship among the logarithmic returns of the indexes as all the correlation coefficients reported in Table 3 below are around 0. Nevertheless, another kind of relationship such as quadratic, hyperbolic or other cannot be excluded.

Table 3 Bilateral correlation coefficients among the logarithmic returns of ONIA

	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**	**EU**
Bulgaria	1.00	0.01	0.02	0.09	0.05	0.02
Romania	0.01	1.00	-0.04	-0.02	0.00	-0.03
Croatia	0.02	-0.04	1.00	0.06	-0.01	0.06
Slovenia	0.09	-0.02	0.06	1.00	0.02	0.06
Cz	0.05	0.00	-0.01	0.02	1.00	0.00
EU	0.02	-0.03	0.06	0.06	0.00	1.00

3.1.3. Beta convergence

This chapter studies the better convergence of the overnight segment of the unsecured money market. Firstly an OLS regression of equation (1) is performed, where $R_{i,t}$ is the return spread of ONIA between country *i* and the Euro area at time t, Δ is a difference operator, (α) is a constant and (L) is the lag length, which is set upon the Schwarz and Akaike information criteria. The highest number of included lags (11) is for the Czech Republic which shows a long memory of the data. The lowest (1) is for Romania and Slovenia. Investigation of the standardized residuals of this regression for all of the studied countries shows a leptokurtic distribution (kurtosis is positive and "fat tails" are present; histogram – normality test is provided in the Appendix 1.1.) and signs for serial correlation. Correlograms of the squared residuals suggest there may be conditional on past information heteroskedasticity. The ARCH LM test is performed and it indicates that the residuals are serially correlated and the equation should be re-specified before using it for hypothesis and forecasting (Appendix 1.2. provides the results of ARCH LM test). To correct the deficiencies of least squares, ARCH models (autoregressive conditional heteroskedasticity) which were introduced by Engle (1982) and generalized as GARCH models (generalized autoregressive conditional heteroskedasticity), by Bollerslev, 1986, can be applied. They treat heteroskedasticity as a variance to be modeled and compute a prediction for the variance of each error term. The most widely used GARCH specification states that the best predictor of the variance in the next period is a weighted average of the long-run average variance, the variance predicted for this period, and the new information in this period which is captured by the most recent squared residual (Engle, 2001). Typically, it can be written this way:

$$\mathrm{E}(u_t)^2 = h_t = w + \alpha_1 u_{t-1}^2 + ... + \alpha_q u_{t-q}^2 + \beta_1 h_{t-1} + ... + \beta_p h_{t-p} \, ,$$

where $w > 0$, $\alpha_1 \geq 0, \ldots, \alpha_q \geq 0$, $q > 0$, $p \geq 0$, $\beta_1 \geq 0, \ldots, \beta_p \geq 0$.

If the sum of all α's and β's is strictly smaller than 1, GARCH (p,q) is stationary.

The performance of GARCH requires continuous samples. The missing observations for the studied period for all of the investigated countries but Bulgaria are filled in by the use of a linear trend in Excel on the basis of the previous 20 values. In the cases where a single observation is missing the value of the previous day is taken. As there are a lot of missing observations for the studied period for Bulgaria, ARCH and GARCH models are not performed.

The results of beta convergence analysis are given in Table 4. The obtained β values are negative for all the studied countries but Bulgaria. Hence there is convergence with the highest speed (indicated by the biggest absolute value of beta) for the Czech Republic, followed by Slovenia, Bulgaria, Croatia and Romania. The absolute values of the beta coefficient for these states are close to one (and even bigger than 1 in the case of the Czech Republic and Slovenia) which means that the leveling of newly arising differences in return differential between the relevant national economy and the euro area can be considered as fast. All of the obtained beta coefficients are significant at 1 percent level. The country specific constant (α) is not significant for all of the states which is also evidence for the process of convergence for these states.

The obtained coefficients in the variance equations are significant and positive as required form the specification of GARCH. models. The sum of the ARCH and GARCH coefficients is less than 1 (except of the case of Slovenia where it equals 1.02) which is required to have a mean reverting variance process. Since the sum is very close to one this process reverts slowly. The standardized residuals are examined for autocorrelation by the use of ARCH LM test which suggests that we can accept the hypothesis of "no residual ARCH". (see Appendix 1.2)

Table 4 Beta convergence - ONIA

	Bulgaria	Romania	Croatia	Slovenia	Cz
α	0.4798 (1.6556)	-0.193 (0.2205)	-0.3719 (0.6293)	0.0195 (0.0549)	0.0156 (0.1234)
β	-1.0732*** (0.1135)	-0.9268*** (0.0659)	-0.9889*** (0.0972)	-1.0988*** (0.037)	-1.1741*** (0.2353)
Number of included lags	2	1	4	1	11
Number of Observations	862	1258	1331	1178	1184

Variance Equation

	Romania	Croatia	Slovenia	Cz
C	15.4386*** (1.8485)	4.5155* (2.4663)	0.4318*** (0.0455)	1.7140*** (0.4368)
ARCH (1)	2.3546*** (0.4288)	0.0838*** (0.0169)	0.2959*** (0.0214)	0.3910*** (0.0756)
ARCH (2)	0.6322*** (0.1568)	-	-	-
GARCH (1)	-	0.9149*** (0.0171)	0.7251*** (0.0125)	0.6055*** (0.0602)

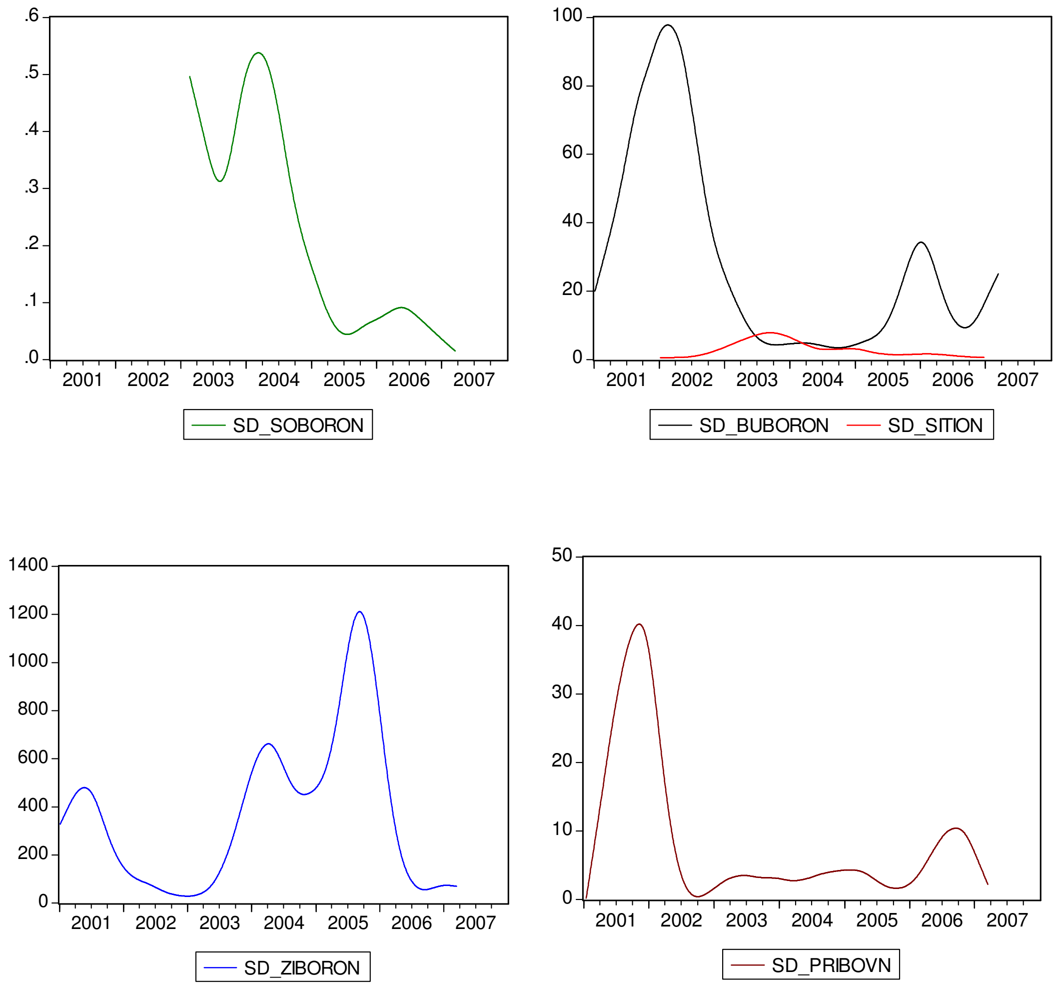
*Notes: Standard deviations in parenthesis; ***, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

3.1.4. Sigma convergence of ONIA

Here I study the sigma convergence of ONIA for the sample countries which assess the degree of integration at any point in time. I use equation (3) where k=1,2; (y_{1t}) is the return of the ONIA for Bulgaria, Romania, Croatia, Slovenia or Cz at time (t) and (y_{2t}) is the return of the ONIA for the eurozone at time (t), (μ_t) is the mean value between the logarithmic returns of the ONIA for the sample country and the eurozone at time (t). In order to see the trend of the sigma coefficients over time the resulting sigmas are filtered with Hodrick-Prescot filter. The resulting sigmas are plotted in Figure 2. The sigma of the Bulgarian ONIA radically decreases after the middle of the year 2004. It shows a slight increase after the middle of 2005 and from the middle of 2006 it is trending again downward and converges to zero. Therefore it can be concluded that there is sigma convergence and a very high degree of financial integration. It might be explained by the falling risk premium because of the EU entry of the country. Compared to the degree of integration between the ONIA of the rest of the examined countries and the EU, the Bulgarian ONIA shows the highest one. Probably this might be connected to the exchange rate regime of the country which is a currency board with exchange rate pegged to the euro.

Sigma convergence is evident for the ONIA of Slovenia, Croatia and the Czech Republic while for the Romanian ONIA there is evidence of sigma divergence.

Figure 2 – Sigma convergence of ONIA



Notes: SD – standard deviation; ZIBORON – Croatia; PRIBOVN – Czech Republic; SOBORON – Bulgaria; BUBORON – Romania; SITION - Slovenia

3.2. IBOR segment of the unsecured money market

3.2.1. 3Month IBOR

- **Data on 3 Month IBOR**

The data for IBOR consists of daily values for 3 Month and 1 Year IBOR. The data for the 3 Month IBOR for Romania, Croatia, Czech Republic and EU covers the period January, 2001 – middle of March, 2007. For Slovenia the data is from the beginning of 2002 till the end of 2006. The available data for Bulgaria starts from the middle of February and ends in the middle of March, 2007 and the series has missing observations from the beginning of May till the middle of July, 2005. Table 5 presents the descriptive statistics for the data on each of the studied countries.

Table 5 Descriptive statistics for 3 Month IBOR

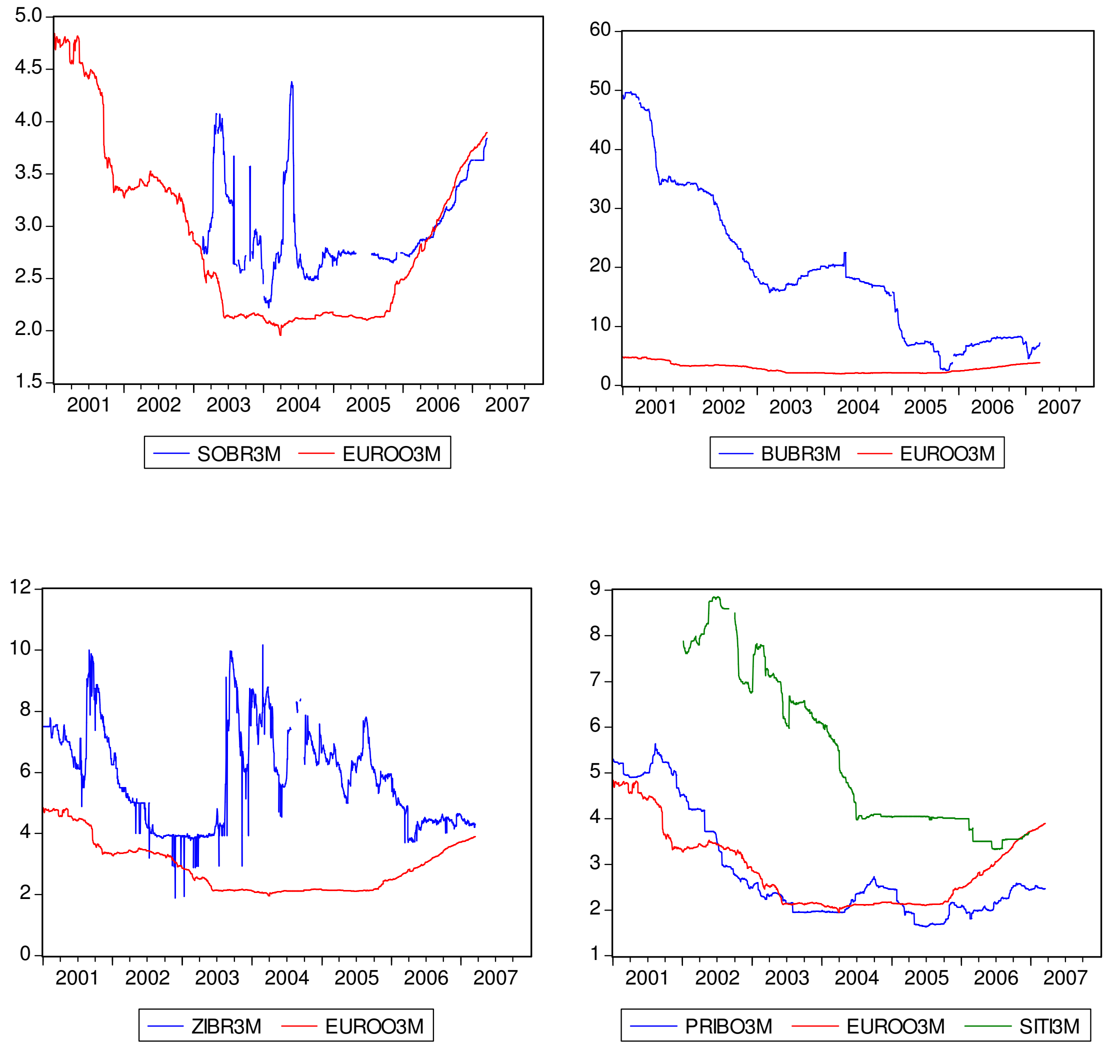
	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**	**EU**
Mean	3.12	28.63	5.76	7.34	3.56	3.30
Median	2.95	27.14	5.50	7.15	3.46	3.35
Maximum	4.08	49.81	10.00	8.85	5.64	4.84
Minimum	2.45	15.75	1.89	5.98	1.95	2.12
Std. Dev.	0.47	10.69	1.81	0.86	1.26	0.86
Skewness	0.68	0.55	0.44	0.21	0.11	0.26
Kurtosis	2.14	2.13	2.09	1.87	1.38	2.01
Jarque-Bera	21.24	62.69	52.49	30.01	87.43	40.39
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	197	771	782	498	782	782

Notes: p-values are reported in the brackets.

The developments of the 3 Month IBOR are shown in Figure 2. A downward trend exhibit the Romanian and Slovenian indexes, the Croatian index shows quite a volatile behaviour till the beginning of 2006. The Bulgarian 3 Month IBOR converges to the EU 3 Month IBOR from the year 2006 and is very volatile during the years 2003 and 2004.

A less volatile and converging to the behaviour of the 3 Month IBOR of the EU over the whole studied period exhibits the IBOR of the Czech Republic.

Figure 2 Developments of 3 Month IBOR



Notes: SOBR3M - Bulgaria; BUBR3M - Romania; ZIBR3M - Croatia;
SITI3M - Slovenia; PRIBO3M - Czech Republic; EUROO3M - EU
Source: Bloomberg

3.2.2. Simple correlation analysis of 3Month IBOR

The simple correlation analysis is made using the logarithmic returns of the 3Month IBOR of Bulgaria, Romania, Croatia, Slovenia, the Czech Republic and EU. The logarithmic returns are calculated using equation (2) and the resulting correlation coefficients are presented in Table 6. All of them are around 0 except for the coefficient between the logarithmic returns of the Bulgarian and the Czech 3Month IBOR. It equals 0.16 which shows a slight positive linear relationship. The rest of the correlation coefficients exhibit no significant linear relationship between the logarithmic returns of the indexes.

Table 6 Bilateral correlation coefficients among the logarithmic returns of 3Month IBOR

	Bulgaria	Romania	Croatia	Slovenia	Cz	EU
Bulgaria	1.00	-0.02	0.03	-0.01	-0.01	0.09
Romania	-0.02	1.00	0.01	0.00	0.01	0.06
Croatia	0.03	0.01	1.00	0.02	-0.01	0.02
Slovenia	-0.01	0.00	0.02	1.00	-0.02	0.09
Cz	-0.01	0.01	-0.01	-0.02	1.00	0.10
EU	0.09	0.06	0.02	0.09	0.10	1.00

3.2.3. Beta convergence of 3Month IBOR

The beta convergence analysis is presented in Table 7. Firstly, OLS regression on equation (1) from part 2.3.2 is run. Close examination of the resulting squared residuals show signs of autocorrelaton. The application of ARCH LM test confirms this (Apendix 2). Therefore ARCH and GARCH models are used for the specification of the variance equation. As the dataset is not continuous the missing observations are filled in using a linear trend in Excel on the basis of the previous 20 values.

Further investigation of the squared residuals shows no serial autocorrelation (the results from the ARCH LM test are provided in Appendix 2.2.).

All of the obtained beta coefficients are significant at 1% level of significance and have a negative sign which is to be interpreted as evidence for convergence. The highest speed of convergence is achieved by the 3 Month IBOR of Croatia since the absolute value of beta for this state is 0.79, followed by the Czech Republic (the absolute value of beta is 0.75), Bulgaria with absolute value of beta 0.7 and Romania and Slovenia which have almost the same absolute values of beta (around 0.63). The country specific constant (α) is significant at 10% level of significance only for Romania and Croatia and its value is around 0 which is also a confirmation of the process of convergence.

Table 7 Beta convergence 3 Month IBOR

	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**
α	0.0472 (0.0298)	-0.0487* (0.0294)	-0.0383* (0.0740)	-0.0365 (0.0119)	-0.0031 (0.0136)
β	-0.6965*** (0.0801)	-0.6339*** (0.0794)	-0.7882*** (0.1442)	-0.6304*** (0.0643)	-0.7518*** (0.0390)
Number of included lags	3	3	10	3	1
Number of Observations	616	1457	1199	1176	1541

Variance Equation

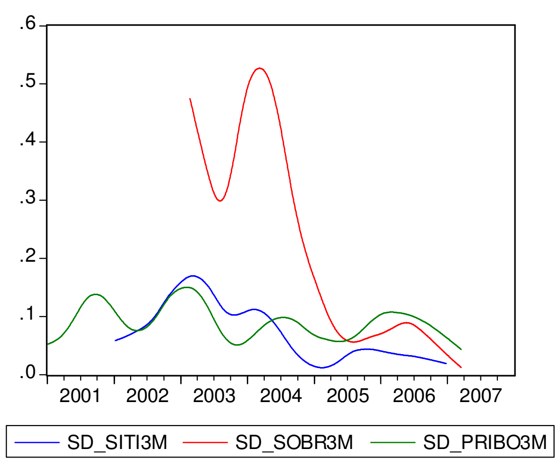
	Romania	**Croatia**	**Slovenia**	**Cz**
C	0.0083 (0.0058)	0.1210** (0.0607)	0.0136*** (0.0044)	0.1921*** (0.0171)
ARCH (1)	0.0480** (0.0228)	0.1420*** (0.0465)	0.2181*** (0.043)	0.4066*** (0.0827)
GARCH (1)	0.9504*** (0.0230)	0.8775*** (0.0359)	0.7346*** (0.0415)	-

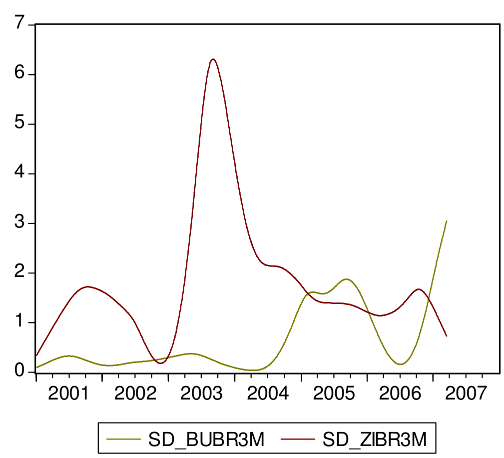
*Notes: Standard deviations in parenthesis; ***, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

3.2.4. Sigma convergence of 3Month IBOR

In this part of the thesis I study the sigma convergence of the 3Month IBOR of the countries under review and the 3Month IBOR of the eurozone. The sigma convergence analysis is made using equation (3) where k=1,2; (y_{1t}) is the return of the 3Month IBOR for Bulgaria, Romania, Croatia, Slovenia or the Czech Republic at time (t) and (y_{2t}) is the return of the 3Month IBOR for the eurozone at time (t), (μ_t) is the mean value between the logarithmic returns of the 3Month IBOR for the sample country and 3Month IBOR for the eurozone at time (t). Figure 3 presents the resulting values of sigma for each country. Sigma convergence is present for all of the sample countries except for Romania, where sigma divergence is evident. The sigmas of the Slovenian and the Czech 3Month IBOR show a very similar pattern and together with the sigma of the Bulgarian 3Month IBOR converge to zero. This implies a very high degree of integration between the 3Month IBOR of these countries and the eurozone one.

Figure 3 – Sigma convergence of 3Month IBOR





Notes: SOBR3M - Bulgaria; BUBR3M - Romania; ZIBR3M - Croatia; SITI3M - Slovenia; PRIBO3M - Czech Republic; EUROO3M - EU

3.2.5. 1Year IBOR

❖ **Data on 1Year IBOR**

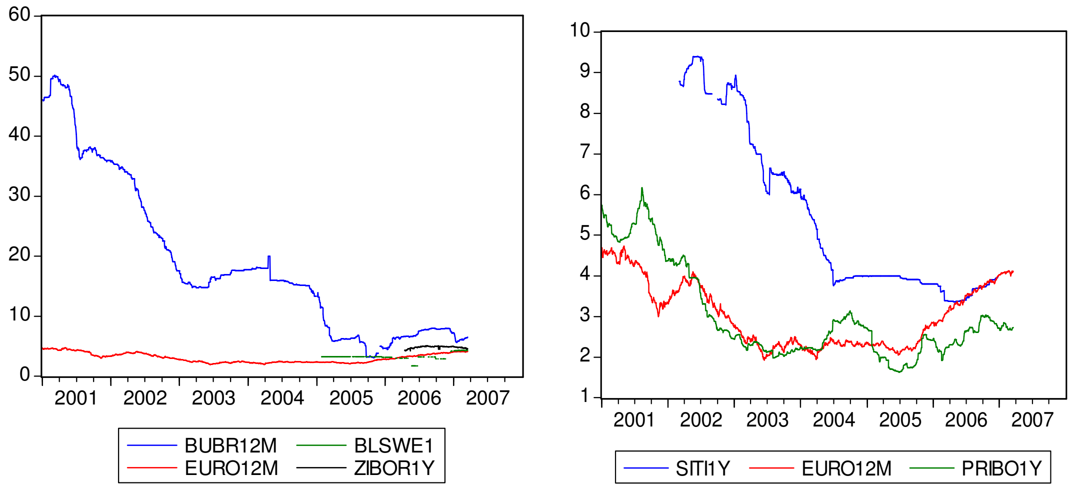
The available daily data on 1 Year IBOR for Romania, the Czech Republic and EU is for the period between January, 2001 and the middle of March, 2007. The datasets for Bulgaria and Croatia consist of fewer observations. For Bulgaria the available data starts at the end of January, 2005 and ends in the middle of March, 2007 while for Croatia the series is over the period middle of April, 2006 till the middle of March, 2007. Slovenian data covers the period March, 2002 till the end of 2006. The descriptive statistics of the data are presented in Table 8 below. Figure 3 underneath shows the developments of the indexes over the studied period. The Romanian and Slovenian 1Year IBOR exhibit a downward trend. The behaviour of the Bulgarian and Croatian 1 Year IBOR shows convergence to the EU 1Year IBOR though because of the lack of observations this can be mentioned only for the periods covered by the datasets. Convergence to the EU 1 Year IBOR over the whole period is evident for the IBOR of the Czech Republic.

Table 8 Descriptive statistics for 1 Year IBOR

	Bulgaria	Romania	Croatia	Slovenia	Cz	EU
Mean	3.28	18.85	4.82	5.4	3.01	3.03
Median	3.27	15.88	4.89	4.00	2.64	2.85
Maximum	4.33	50.12	5.06	9.4	6.17	4.73
Minimum	1.72	3.09	4.20	3.36	1.63	1.93
Std. Dev.	0.54	12.95	0.18	1.98	1.13	0.79
Skewness	-0.34	0.90	-1.38	0.76	1.11	0.45
Kurtosis	5.42	2.74	4.63	2.04	2.98	1.85
Jarque-Bera	104.41	220.10	103.05	166.96	335.14	144.19
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
Observations	397	1608	241	1235	1619	1619

Notes: p-values are reported in the brackets.

Figure 3 1Year IBOR



Notes: BLSWE1 - Bulgaria; BUBR12M - Romania; ZIBR1Y - Croatia;
SITI1Y - Slovenia; PRIBO1Y - Czech Republic; EURO12M - EU
Source: Bloomberg

3.2.6. Simple correlation analysis of 1Year IBOR

Table 9 consists of the bilateral correlation coefficients among the 1 Year IBOR which are calculated by the software Eviews. The correlation coefficient between the Bulgarian index and the Czech one has a value of 0.16 which is evidence for some positive linear relationship while the rest of the coefficients are around zero, showing no linear relationship among the 1Year IBOR of these countries.

Table 9 Bilateral correlation coefficients among the logarithmic returns of 1 Year IBOR

	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**	**EU**
Bulgaria	1.00	-0.12	0.08	0.02	-0.04	0.10
Romania	-0.12	1.00	0.04	-0.01	0.04	-0.01
Croatia	0.08	0.04	1.00	0.05	0.02	0.04
Slovenia	0.02	-0.01	0.05	1.00	-0.01	0.04
Cz	-0.04	0.04	0.02	-0.01	1.00	0.21
EU	0.10	-0.01	0.04	0.04	0.21	1.00

3.2.7. Beta convergence of 1Year IBOR

In this section I study the beta convergence for the 1Year IBOR of Bulgaria, Romania, Croatia, Slovenia and the Czech Republic. Firstly an OLS regression is run on equation (1), where $R_{i,t}$ is the return spread of 1Year IBOR between country *i* and the Euro area at time *t*, Δ is a difference operator, α is a constant and L is the lag length (set upon the Schwarz and Akaike information criteria). For all of the studied countries but Croatia the standardized residuals from this regression do not follow a normal distribution (histogram – normality test is provided in Appendix 3.1.) and investigation of their correlogram suggests for existence of serial correlation. Performance of ARCH LM test on the residuals from the OLS regression on equation (1) for all of the countries but Croatia confirms the existence of conditional on past information heteroscedasticity (Appendix 3.2.). Therefore ARCH (GARCH) models are used in order to improve the efficiency of estimates. As the sample needs to be continuous the missing observations for the studied period are filled in by the use of a linear trend in Excel on the basis of the previous 20 values. In the cases where a single value is missing the observation of the previous day is taken.

The results of the beta convergence analysis are presented in Table 10. The obtained values for beta for all of the studied countries are negative implying the existence of convergence. The highest speed of convergence has the Croatian 1 Year IBOR (the absolute value of beta is 1.3188) which may be due to the currency regime of the country. The National Bank of Croatia tries to maintain constant level of their currency to the euro (see section 4. Integration of Foreign Exchange Markets for details about the currency regimes). The absolute value of the beta for the Czech Republic 1 Year IBOR is close to 1 which also implies a high speed of convergence. It is followed by Slovenia which has a beta of -0.7874, Romania (with a beta of -0.7655) and Bulgaria (beta equals -0.6555). All of the beta coefficients are significant at the 1 percent level. The country specific constant α is significant only for Bulgaria (at the1 percent level of significance) and Romania (at the 10 percent level) and has values close to zero.

The coefficients in the variance equations are positive and the sum of ARCH and GARCH coefficients is less than one, as required form the GARCH specification. The correlograms of the snadardized residuals show no signs of autocorrelation. ARCH LM test confirms as well that there is no "residual ARCH" (the results of the ARCH LM test are provided in Appendix 3.2.).

`Table 10 Beta convergence 1 Year IBOR

	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**
α	-0.0955*** (0.022)	-0.051* (0.0287)	-0.0583 (0.0665)	-0.0391 (0.0257)	-0.0269 (0.0258)
β	-0.6555*** (0.0555)	-0.7655*** (0.0427	-1.3188*** (0.1107)	-0.7874*** (0.0684)	-0.935*** (0.0342)
Number of included lags	1	2	1	6	1
Number of Observations	495	1614	238	1247	1616

Variance Equation

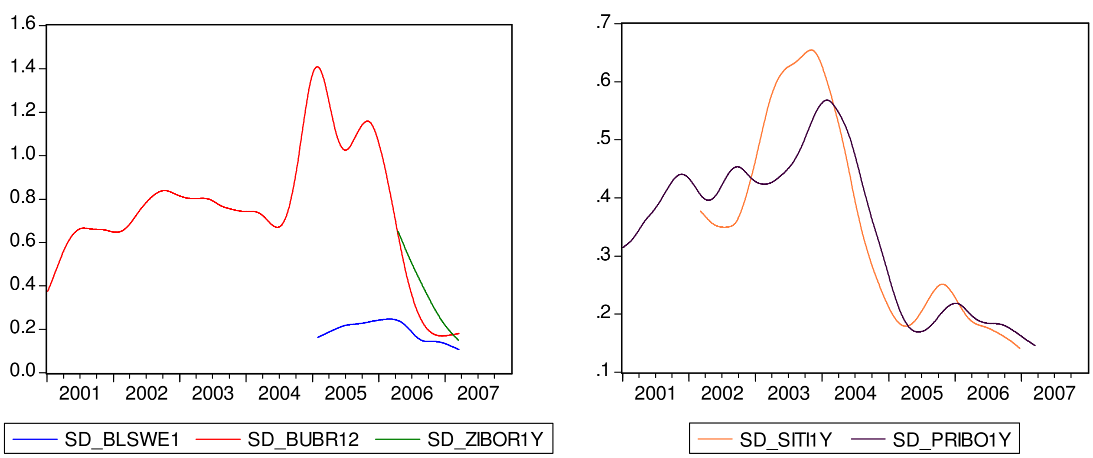
	Bulgaria	**Romania**	**Slovenia**	**Cz**
C	0.0389* (0.0209)	0.061* (0.0357)	0.0013 (0.0011)	1.0323*** (0.0632)
ARCH (1)	0.2358*** (0.0731)	0.0829*** (0.0218)	0.0195*** (0.0037)	0.0584* (0.0314)
GARCH (1)	0.6667*** (0.112)	0.0067 (0.025)	0.9787*** (0.0041)	-
GARCH (2)	-	0.8782*** (0.0389)	-	-

*Notes: Standard deviations in parenthesis; ***, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

3.2.8. Sigma convergence of 1Year IBOR

Here I study the sigma convergence of 1Year IBOR of the studied countries and the eurozone. The sigma convergence analysis is performed using equation (3) where k=1,2; (y_{1t}) is the return of the 1Year IBOR for Bulgaria, Romania, Croatia, Slovenia or the Czech Republic at time (t) and (y_{2t}) is the return of the 1Year IBOR for the eurozone at time (t), (μ) is the mean value between the logarithmic returns of the 1Year IBOR for the sample country and 1Year IBOR for the eurozone at time (t). The resulting sigma coefficients are plotted in Figure 4. They all show a declining path implying the existence of sigma convergence and hence integration of the 1Year IBOR of these countries and the 1Year IBOR of the eurozone. For Romania a clear declining pattern of sigma is evident from the year 2006, which is the year before the EU entry of the county. For Slovenia and the Czech Republic sigma shows a declining pattern from the year 2004 which is the year in which these countries became full members of the EU. The highest degree of integration shows the Bulagarian 1Year IBOR which may be associated not only with the EU entry of the country but also with the currency board regime in the country (see Section 4 for details on the currency regime).

Figure - Sigma convergence of 1Year IBOR



Notes: BLSWE1 - Bulgaria; BUBR12M - Romania; ZIBR1Y - Croatia;
SITI1Y - Slovenia; PRIBO1Y - Czech Republic; EURO12M – EU

4. Integration of foreign exchange markets

The foreign exchange market is the place where currencies are traded. There is no central marketplace for currency exchange; rather it is an OTC market where brokers/dealers negotiate directly with one another. It includes trading between large banks, central banks, currency speculators, multinational corporations, governments, and other financial markets and institutions. Individuals are a small fraction of this market and they typically participate indirectly through banks or brokers.

Foreign exchange markets are the biggest segment of financial markets in terms of daily traded values. They are usually the first to display the characteristics of integrated markets when barriers to the free flow of capital are removed. If evidence of segmentation is found in foreign exchange markets it is very likely to be present in other smaller, less liquid and less efficient segments of financial markets (Vieira C. and Vieira I., 2007).

The euro has an important role for the economies of Southeastern European countries. Most of them have tied their exchange rate to the euro. Bulgaria has operated under currency board arrangements since 1997 when the exchange rate was pegged to the German mark to stabilize the economy after one of the worst financial crises in a transition economy. During the crises inflation reached hyperinflation levels, the currency depreciated by more than 20 times within a few months and a big part of the banking sector collapsed. The currency board lowered inflation very rapidly and has sustained low inflation since 1997. Bulgarian National Bank and the Bulgarian Ministry of Finance agreed on joining the EMU as soon as 2009 with a transition from the currency board to EMU membership at the current exchange rate.(Valev, 2006).

The exchange rate regime in Romania is a managed floating with no predetermined path for the exchange rate and with a reference currency euro. Over the period under review the domestic currency of Romania has experienced redenomination as of 1 July 2005 (National Bank of Romania).

In the Czech Republic the monetary policy regime since December 1997 is inflation targeting.(Czech National Bank). The envisaged date of introduction of the euro in the Czech Republic is 2012 (Czech Republic Ministry of Finance).

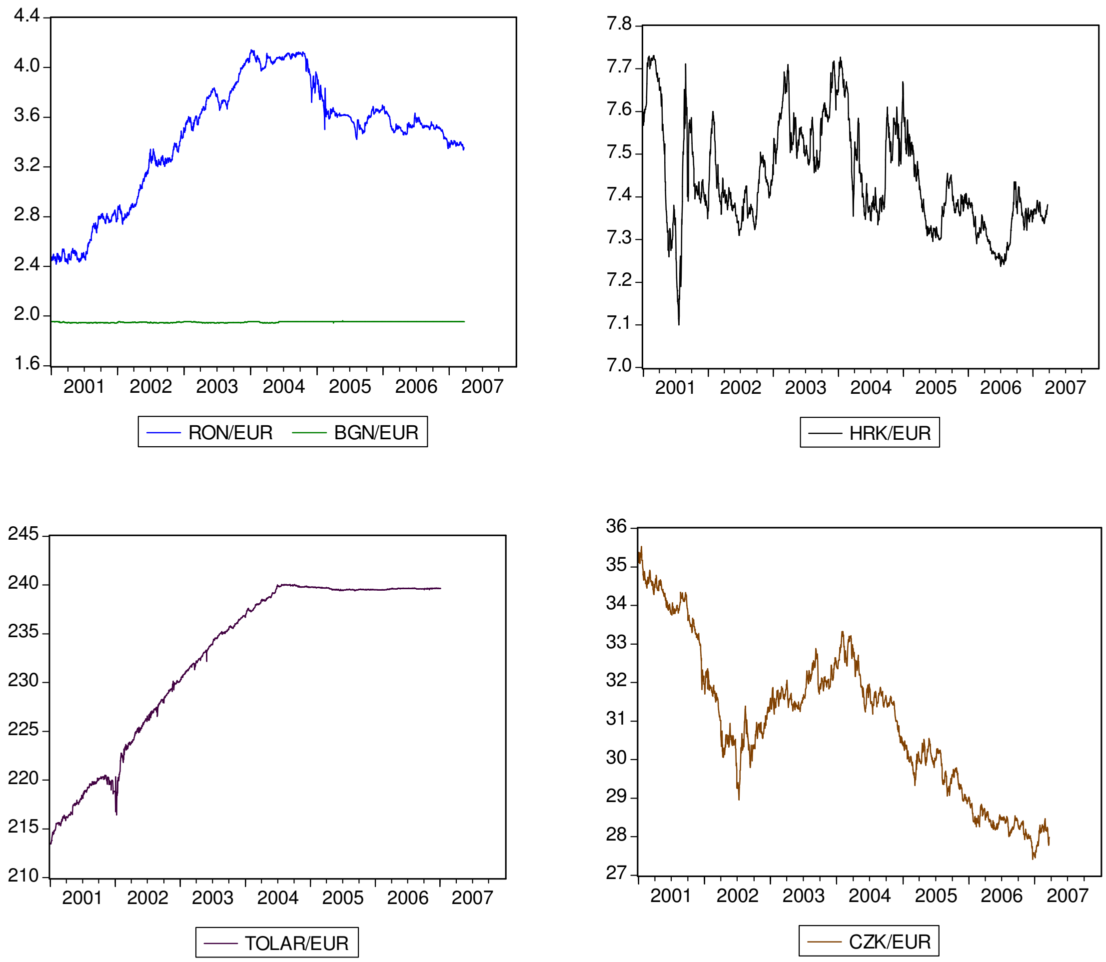
Croatia has conducted tightly managed float with the euro as the reference currency. (Toma, 2007) The Croatian National Bank (CNB) occasionally intervenes in the market in order to prevent excessive exchange rate fluctuations and to maintain relative stability of the exchange rate. The exchange rate of the kuna against the German mark and euro fluctuated within a narrow band of plus/minus 6% around the average exchange rate in the period from kuna introduction since 1994 until present time. The CNB maintains the stability of the kuna/euro exchange rate in order to meet its primary objective of maintaining price stability. (Croatian National Bank, www.hnb.hr) In highly euroised economies prices are very sensitive to exchange rate fluctuations. The extent of euroization in Croatia is among the highest in the world. The banking sector liabilities are predominantly in euro. Approximately 80 percent of the deposits in the banking system are denominated in foreign currency, of which around 80 percent in euro. The CNB estimates that even after the euro changeover in 2001 foreign currency cash in circulation is larger than the domestic cash. According to the CNB there is over 2 bn (euro) of foreign currency cash compared to 1.5 bn (euro) in domestic currency. The level of currency substitution is also persistent. Persistence of a currency substitution is a phenomenon referred to as a hysteresis or irreversibility of currency substitution. Economic agents in Croatia have experienced frequent devaluations and partial expropriations of foreign currency savings. This dates to the former Yugoslavia and created a low credibility of domestic currency. Yet, after a decade of low inflation and exchange rate stability people are still holding foreign currency savings. And at times even a significant interest rate premium on domestic currency denominated instruments could not reverse high level of currency substitution. This high level of currency substitution has a huge influence on financial stability and the conduct of monetary policy.(Vujčić, 2004).

The exchange rate system in Slovenia before its ERM II entry (on 28 June 2004) was a de facto crawling peg. The Bank of Slovenia had actively managed the exchange rate on a depreciating path in order to discourage interest sensitive capital inflows. Nominal depreciation was used as a tool to lower the expected capital gains on foreign investments into tolar assets resulting from the prevailing positive interest rate differential with the euro area (uncovered interest rate parity). The tolar-euro exchange rate depreciated by some 26 percent between the introduction of the euro in January 1999 and April 2004. At the same time in line with the progressive decrease in the interest rate differential with the euro area the annual pace of depreciation decreased from 5 percent at the beginning of 2003 to nil in June 2005, one year after the stabilization of the tolar-euro exchange rate upon ERM II entry. The ERM II central parity retained for the tolar corresponded to the market exchange rate on the last trading day before the decision on ERM II entry. Inside the ERM II the tolar-euro exchange rate stayed close to the central rate with maximum deviations of 0.16 percent on the appreciation side of the fluctuation band. (Convergence Report on Slovenia, 2006)

4.1. Data

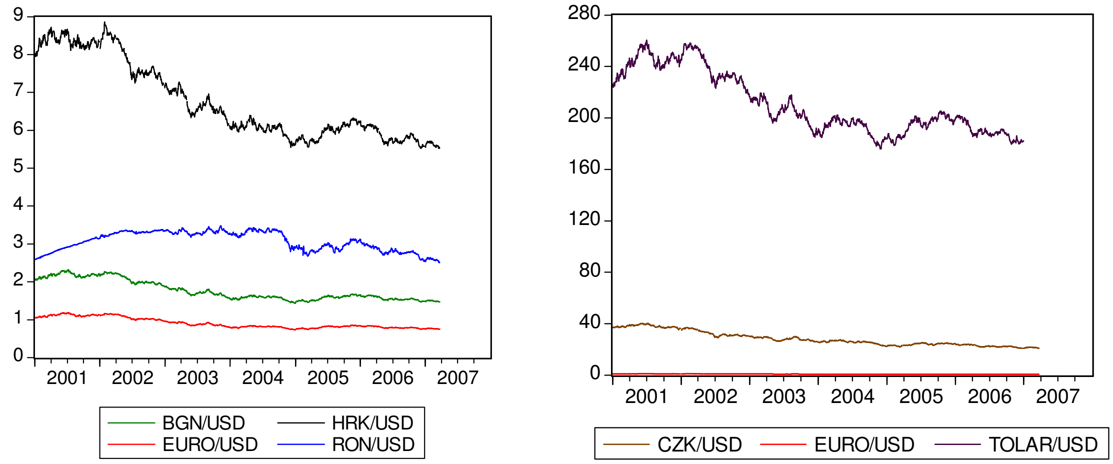
The study is based on daily exchange rate values of the national currencies vis-à-vis USD and euro. The currency series consist of daily prices for the Bulgarian lev (BGN), Romanian leu (RON), Croatian kuna (HRK), Slovenian tolar (SIT), the Czech koruna (CZK) and the euro (EUR).The observation period starts from the beginning of January, 2001 and ends on the 22 March, 2007. Figure 4 shows movements in the daily data of the national currencies vis-à-vis euro over the period under review while Figure 5 shows the developments of the national currencies exchange rates vis-à-vis USD. The descriptive statistics of the exchange rates of the national currencies vis-à-vis euro and vis-à-vis USD is presented in Table 11 underneath.

Figure 4   Exchange rate developments vis-à-vis EURO



Notes : BGN – Bulgarian lev; RON – Romanian leu; HRK – Croatian kuna;
Tolar – Slovenian tolar; CZK – Czech koruna
Source: Eurostat

Figure 5 Exchange rate developments vis-à-vis USD



Notes : BGN – Bulgarian lev; RON – Romanian leu; HRK – Croatian kuna; Tolar – Slovenian tolar; CZK – Czech koruna
Source: Eurostat

Table 11: Descriptive statistics for national currencies exchange rates vis-à-vis euro and UDS

	BGN/		RON/		HRK/		TOLAR/		CZK/		EUR/
	EUR	USD	EUR	USD	EUR	USD	EUR	USD	EUR	USD	USD
Mean	2.0	1.8	3.4	3.1	7.4	6.7	233	210	31	28.3	0.9
Median	2.0	1.6	3.5	3.1	7.4	6.2	237	200	31.3	26.6	0.8
Maximum	2.0	2.3	4.1	3.5	7.7	8.9	240	261	35.5	40.5	1.2
Minimum	1.9	1.4	2.4	2.5	7.1	5.5	214	176	27.4	20.7	0.7
Std. Dev.	0.0	0.3	0.5	0.3	0.1	1.0	8.3	23.7	1.9	5.6	0.1
Skewness	-0.4	0.7	-0.6	-0.3	0.5	0.6	-0.8	0.6	0.2	0.7	0.7
Kurtosis	1.3	1.9	2.5	1.7	2.5	1.9	2.2	1.9	2.2	2.2	2.0
Jarque-Bera	227.8	206	124.5	134.2	72.3	193.5	224	164	48.4	170.8	205
	[0.0]	[0.0]	[0.0]	[0.0]	[0.00]	[0.0]	[0.00]	[0.0]	[0.00]	[0.00]	[0.00]
Observations	1624	1623	1624	1623	1624	1594	1568	1565	1624	1593	1614

Notes: p-values are reported in the brackets; BGN – Bulgarian lev; RON – Romanian leu; HRK – Croatian kuna; Tolar – Slovenian tolar; CZK – Czech koruna

4.2. Simple correlation analysis

The simple correlation analysis is made for the logarithmic returns of the national currencies exchange rates vis-à-vis USD. Daily logarithmic returns are calculated as follows:

$r_t = \ln(P_t) - \ln(P_{t-1})$

where P_t is the exchange rate (BGN/USD, RON/USD, HRK/USD, TOLAR/USD, CZK/USD, EUR/USD) during time t, and P_{t-1} is exchange rate during time t-1.

The correlation coefficients are shown in Table 11. The highest value (0.99) has the correlation coefficient between the exchange rate returns of the Bulgarian lev vis-à-vis USD and the EUR vis-à-vis USD. This is explained by the presence of a currency board in Bulgaria and the pegged exchange rate of the Bulgarian lev against the euro. A very high correlation (0.94) exhibits also the returns of the exchange rates of the Croatian kuna against USD and EUR against USD. This may result form the monetary policy of the CNB which, as mentioned above, keeps the stability of the kuna/euro exchange rate within a narrow band. Significant is the correlation between the returns of the exchange rates of the Czech koruna vis-à-vis USD and EUR against USD. It has a value of 0.84 and it is followed by the correlation coefficient of the returns of the exchange rates between the Romanian RON vis-à-vis USD and EUR vis-à-vis USD which equals 0.56. No significant correlation show the returns of the Slovenian Tolar vis-à-vis USD and EUR vis-à-vis USD.

Table 11 Correlation analysis - Daily returns of national currencies exchange rates vis-à-vis USD

	BGN	RON	HRK	SIT	CZK	EURO
BGN	1.00	0.56	0.94	0.04	0.84	0.99
RON	0.56	1.00	0.53	0.02	0.53	0.56
HRK	0.94	0.53	1.00	0.03	0.79	0.94
TOLAR	0.04	0.02	0.03	1.00	0.05	0.04
CZK	0.84	0.53	0.79	0.05	1.00	0.84
EURO	0.99	0.56	0.94	0.04	0.84	1.00

Notes: BGN – Bulgarian lev; RON – Romanian leu; HRK – Croatian kuna; SIT – Slovenian tolar; CZK – Czech koruna

Source: Eurostat

4.3. Beta convergence

Following the work of Komárková (2007) the national currencies exchange rates vis-à-vis USD are used for the beta-convergence analysis. At first OLS regression on equation (1) is performed where $R_{i,t}$ is the return spread between the national currencies exchange rates vis-à-vis USD and the benchmark of the exchange rate of the euro vis-à-vis USD, Δ is a difference operator, (α) is a constant and (L) is the lag length, which is set upon the Schwarz and Akaike information criteria. The resulting standardized residuals from this regression for all of the studied currencies are not normally distributed (histogram – normality test is provided in Appendix 4.1.). Correlograms of the squared residuals show signs for serial correlation. The ARCH LM test is performed and the null hypothesis of no ARCH effects is rejected (Appendix 4.2.). Therefore the least square method cannot be used and ARCH (GARCH) models are applied to equation (1) for all of the currencies under review. The results of the beta convergence analysis are presented in Table 12. All of the obtained β values are negative implying a process of convergence between the national currencies of the studied countries and the euro. The highest absolute value of β has the Slovenian tolar (-1.93) which is a natural result from the participation of the country in the ERM 2 and the following adoption of the euro.

The absolute values of the β coefficients for the rest of the currencies are close to 1. The biggest among them is the speed of convergence for Bulgarian lev for which the β coefficient has a value of -1.136, followed by Romania (-1.0279), the Czech Republic (-1.0057) and Croatia (-0.8163). All of the obtained β coefficients are significant at 1 percent level. For all of the currencies the country specific constant α is insignificant which also indicates the process of convergence to the euro.

The coefficients obtained in the variance equations are significant and positive. The sum of the ARCH and GARCH coefficients is close to but less than 1 (except of the case of Romanian leu where it equals 1.04). Examination of the correlograms of the standardized residuals shows no signs for autocorrelation. This is also confirmed by the results from the ARCH LM test which are provided in Appendix 4.2.

Table 12 Beta convergence

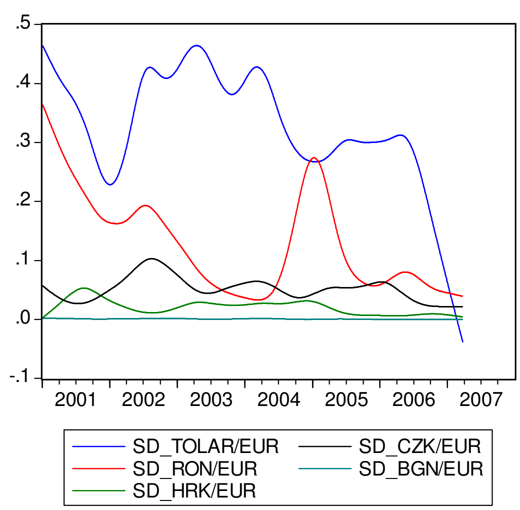
	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**
α	0.0013 (0.0018)	0.0165 (0.011)	-0.0035 (0.0041)	0.0148 (0.0164)	-0.0109 (0.0076)
β	-1.136*** (0.0463)	-1.0279*** (0.0379)	-0.8163*** (0.0332)	-1.9322*** (0.0442)	-1.0057*** (0.0361)
Number of included lags	1	1	1	1	1
Number of Observations	1620	1620	1620	1564	1620
Variance Equation					
	Bulgaria	**Romania**	**Croatia**	**Slovenia**	**Cz**
C	0.0025*** (1.06E-05)	0.1426*** (0.0043)	0.0006*** (0.0001)	0.0104** (0.005)	0.0054*** (0.0009)
ARCH (1)	0.2715*** (0.0478)	0.379*** (0.0342)	0.0848*** (0.0087)	0.0475*** (0.0131)	0.0856*** (0.01)
ARCH (1)	-	0.1558*** (0.026)	-	-	-
GARCH (1)	-	-	0.9016*** (0.0098)	0.93*** (0.0188)	0.8693*** (0.0146)
GARCH (2)	-	0.5135*** (0.1013)	-	-	-

*Notes: Standard deviations in parenthesis; ***, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

4.4. Sigma Convergence of Foreign Exchange Markets

In this chapter I study the sigma convergence of the foreign exchange markets of Bulgaria, Romania, Croatia, Slovenia, Czech Republic and the eurozone. I use formula (3) where k=1,2; (y_{1t}) is the exchange rate return of the respective national currency vis-à-vis USD at time (t) and (y_{2t}) is the return of the euro vis-à-vis USD at time (t), (μ) is the mean value between the logarithmic return of the respective national currency exchange rate vis-à-vis USD and the return of the euro vis-à-vis USD at time (t). The resulting sigmas are plotted in Figure 6. It shows that sigma convergence is present for all of the studied foreign exchange markets and full integration is achieved by the Slovenian Tolar. The explanation lies in the participation of the country in the ERM II and the following adoption of the euro in January 2007. The sigma of the Bulgarian and Croatian foreign exchange market also converge to 0 which might be a result of the exchange rate regime in these countries (in Bulgaria a currency board is present and the exchange rate is pegged to the euro; in Croatia the Croatian National Bank keeps the exchange rate of the national currency, kuna vis-à-vis euro very stable).

Figure 6 – Sigma convergence of foreign exchange markets



Notes: SD – standard deviation; BGN – Bulgarian lev; RON – Romanian leu; HRK – Croatian kuna; Tolar – Slovenian tolar; CZK – Czech koruna

5. Conclusion

In this thesis I have examined the integration of the money markets and foreign exchange markets of several South Eastern European countries and the eurozone. The countries in question are Bulgaria, Romania, Croatia and Slovenia. As a Central European country and a full member of the EU since 2004 I have included the Czech Republic. Using the concept of beta and sigma convergence I have studied the speed of convergence and the degree of integration of the unsecured money markets and foreign exchange markets in these countries and the EU. The empirical findings suggest a very high speed of convergence for the overnight, 3-month and 1-year segments of the unsecured money markets. The results of the sigma convergence analysis for the overnight and 3-month segments of the unsecured money markets show an increasing degree of the integration with the EU for all of the examined countries but Romania which reveals sigma-divergence. The 1-year segment of the unsecured money market for all of the sample countries shows an increasing degree of integration with the EU.
The findings of the beta and sigma convergence for the foreign exchange markets point to a high speed of convergence and to a very high degree of integration with the EU. Full integration has achieved Slovenia which is due to its participation in the ERM II and the subsequent adoption of the euro in 2007. The highest degree of integration with the EU among the rest of the examined foreign exchange markets is achieved by Bulgaria and Croatia. The explanation for this is the respective exchange rate regimes of these countries, which in the case of Bulgaria is a currency board with a pegged exchange rate to the euro. In the case of Croatia the Croatian National Bank maintains the stability of the kuna/euro exchange rate in order to meet its primary objective of maintaining price stability.

The field of financial integration of South Eastern Europe has not been fully investigated. Therefore I strongly believe that there will be further development of this topic in the future.

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3) www.bnb.bg

4) www.bnro.ro

5) www.bsi.si

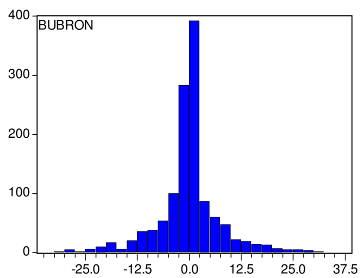
6) www.mfcr.cz

Appendices

Appendix 1: ONIA OLS residuals form equation (1)

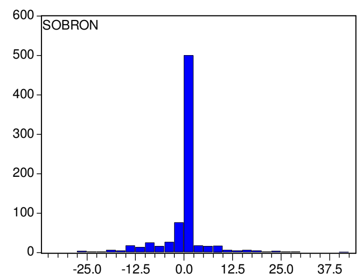
App. 1.1. Histograms and normality tests

Romania



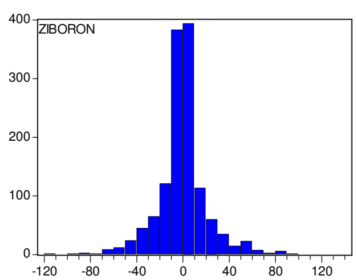
Series: Residuals	
Sample 1/08/2001 3/15/2007	
Observations 1258	
Mean	1.41e-16
Median	0.152637
Maximum	36.21644
Minimum	-33.29283
Std. Dev.	7.817689
Skewness	-0.011363
Kurtosis	6.605483
Jarque-Bera	681.4179
Probability	0.000000

Bulgaria



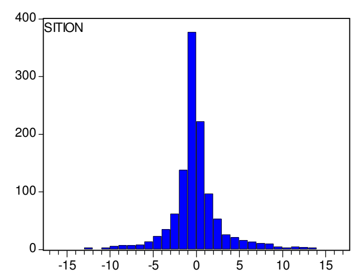
Series: Residuals	
Sample 3/03/2003 3/15/2007	
Observations 793	
Mean	-5.29e-16
Median	0.478377
Maximum	41.59091
Minimum	-33.56598
Std. Dev.	7.214097
Skewness	0.291139
Kurtosis	10.33703
Jarque-Bera	1789.901
Probability	0.000000

Croatia



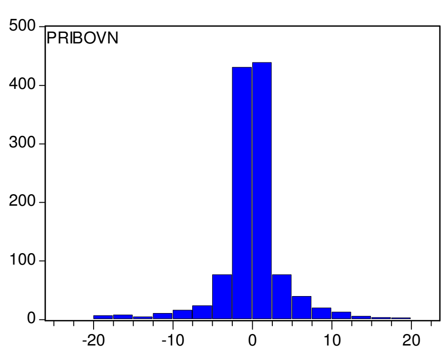
Series: Residuals	
Sample 1/11/2001 3/12/2007	
Observations 1331	
Mean	-4.47e-16
Median	-0.055377
Maximum	136.2019
Minimum	-115.5996
Std. Dev.	22.85917
Skewness	0.298093
Kurtosis	8.078246
Jarque-Bera	1449.904
Probability	0.000000

Slovenia



Series: Residuals	
Sample 1/09/2002 12/22/2006	
Observations 1178	
Mean	1.78e-16
Median	-0.111240
Maximum	16.53385
Minimum	-16.39186
Std. Dev.	3.219124
Skewness	0.427523
Kurtosis	8.379435
Jarque-Bera	1456.274
Probability	0.000000

Czech Republic



Series: Residuals	
Sample 1/19/2001 3/12/2007	
Observations 1184	
Mean	6.26e-18
Median	0.021249
Maximum	20.13455
Minimum	-23.94305
Std. Dev.	4.197558
Skewness	-0.495584
Kurtosis	10.45369
Jarque-Bera	2789.305
Probability	0.000000

Appendix 1.2. – ARCH LM test on OLS and GARCH residuals from equation (1)

ARCH LM Test

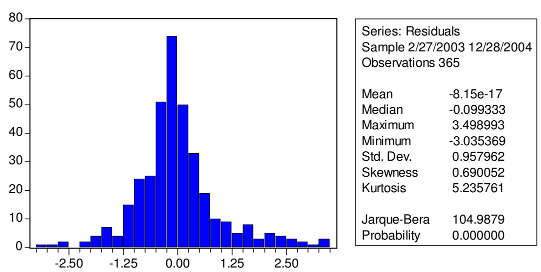
	Romania	Croatia	Slovenia	Cz
OLS Residuals				
F-statistic	92.95***	38.98***	34.7***	130.89***
Obs*R-squared	159.62***	74.49***	66***	225.33***
ARCH/GARCH Residuals				
F-statistic	0.56	0.14	0.9	0.82
Obs*R-squared	1.11	0.29	1.81	1.65

The null hypothesis is that there are no ARCH effects in the residuals
****, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

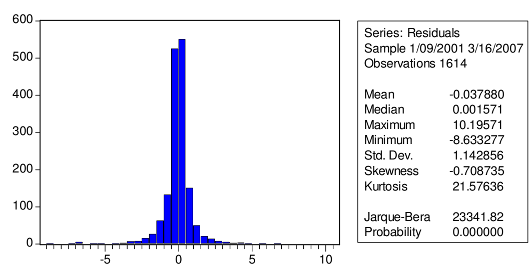
Appendix 2: OLS residuals form equation (1) for 3Month IBOR

App. 2.1. Histograms and normality tests

Bulgaria

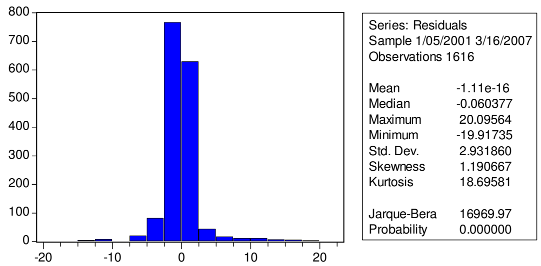


Romania

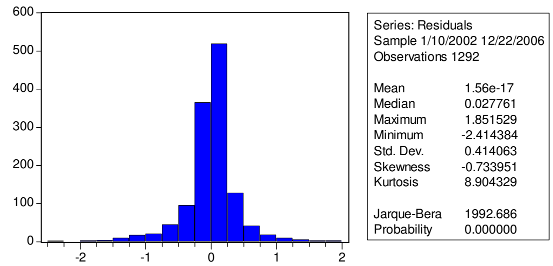


App. 2.1. Histograms and normality tests

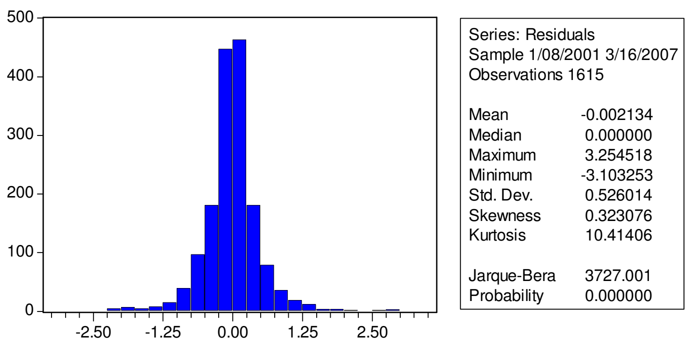
Croatia



Slovenia



Czech Republic



Appendix 2.2. – ARCH LM test on OLS and GARCH residuals from equation (1)

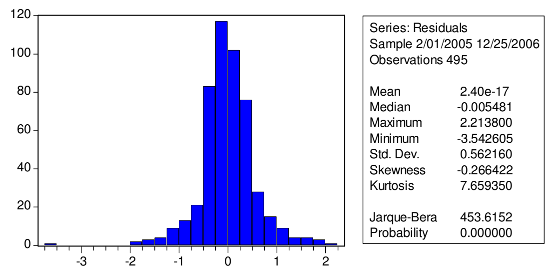
ARCH LM Test:	Romania	Croatia	Slovenia	Cz
OLS residuals				
F-statistic	20.96***	51.59***	13.05***	9.39***
Obs*R-squared	40.92***	97.14***	25.64***	18.59***
ARCH/GARCH residuals				
F-statistic	0.30	0.40	0.45	0.27
Obs*R-squared	0.60	0.81	0.90	0.54

The null hypothesis is that there are no ARCH effects in the residuals
****, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

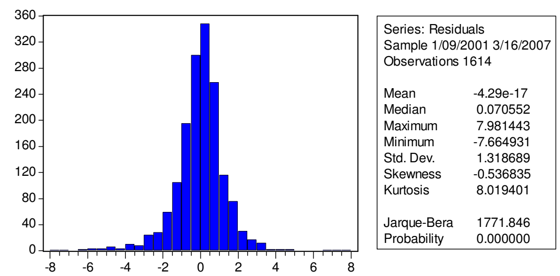
Appendix 3 – Tests on residuals from equation (1) for 1 YEAR IBOR

Appendix 3.1. – OLS residuals from equation (1) – histograms and normality tests

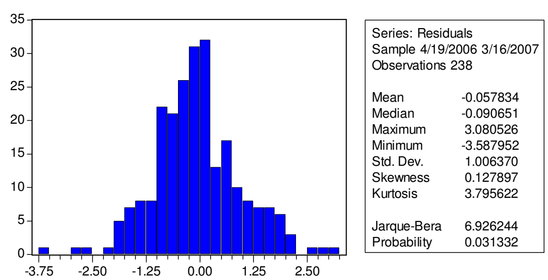
Bulgaria



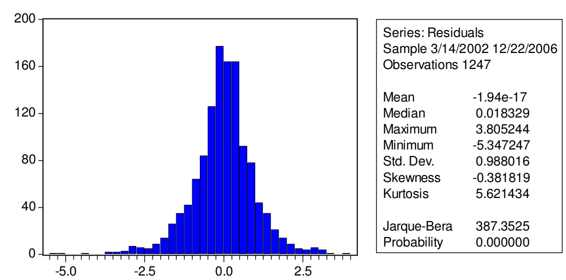
Romania



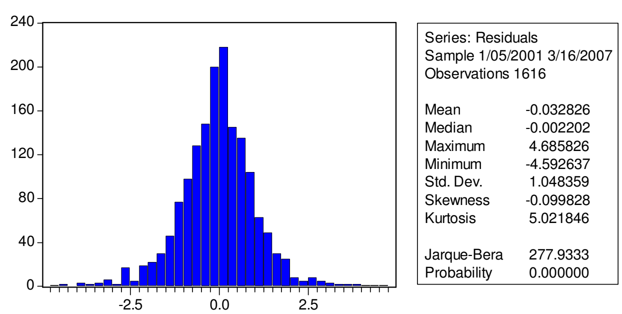
Croatia



Slovenia



Czech Republic



Appendix 3.2. – ARCH LM test on OLS and GARCH residuals from equation (1)

Table ARCH LM test

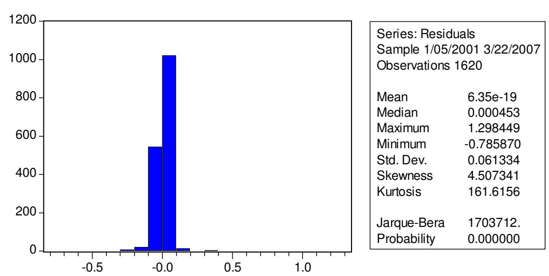
	Bulgaria	Romania	Croatia	Slovenia	Czech Republic
OLS Residuals					
F-statistic	7.26***	22.1***	0.51	7.71***	6.63***
Obs*R-squared	14.2***	43.1***	1.02	15.27***	13.17***
ARCH/GARCH Residuals					
F-statistic	0.55	0.09	-	0.36	0.59
Obs*R-squared	1.11	0.19	-	0.73	1.17

The null hypothesis is that there are no ARCH effects in the residuals
****, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*

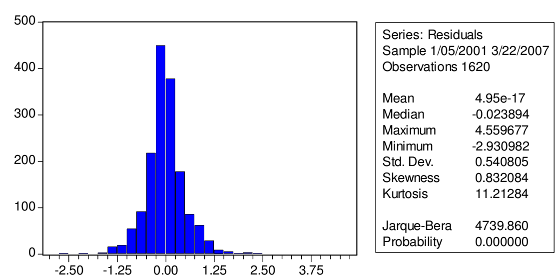
Appendix 4 – Tests on residuals from equation (1) for foreign exchange markets

Appendix 4.1. – OLS residuals from equation (1) – histograms and normality tests

Bulgarian lev

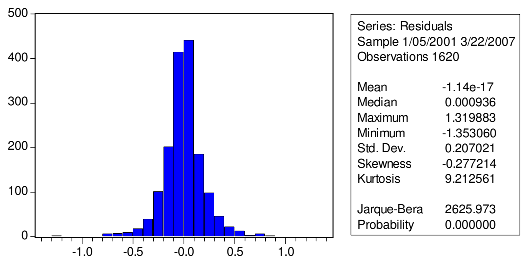


Romanian leu

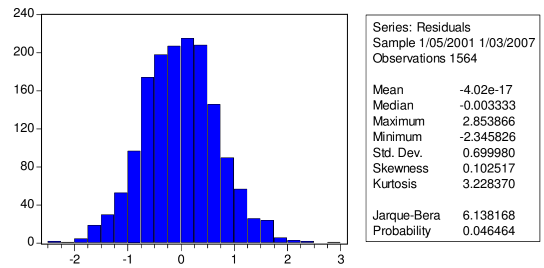


Appendix 4.1. – OLS residuals from equation (1) – histograms and normality tests

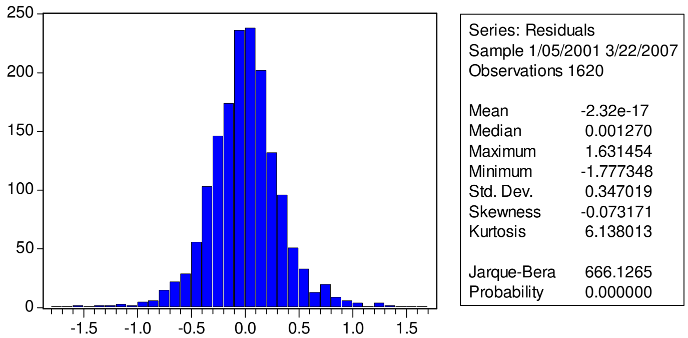
Croatian kuna



Slovenian tolar



Czech koruna



Appendix 4.2. – ARCH LM test on OLS and GARCH residuals from equation (1)

Table ARCH LM test

	BGN	RON	HRK	SIT	CZK
OLS residuals					
F-statistic	224.03***	473.73***	70.08***	7.23***	89.58***
Obs*R-squared	197.01***	366.84***	67.25***	14.35***	84.98***
ARCH/GARCH residuals					
F-statistic	0.02	0.35	0.16	2.33	0.03
Obs*R-squared	0.02	0.35	0.16	2.33	0.03

The null hypothesis is that there are no ARCH effects in the residuals
****, **, and * - denotes significance at 1 percent, 5 percent, and 10 percent, respectively*