2009-11-14

The CEECs' Banking System: A Risk Study during the Global Financial Crisis

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Recommended Citation

Andreosso-O'Callaghan, B., Morales, L. & Tarkovska, V. The CEECs' Banking System: A Risk Study during the Global Financial Crisis. *International Conference on Global Trends in the Efficiency and Risk Management of Financial Services and the Financial Crisis, 2009.*Hosted by Efficiency and Productivity Research Unit (EPRU). University of Leicester, UK.

A Risk Study of the CEECs' Banking System during the Global Financial Crisis

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October 23, 2009

Abstract

We consider operational risk and market integration in the banking system of the Central and East European Countries' (CEECs). The analysis provides an interesting framework in relation to the effects of the global financial crisis in some European emerging banks. We implement an econometric model that takes into account the level of integration of these banks in relation to a number of most developed institutions, which are represented by the Dow Jones STOXX 600 index, with the objective of analyzing how this could be impacting the level of operational risk in the region. This paper provides new evidence that links market development and the level of risk associated with this region. In addition, we also look at entity size, and the importance of intangible assets, as these variables are considered of great relevance when analysing operating risk. Our results provide clear evidence of high levels of correlation in the region; however, no integration with the major indices was detected; this reflects the lack of development of the banking system in the CEECs. The results also show that entity size is the key factor having a directly impact in the level of Operational risk, since the other variables are found to be insignificant.

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1. Introduction

During the 2000s, operational risk (OR) has received increasing attention from both financial institutions and policymakers, as large losses have resulted in the failure, merger, or substantial equity price declines of a variety of well-known firms, where unauthorized trading may be the best-known operational loss type, having caused numerous financial scandals (Fontnouvelle et al., 2006). During the past decade, researchers have been discussing and analysing the level of integration between financial markets. Great attention has been devoted to the major consequences derived from financial failure on one market, and on how this could create a negative chain of subsequent effects in other markets. Consequently, market liquidity and credit risks are at the centre of discussion in academia, and among practitioners. Alongside, a new type of risk has been introduced and proposed for consideration; this is identified as operational risk (OR). This type of risk has been recognised as being at the heart of the big losses and main financial scandals in recent times, due to the enormous difficulties associated with its detection and quantification (Sundmacher, 2004; and Fontnouvelle et al., 2003). However, there has been little published research regarding such questions as: how operational risk might be quantified, or whether operational losses even constitute a material risk for the typical financial institution.

The Basel II proposal (2004:128) defines operational risk as *"the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events"*. This definition includes legal risk; however, it excludes strategic and reputation risk. Basel II is characterized by a greater degree of detail, where the structure of the New Framework takes the form of three Pillars: i) Capital Requirements, ii) Supervision Authority, and iii) Market Discipline or Transparency.

In order to help in the quantification of OR, the Basel II Accord proposes three main methods for effective management of operational risk, namely: Basic Indicator Approach (BIA), Standardised Approach (SA) and Advanced Management Approach (AMA). Academics and practitioners around the globe have discussed the suitability of the three methods, as well as their shortcomings and limitations (Sundmacher, 2004, Ford and Sundmacher, 2004, Bonsón et al., 2007, Hildebrand, 2008). In this regard,

researchers have found that a key factor to be considered when selecting a particular model can be summarised as: the BIA could be used by any bank, regardless of complexity of its activities (Basel, 2003). However, the Committee suggest that the optimal methodology for OR quantification should be based on the use of AMA where institutions must meet specific admission criteria (Committee, 2006a; 148-155). Hageback (2005) argues that the application of AMA could result in lower capital requirements than regulators expected in comparison with a standardised approach. On the other hand, the AMA has been criticised for its complexity (Alexander, 2003; Moosa, 2008; and Beans, 2007), as well as for the difficulties associated when selecting and gathering information with the adequate level of quality required for accurate evaluation (Grody, *et al.,*2005; Guilen *et al.* 2007; Roy, 2008; and Ling, 2008). Therefore, we consider appropriate the analysis of OR in the CEECs' banking system under the BIA, as we will be able to surmount the problems associated with data quality.

Despite the fact that European banking regulation has been harmonized to a certain degree over the last few decades, the European banking industry remains fragmented, as shown by the relatively high market shares of banks in their home countries (Moerman, et al., 2004). Although the harmonization process has progressed substantially, there are a couple of reasons why the integration process in not complete; one of the main issues relates to natural or strategic barriers (such as distance and language) and other important differences such as company law, contract law and fiscal matters. These differences have derived from the existence of diverse approaches when assessing risk management and capital regulation across the banking, securities, and insurance sectors, where major disparities exist among them. As a result, we intend to develop an analysis that focuses on the banking sector in the European emerging economies, due to the fact that the banking sector is usually found to be the least integrated segment of the European financial system (Sørensen and Gutiérrez, 2006). According to Freixas (2003) and to ECB (2004), European Union banking systems are inherently heterogeneous due to historical differences in market structures, bank supervision and regulation, and legal traditions. In addition, the launch of the euro, along with the intensifying efforts to achieve a higher degree of financial integration has not

had a crucial impact on the speed of the adjustment of banks. Thus, the main goal of our research is to explore a range of ratios that help us understand the causative factors that could lead to operational losses. Initially, we consider that market integration, entity size, country effect, and intangible assets are key sources of operational losses.

The remainder of this paper is organised as follows. Section 2 analyses the CEECs' research framework, looking at empirical analyses done in the area until now. Section 3 outlines and discusses the data and methodology used in this paper. Section 4 presents the empirical findings, and finally section 5 concludes this analysis.

2. The CEECs' Research Framework

The Financial Services Authority (FSA, 2003) has implemented studies advising on how operational risk is relevant not only to big internationally active banks or financial institutions, but also to smaller ones. Theoretically, smaller institutions can calculate OR by using more advanced techniques (i.e. AMA); however, there are still important problems associated with such model. First of all, banks/financial institutions will need similar means to collect data, albeit to a different degree of sophistication (FSA, July, 2003). In this way, existing research (Roy, 2008; Ling, 2008; and Holmes, 2003) has reported that 80 per cent of the OR estimations are data related; more specifically, loss-related data is not always available, and if it is available, its quality might not be satisfactory. Fontnouvelle et al. (2006) analyse available databases of publicly disclosed operational losses and found significant reporting bias, as small losses are not always disclosed by the banks. In this line, Sodhi and Holland (2007) advise that losses only above a certain threshold, say €10,000, are represented in the banks' databases. Consequently a significant bias can occur as Guillen et al. (2007) point out in their study. Therefore, there is an increasing need for establishing clear and appropriate industry-wide standards on how data should be collected and referenced (Grody et al., 2005).

Moosa (2008) talks about some other difficulties associated with the use of the advanced techniques for OR quantification; this author believes that the development of internal models should not be motivated by the Regulators, due to the lack of consensus in approach and implementation of internal models for AMA. He argues that there are no

obvious reasons why AMA would provide better standards than the less sophisticated approaches. Milligan (2004), among others, brings into the discussion the cost of implementation of the advanced method; this cost is generally considered to be very high, given that, as a result, banks will not consider the implementation of this approach unless the benefits of it are demonstrated. Thus, the alternative for the banks is to use less advanced models, like the Basic Indicator Approach. Under this approach, operational risk capital is set equal to 15 percent of annual gross income over the previous three years. It represents certain insufficiencies, but it is considered, a priori, as a transitional model in a progression towards advanced methodologies. It is well thought-out as a good alternative in the face of a proper implementation of the Basel Accord (Jimenez-Rodriguez et al., 2007).

Holmes (2003) outlines four reasons why operational risk quantification is more difficult than market or credit risk: i) there is a lack of position equivalence (i.e., exposure amount), ii) it is difficult to construct a complete portfolio of operational risk exposures, iii) loss data is affected by the continual change of organizations and the evolution of the environment in which they operate, and iv) it is difficult to validate operational risk models. These difficulties mean that widely differing approaches have been taken in attempting to tackle operational risk quantification.

Bonsón, *et al*. (2007) analyse the New Basel Capital Accord (II) framework on how entities can manage their risks in a more detailed and efficient manner. They analyse the three alternative methods (the Basic Indicator Approach, Standard Approach and Advanced Measurement Approach). Their paper discusses the exactitude of the underlying implicit hypotheses that support each method; their findings are that the key indicator in these methods, the ratio between effective operating losses and gross income, does not maintain minimum conditions of stability against factors such as the entity and the time. Their results demonstrate that the effect of applying these methods is usually an over-weighting of the protection against Operational Risk. Therefore, it can be seen that the Income Statement-based methods appear to represent a "blind" instrument of protection and may handicap the competitive capacity of entities by generating excessively high capital requirements in the majority of them.

Bonsón, *et al*. (2008) analyse the banking/investment sector proposing a scheme of evolution that details the stages of enhancement in the sophistication of their information systems that banking entities may implement, so as to be capable of capturing, mitigating and managing operational risk. They create a proxy variable to capture the information sophistication of each entity, analysing also the entity size, intangible assets weight, and the country effect. Their results bring evidence that the entity size has been revealed as the most important factor when deciding on where to position the entity in the scheme of system sophistication proposed.

Koutsomanoli, Mamatzakis and Christos (2008) analysed the process of financial integration in the European Union (EU) in terms of convergence in the speed of adjustment of cost inefficiency to equilibrium level. The authors studied the efficiency scores in the banking industry of the EU-15 region over the period 1995-2005, finding evidence of considerable variation in the speed of adjustment across banking systems, while over time it appears that continuing efforts to advance financial integration have not as yet led to an improvement in the speed of adjustment to long run equilibrium.

After looking at existing research analysing OR issues, it is visible that more research is needed along these lines. Consequently, this paper major contribution to the existing discussion is focused on the study of OR in the CEECs, using the Basic Indicator Approach to quantify OR in the region. The next section discusses the data and methodology that have been employed in this analysis.

3. Data and Econometric Models

3.1 Data Description

The analysis focuses on the CEECs' banking system, where market integration and levels of operating risk are studied using time series and panel data analysis.[4] The Dow Jones STOXX Eastern Europe 300 is considered when selecting the banks that will be presented in the study. All banks from the countries listed in the index where checked

[4] The CEECs comprise the Czech Republic, Hungary, Poland, Romania, Slovenia, Cyprus, Greece, and also Turkey, Croatia, Macedonia, Serbia and Russia.

and where data was available the financial institution was selected and included in our sample, giving a total of 29 banks to be analysed. The time frame of the study spans from the period January 2006 to 31 December of 2008, as our focus of interest is based on the effects of the current financial crisis in terms of market integration and operating risk. Data was taken from Dow Jones STOXX 600 index, Dow Jones STOXX Eastern Europe 300, and DataStream.

The Basel Capital Accord requires banks to meet a capital requirement for operation risk as part of an overall risk-based capital framework, where three distinct options for calculating operational risk charges are proposed (Basic Approach, Standardised Approach, and Advanced Measurement Approaches), reflecting increasing levels of risk sensitivity (Moscadelli, 2004). Our analysis proposes to look at operating risk issues in the CEECs using the Basic Approach; as has been stated by the Committee, this measure should be applicable to any bank, independently of the complexity of its activities, provided that it follows the directives of the document *"Sound Practices for the Management and Supervision of Operational Risk"* (Basel, 2003). The other main reason for selecting the BIA is supported by other studies' findings (Roy, 2008; Ling, 2008, and Holmes, 2003) arguing that the most advanced approaches are considered biased due to major issues regarding data collection. The data and methodology is discussed in detail in the next section.

3.2 Econometric Models

3.2.1 Basic Indicator Approach

This method consists in determining the capital requirement for Operational Risk by applying a fixed factor of 15 per cent of the mean of the gross income obtained by the entity in the last three previous accounting periods (i.e. periods when the gross income figure was not zero or negative). Any years for which reported gross income is zero or negative is excluded from the calculation of both numerator and denominator. The Basic Indicator Approach is easy to implement and universally applicable across banks to arrive at a charge for operational risk. Its simplicity, however, comes at the price of only limited

responsiveness to firm specific needs and characteristics. While the Basic Indicator Approach might be suitable for smaller banks with a simple range of business activities, internationally active banks, and banks with significant operational risk should use a more sophisticated approach. Taking into account that the CEECs' banking system is developing, and that there are major issues when obtaining data that allow us to use the AMA, we consider appropriate to use this approach in our study. In addition, considering that a number of studies suggest that a considerable proportion of the world's banks will not be in a position to use the more sophisticated measurement methodologies, at least initially, we will thus resort to the basic measurement approaches (Harmer 2004, p.44).

$$K_{BIA} = \left[\sum_{1}^{n} GI_{1...,n} * \alpha \right] / n \qquad \textbf{(1)}$$

where:

K_{BIA} = the capital charge under the Basic Indicator Approach

GI = annual gross income, where positive, over the previous three years

n = number of the previous three years for which gross income is positive.

α = 15% which is set by the Committee, relating the industry-wide level of required capital to the industry-wide level of the indicator. The criterion to determine this value is not included in the Basel Accord text.

The Income Statement-based methods assume that as an entity obtains larger gross incomes, its higher level of activity exposes it to more and larger risks in terms of losses of the kind typified under operational risk. Hence, it is expected that a positive relationship is to be found between the two accounting variables (Bonsón, et al. 2007).

The Basic and Standardised Methods proposed by the Committee for the calculation of the regulatory capital for operational risk, present certain conceptual deficiencies, particularly with respect to the exposure indicator, that is the gross income. The fact that its quantification depends, ultimately, on the accounting framework of each country, makes regulatory arbitrage possible. In addition, the Basic Approach offers an

entity little incentive to develop better risk control systems, since it does not require the regulator to monitor compliance with any qualitative requirement for its implementation. However, and as has been discussed previously, more advance methods like the Advanced Measurement Approach requires sophisticated data; more specifically, this type of advanced approach still lacks sufficient robustness for its consequent practical implementation (Jimenez et al., 2007).

3.3 Model Variables

The following ratios are worked out, as they have been identified by the literature as significant variables when analysing operational risk issues. Our main contribution to the model consists in the inclusion of dummy variables that allows analysing market integration issues and its effects on the banks operating risk.

1. Potential Operational Risk Indicator = K_{BIA}
2. Banks' Size = Total Assets (log value)
3. Liquidity Risk = LTA = Loans/Assets
4. Degree of Capitalization = Equity/Assets
5. Weight of Intangible Assets = Intangible Assets/Total Assets
6. Integration Effect = dummy variable that identifies markets integrated with the Dow Jones STOXX 600 index or Dow Jones STOXX Easter Europe 300 Index
7. Causality Effect = dummy variable that identifies causal effects from the Dow Jones STOXX 600 index or Dow Jones STOXX Easter Europe 300 Index

Each ratio is calculated for the time period under analysis (2006 to 2008), where the main objective is to identify which variables are significant in the CEECs banking sector; the aim is also to find out whether there is a change of pattern at the time when the financial crisis hit the region.

3.4 Unit Roots, Cointegration and Causality Analysis

The time series analysis implemented in this study involves: testing for unit roots using Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests; testing for serial correlation of errors, using the Lagrange Multiplier (LMF test); testing for cointegration, using the Engle-Granger procedure and Johansen Cointegration test; the Granger causality test is also used to investigate the causal relationship between each ban stock prices, versus the Dow Jones STOXX 600 index, which is a broad index of European stock denoted in Euros, and Dow Jones STOXX Eastern Europe 300.

The initial model for the causality test will be:

$$Y_t = \alpha_0 + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + \varepsilon_{yt} \quad \textbf{(2)}$$

$$Y_t = \sum_{i=1}^{n} \alpha_b Y_{i=1} + \sum_{i=1}^{n} \beta_c X_{i=1} + \upsilon_T \quad \textbf{(3)}$$

$$\Delta Y_t = \beta_0 + \lambda e_{1,t-1} + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta X_{t-1} + \varepsilon_{yt} \quad \textbf{(4)}$$

The cointegration test will be implemented in order to find out if there is a long run relationship between the individual banks and the STOXX indices; therefore, the Engle & Granger and Johansen Cointegration test are applied. Once it is established whether equity markets move together in the long term, the next step consists in analysing if there is evidence of causal relationships between the various markets. Thus, the analysis proceeds and implements causality tests between the banks and the indices using equation (4). The results from the cointegration and causality analysis will allow creating dummy variables that associate the level of operating risk in every bank with the degree of market integration of the institution with the general and regional indices.

3.4 OLS and Logit Models

The second part of our econometric analysis consists in running Ordinary Least Squares and Logit models with the main goal of indentifying which variables have a

relevant effect in relation to Operational Risk. As a consequence, the OLS model (equation 5) will be used taking as the dependent variable the ratio for Operational Risk (OR), and as explanatory variables: i) entity size (Size), ii) liquidity ratio (Liq), iii) degree of capitalization (Cap), iv) intangibles weighting (Int), v) market integration (MI) and regional integration (RI). Subsequently, the Logit models are used to identify the effects of operational risk regarding market and regional integration (equations 6 and 7). The equations used in the analysis are specified as follows,

$$OR = \alpha + \beta_1 Size + \beta_2 Liq + \beta_3 Cap + \beta_4 Int + \beta_5 dummy + \varepsilon_{n.,t} \quad \textbf{(5)}$$

$$MI = c + \delta_1 OR + \delta_2 Size + \delta_3 Liq + \delta_4 Cap + \delta_5 Int + \nu_{n.,t} \quad \textbf{(6)}$$

$$RI = \text{int} + \lambda_1 OR + \lambda_2 Size + \lambda_3 Liq + \lambda_4 Cap + \lambda_5 Int + e_{n.,t} \quad \textbf{(7)}$$

Each of the above equations is applied during a three year time frame, from 2006 to 2008, with the objective of identifying changes in patterns during the financial crisis. The results obtained are discussed in detail in the next section.

4 Empirical Evidence Analysis

4.1. Descriptive Analysis

The correlation analysis shows evidence of high levels of positive correlation among all the financial institutions (Table one in the Appendix). The coefficients are very high in general, moving from 0.60 to 0.98, with the exception of Finansbank (Turkey) that exhibit low levels of correlation with the other banks (the values in this case range from 0.14 to 0.39). In the case of TT HELLENIC POSTBANK (Greece) versus SBERBANK (Russia), TURK EKONOMI BANKASI, and TURKIYE IS BANKASI (Turkey), the coefficients are 0.59, 0.50 and 0.58 respectively. These high levels of correlation indicate that these markets share similar characteristics; therefore, we think that this could have major implications in relation to operational risk in the region.

4.2. CEECs Banking Sector Integration Analysis

The results from the Engle & Granger test indicate that the markets are not integrated neither with the general banking index or with the regional one (table 2 in the Appendix); these results tend to be confirmed by the Johansen cointegration test, with the exceptions of EFG Eurobank Ergasias (Greece), Getin Holding (Poland) and Proton bank (Greece)[5], exceptions that reflect a lack of development of the banking system in the CEECs. This might look particularly surprising for these banks, since they are located in the European Union. Indeed, we expect these countries (Greece and Poland) to reflect high levels of integration, given that (i) they have been part of the EU for nearly 30 years (case of Greece), and (ii) their accession process implied the acceptance of the *acquis communautaire* (case of Poland). The *acquis* involves the harmonization of the financial institutions of the countries that aspire to join the EU. However, the results show that the EU integration process is not having a major impact on these countries or is moving quite slowly.

The main findings from the causality analysis reflect weak evidence of causality effects in these markets. Overall, when causality is found, the coefficients tend to be significant at 10 per cent, and in most of the cases the Dow Jones STOXX 600 is the index that generates an influence in the banks (Alpha Bank, Bank BPH, Bank Zachodni, Kredyt Bank, National Bank of Greece, Pekao, Bank of Piraeus and Sberbank of Russia). In the case of the Dow Jones STOXX Eastern Europe 300, the results show causality in the cases of Asya Katilim Bankasai, EFG Eurobank Egasias, and Getin Holding), results that bring evidence that these financial institutions show signs of independent behavior; this means that each bank behaves as an individual entity. At this stage, we are not expecting to find strong connections among the region in relation to OR.

4.3.CEECs Banking Sector Risk Analysis

The results obtained from our Ordinary Least Squares regression (equation 5) analysing market and regional integration (tables 3 and 4) bring evidence that institution

[5] An ECM is used when analysing causality from the general and regional indices for these banks.

size is a key variable in the banks operational risk. The results also show that liquidity, the degree of capitalization, and market and regional integration are not found to be significant variables. These results are in line with those of Bonsón et al (2007) who also found that entity size is the most relevant variable when analysing operational risk. As the banks in the region are not integrated we can conclude that, as most of the banks tend to be small or medium sized, bigger institutions will be the ones that face higher levels of risk.

The results from the Logit models (equations 6 and 7, results in table 5 and 6 in the appendix) analysing market and regional integration show that none of the variables (risk, size, degree of capitalization, and intangibles weighting) are significant. Thus, as the integration analysis showed the lack of integration found in the area is also sustained by our findings.

5 Conclusions

Operational risk is relevant to all firms despite the size, geographical presence and level of international activity. In fact, research has found that small firms are taking an appropriate step towards the implementation of OR framework (FSA, 2003). However, the big firms are the ones that will have a greater exposure to this type of risk due to the higher volume of activity (Chapelle *et al*. 2008). Thus, firm size has been identified as an important factor in consideration of OR associated with the company. Bigger firms can afford to use sophisticated information systems and they will have a comparative advantage before the smaller companies (Bonsón *et al*. 2008).

Our analysis is in line with that of Bonsón *et al*. (2007), where our results identify entity size (measured by the asset value) to be significant and positively correlated with the level of Operational risk. The rest of the variables included in our models, namely liquidity ratio (Liq), iii) degree of capitalization (Cap), iv) intangibles weighting (Int), v) market integration (MI) and regional integration (RI) have been found to be insignificant. Being aware that OR analysis is still developing, future research along these lines is needed, and new variables like credit exposure, banking regulation, etc. should be explored in order to improve our understanding of the area.

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Figure 1: AKBANK (AK)

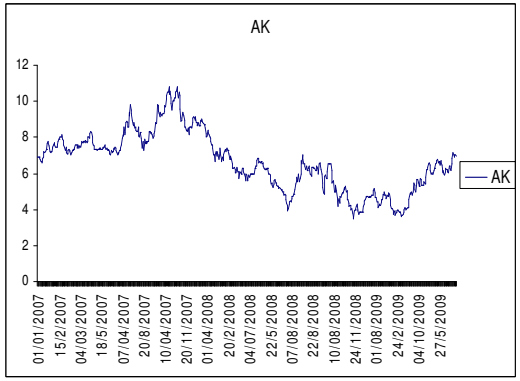

Figure 2: ALPHA BANK (AL)

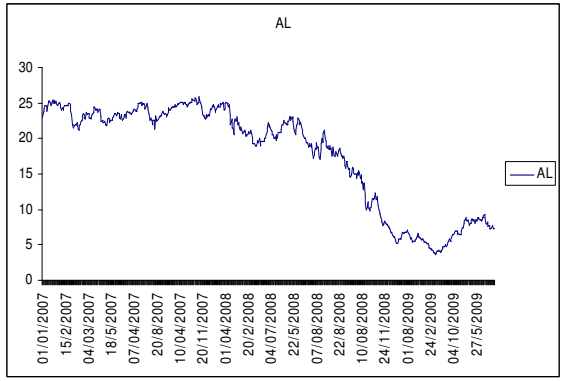

Figure 3: ASYA KATILIM BANKASI (AS)

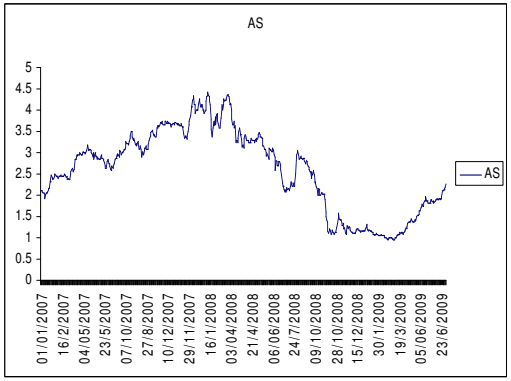

Figure 4: BANK BPH (BP)

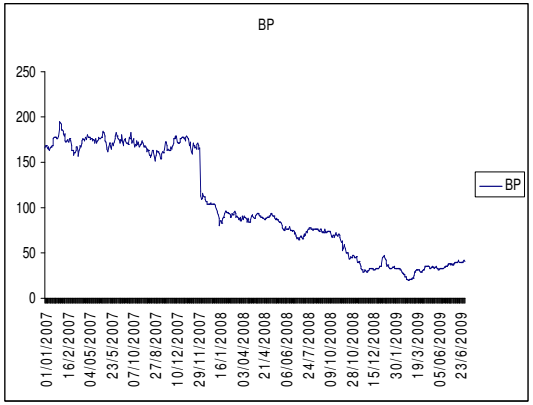

Figure 5: BK.OF MOSCOW (MO)

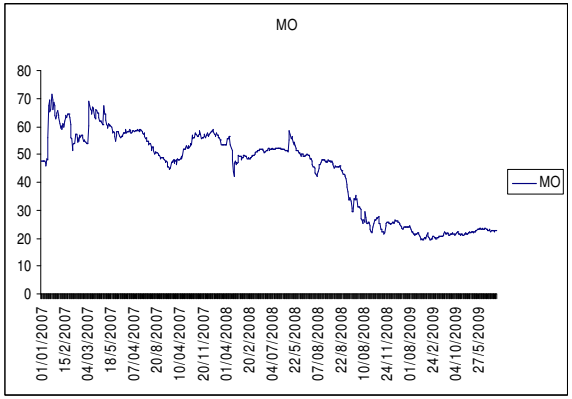

Figure 6: BANK ZACHODNI WBK (ZA)

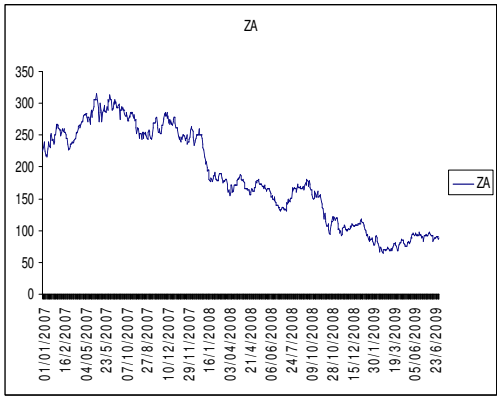

Figure 7: BRE BANK (BR)

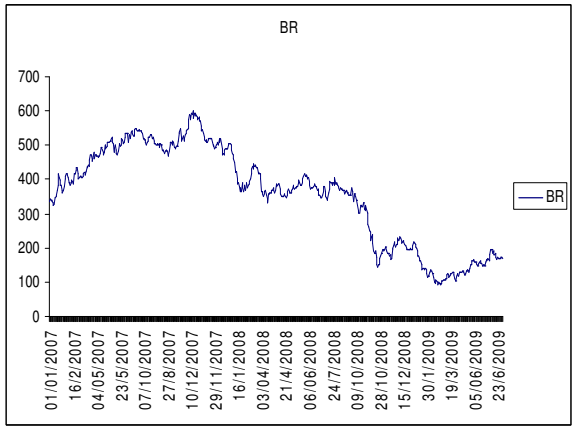

Figure 8: EFG EUROBANK ERGASIAS (EF)

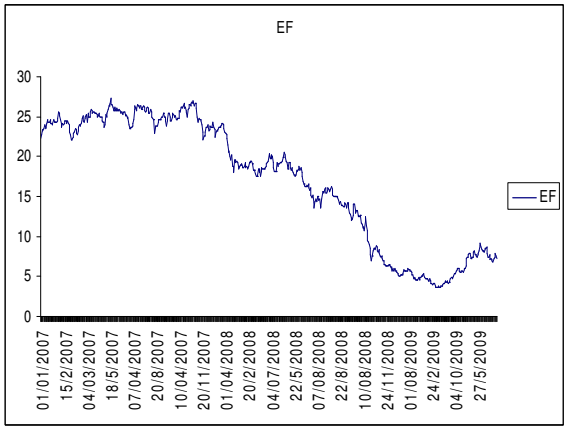

Figure 9: EMPORIKI BK.OF GREECE (EM)

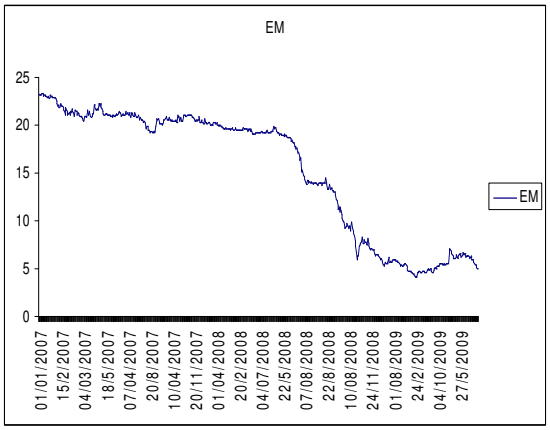

Figure 10: FINANSBANK (FI)

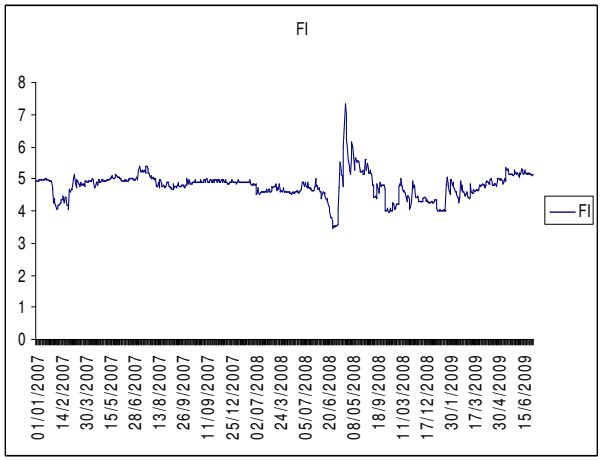

Figure 11: GETIN HOLDING (GE)

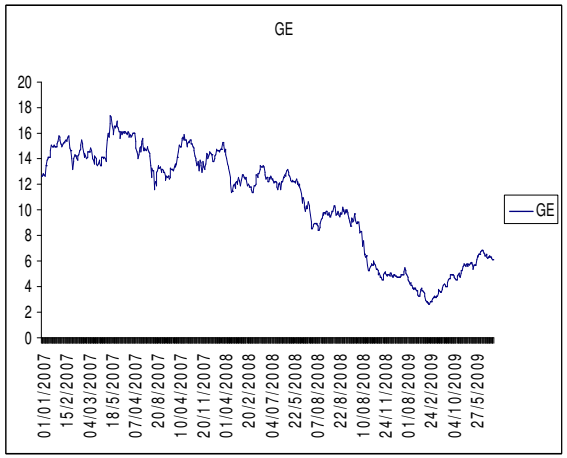

Figure 12: GSD HOLDING (GS)

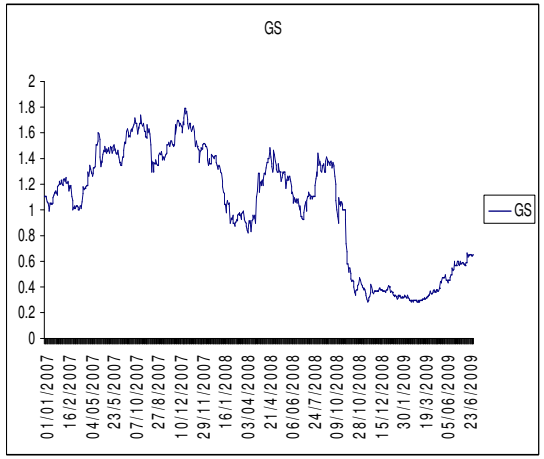

Figure 13: HANDLOWY (HA)

Figure 14: ING BANK SLASKI BSK (IN)

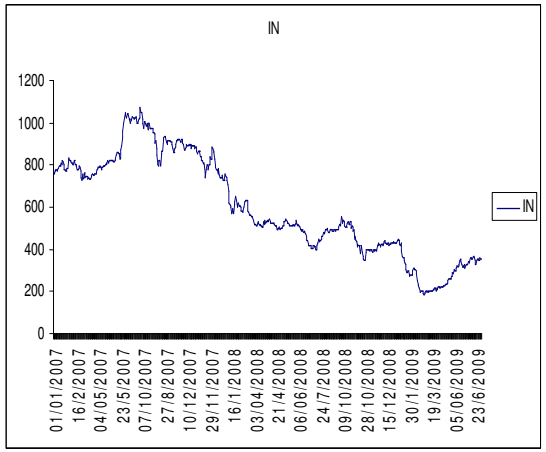

Figure 15: KOMERCNI BANKA (KO)

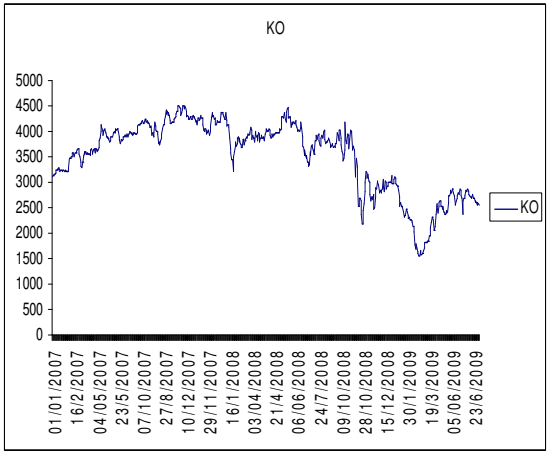

Figure 16: KREDYT BANK (KR)

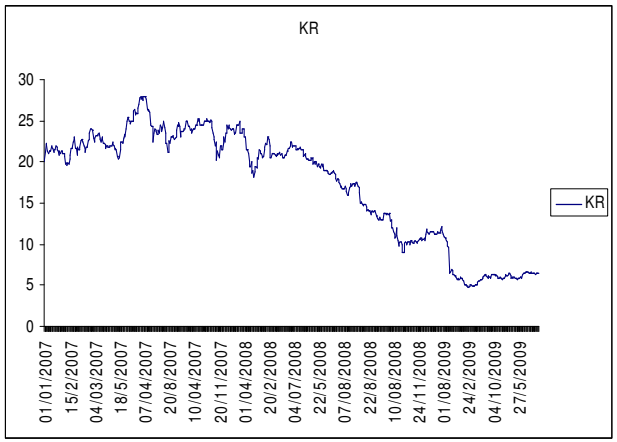

Figure 17: NATIONAL BK.OF GREECE(NAT)

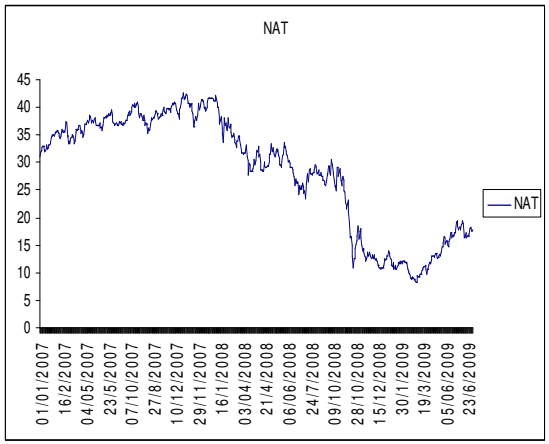

Figure 18: OTP BANK (OT)

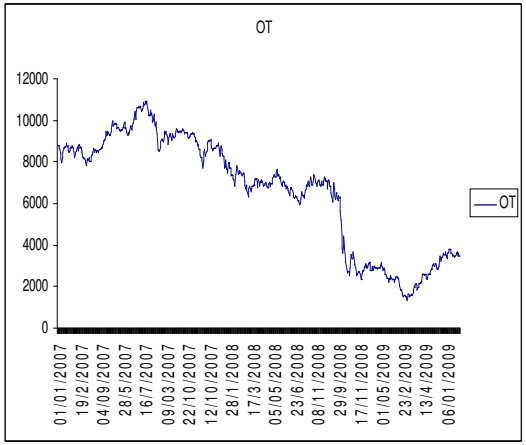

Figure 19: PEKAO (PE)

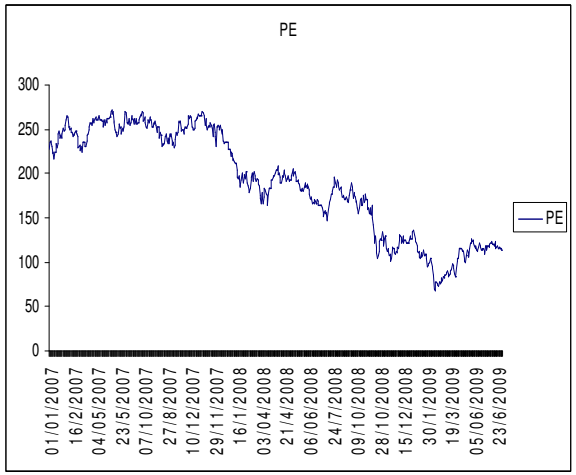

Figure 20: BANK OF PIRAEUS (BA)

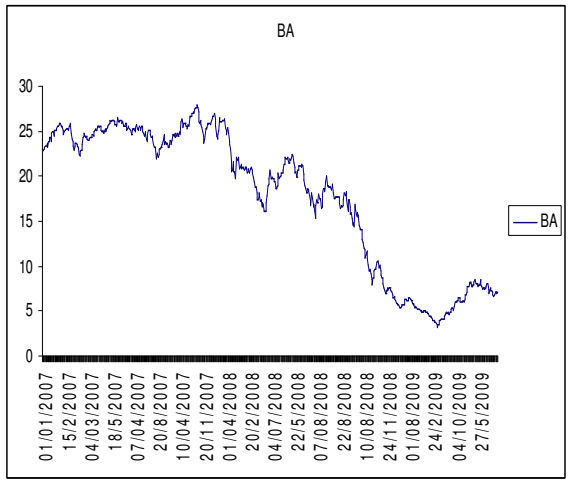

Figure 21: PKO BANK (PK)

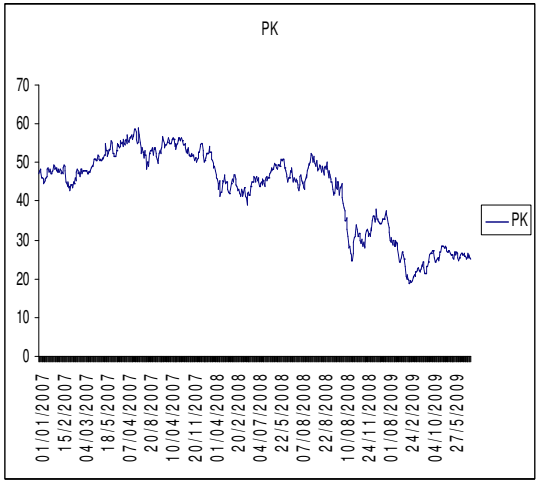

Figure 22: PROTON BANK (PR)

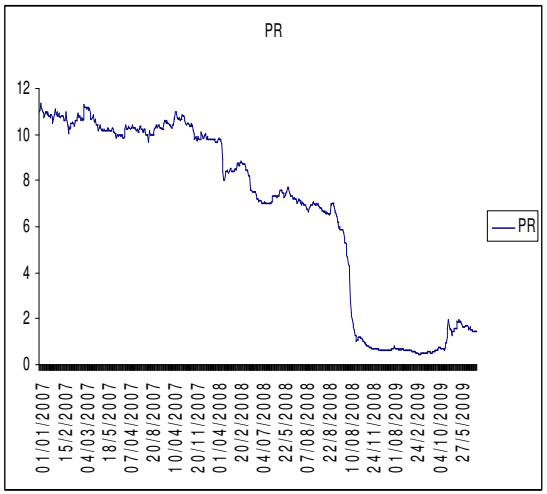

Figure 23: SBERBANK OF RUSSIA (SB)

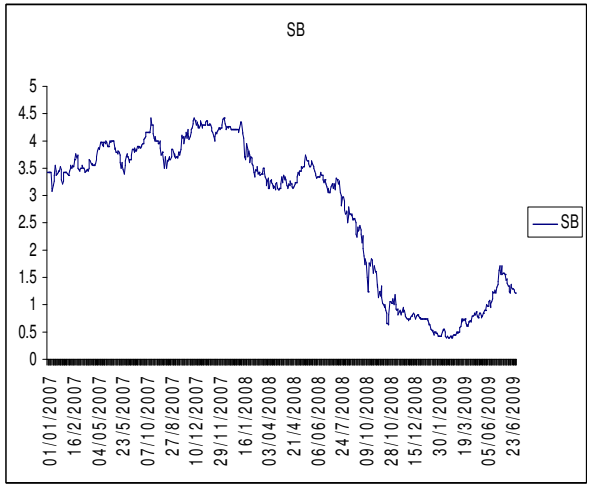

Figure 24: SEKERBANK (SE)

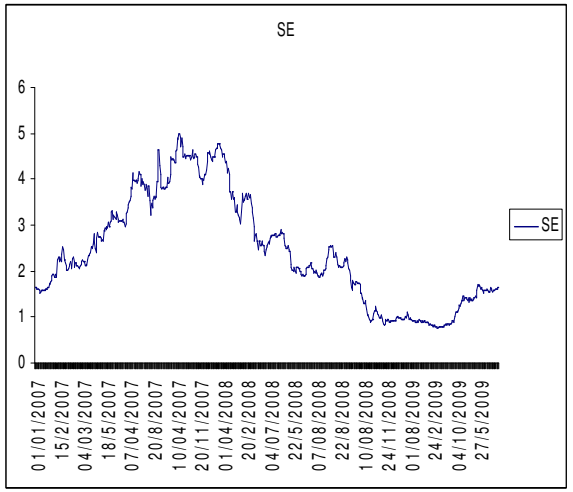

Figure 25: TT HELLENIC POSTBANK (TT)

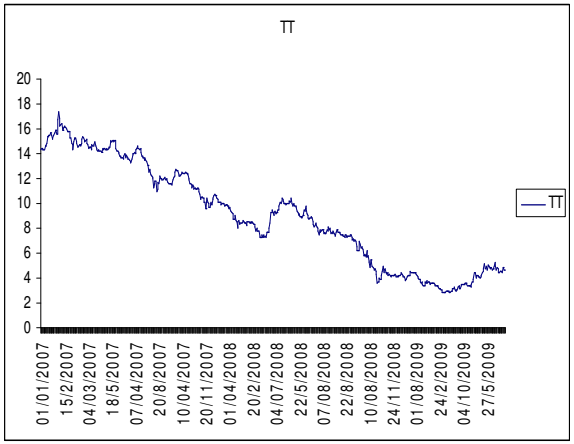

Figure 26: TURK EKONOMI BANKASI (TUR)

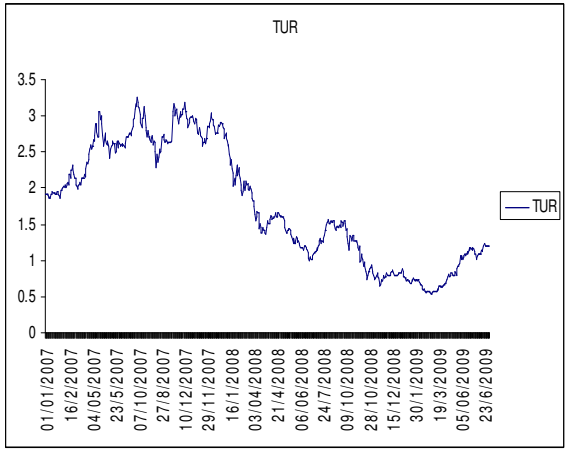

Figure 27: TKI.GARANTI BKSI (TK)

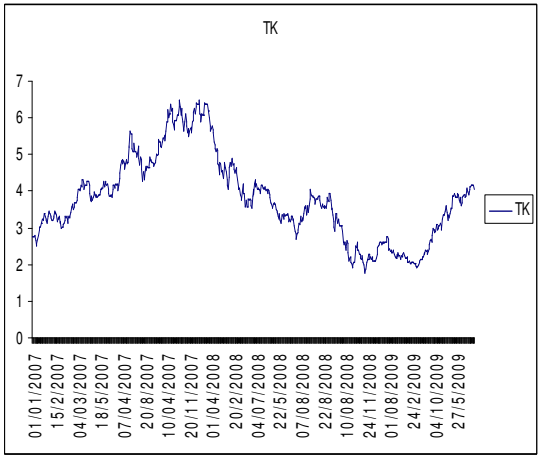

Figure 28: TURKIYE IS BANKASI 'C' (TU)

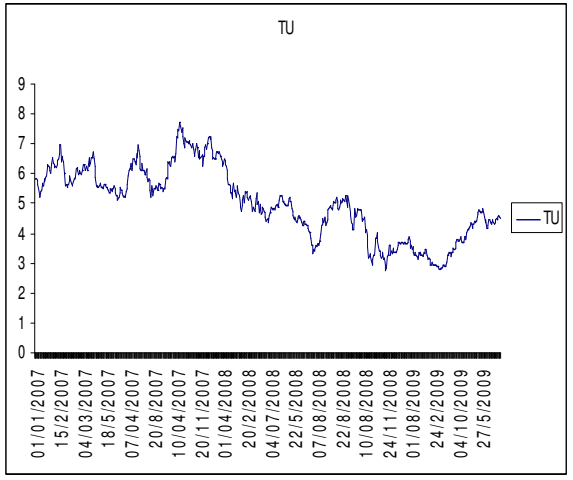

Figure 29: YAPI VE KREDI BANKASI (YA)

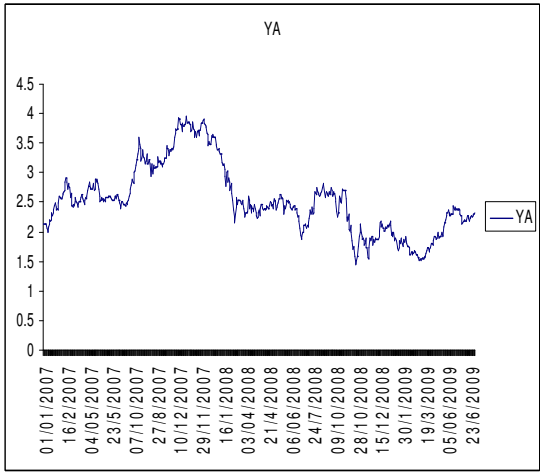

Figure 30: BANK MILLENNIUM (MI)

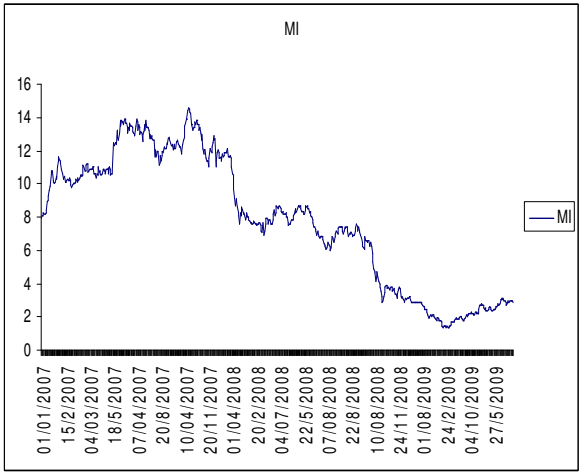

Figure 31: DJ STOXX EE 300 E - PRICE INDEX (EE)

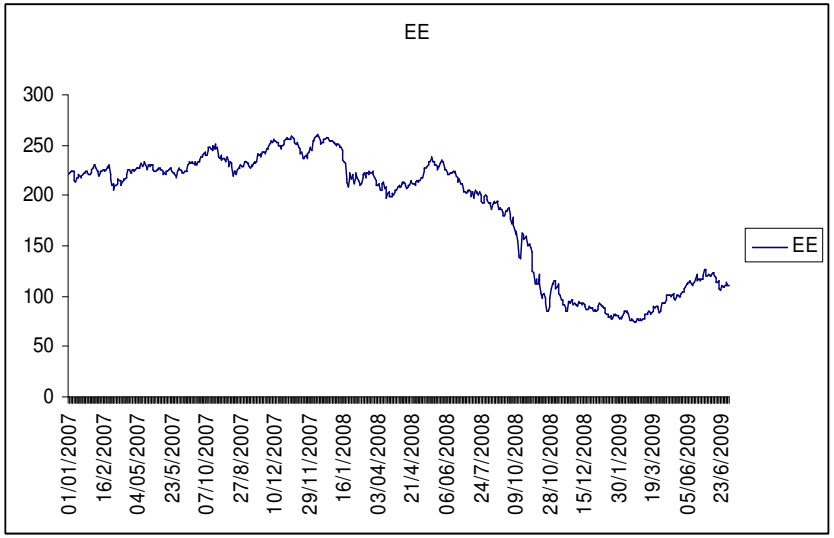

Figure 32: DJ STOXX 600 BANKS E - PRICE INDEX (DJ)

Table 1: Correlations

	AK	AL	AS	BP	MO	ZA	BR	EF	EM	FI	GE	GS	HA	IN	KO	KR	NAT	OT	PE	BA	PK	PR	SB	SE	TT	TUR	TK	TU	YA	MI	EE	DJ
AK	**1.00**	0.78	0.77	0.81	0.70	0.83	0.82	0.84	0.74	0.39	0.81	0.82	0.83	0.82	0.71	0.75	0.86	0.82	0.85	0.81	0.75	0.80	0.81	0.87	0.72	0.93	0.89	0.96	0.91	0.85	0.79	0.80
AL		**1.00**	0.85	0.87	0.95	0.90	0.94	0.97	0.98	0.22	0.97	0.92	0.92	0.86	0.88	0.95	0.97	0.96	0.94	0.99	0.93	0.98	0.97	0.79	0.89	0.86	0.70	0.86	0.75	0.94	0.98	0.94
AS			**1.00**	0.62	0.79	0.71	0.84	0.81	0.83	0.28	0.82	0.83	0.80	0.67	0.86	0.84	0.89	0.82	0.76	0.83	0.80	0.82	0.90	0.91	0.61	0.81	0.87	0.80	0.81	0.79	0.90	0.72
BP				**1.00**	0.86	0.97	0.88	0.94	0.89	0.19	0.91	0.83	0.90	0.95	0.67	0.87	0.87	0.91	0.96	0.91	0.83	0.92	0.84	0.67	0.96	0.89	0.59	0.86	0.68	0.93	0.83	0.97
MO					**1.00**	0.89	0.90	0.94	0.97	0.21	0.95	0.88	0.87	0.82	0.81	0.93	0.92	0.93	0.92	0.96	0.89	0.95	0.94	0.69	0.91	0.82	0.61	0.81	0.66	0.90	0.94	0.93
ZA						**1.00**	0.94	0.96	0.90	0.24	0.94	0.88	0.94	0.97	0.77	0.92	0.92	0.95	0.98	0.94	0.89	0.93	0.89	0.76	0.93	0.94	0.68	0.88	0.74	0.97	0.88	0.97
BR							**1.00**	0.95	0.92	0.25	0.94	0.95	0.96	0.92	0.90	0.96	0.96	0.97	0.96	0.96	0.96	0.94	0.95	0.86	0.85	0.93	0.78	0.86	0.82	0.98	0.95	0.91
EF								**1.00**	0.97	0.23	0.98	0.92	0.96	0.93	0.83	0.96	0.97	0.98	0.98	0.99	0.92	0.98	0.96	0.80	0.94	0.93	0.72	0.89	0.77	0.97	0.96	0.98
EM									**1.00**	0.16	0.97	0.88	0.91	0.86	0.83	0.96	0.95	0.95	0.94	0.97	0.90	0.98	0.96	0.75	0.92	0.85	0.65	0.83	0.68	0.92	0.97	0.95
FI										**1.00**	0.23	0.35	0.25	0.21	0.24	0.14	0.28	0.30	0.24	0.24	0.24	0.23	0.26	0.28	0.18	0.31	0.39	0.34	0.33	0.24	0.25	0.22
GE											**1.00**	0.91	0.95	0.90	0.84	0.95	0.96	0.97	0.96	0.98	0.91	0.97	0.95	0.78	0.93	0.89	0.70	0.88	0.73	0.96	0.95	0.96
GS												**1.00**	0.92	0.85	0.89	0.89	0.93	0.95	0.91	0.93	0.95	0.91	0.93	0.84	0.81	0.88	0.79	0.86	0.83	0.94	0.94	0.87
HA													**1.00**	0.94	0.85	0.95	0.94	0.95	0.95	0.94	0.92	0.92	0.93	0.84	0.87	0.93	0.76	0.85	0.77	0.97	0.92	0.93
IN														**1.00**	0.74	0.90	0.89	0.93	0.95	0.90	0.87	0.89	0.84	0.76	0.90	0.93	0.67	0.85	0.74	0.96	0.83	0.94
KO															**1.00**	0.87	0.89	0.87	0.82	0.86	0.93	0.83	0.88	0.82	0.67	0.77	0.75	0.76	0.79	0.84	0.90	0.75
KR																**1.00**	0.94	0.95	0.94	0.96	0.94	0.95	0.95	0.81	0.87	0.88	0.69	0.82	0.72	0.95	0.95	0.92
NAT																	**1.00**	0.97	0.95	0.98	0.93	0.97	0.97	0.87	0.86	0.93	0.80	0.91	0.83	0.96	0.97	0.93
OT																		**1.00**	0.97	0.98	0.95	0.97	0.95	0.81	0.91	0.92	0.73	0.88	0.77	0.97	0.96	0.96
PE																			**1.00**	0.97	0.92	0.96	0.92	0.78	0.94	0.93	0.71	0.91	0.78	0.97	0.92	0.98
BA																				**1.00**	0.94	0.98	0.97	0.80	0.92	0.90	0.72	0.89	0.77	0.96	0.97	0.96
PK																					**1.00**	0.92	0.92	0.79	0.82	0.84	0.70	0.81	0.78	0.94	0.93	0.87
PR																						**1.00**	0.96	0.78	0.92	0.89	0.69	0.88	0.74	0.95	0.97	0.96
SB																							**1.00**	0.86	0.85	0.89	0.79	0.87	0.80	0.93	0.99	0.91
SE																								**1.00**	0.59	0.89	0.95	0.83	0.92	0.84	0.84	0.70
TT																									**1.00**	0.83	0.50	0.81	0.58	0.89	0.85	0.98
TUR																										**1.00**	0.85	0.93	0.86	0.94	0.87	0.90
TK																											**1.00**	0.85	0.94	0.76	0.77	0.62
TU																												**1.00**	0.90	0.89	0.86	0.87
YA																													**1.00**	0.81	0.79	0.68
MI																														**1.00**	0.93	0.95
EE																															**1.00**	0.90
DJ																																**1.00**

Table 2: Unit Roots, Cointegration, and Causality Analysis

Stoxx Indices	ADF Levels	ADF First Differences	Johansen Cointegration Test	Granger Causality
DJ STOXX 600 BANKS E - PRICE INDEX	-0.62	-25.43*	n/a	n/a
DJ STOXX EE 300 E - PRICE INDEX	-0.32	-24.41*	n/a	n/a
Banks' List				
AKBANK	-1.64	-24.45*	No	AK→DJ***
ALPHA BANK	-0.25	-25.81*	No	AL↔DJ***
ASYA KATILIM BANKASI	-1.19	-22.44*	No	DEE→AS**
BANK BPH	-0.81	-23.96*	No	DJ→BP***
MOSCOW MUN.BK.-BK.OF MOSCOW	-0.81	-9.13*	No	No
BANK ZACHODNI WBK	-0.40	-10.71*	No	DJ→ZA**
BRE BANK	-0.48	-22.62*	No	BR→DEE*
EFG EUROBANK ERGASIAS	-0.32	-23.69*	Yes	DEE→EF***; DEE↔DJ*
EMPORIKI BK.OF GREECE	0.22	-27.52*	No	EM→DEE**; EM→DJ**
FINANSBANK	-3.67*	n/a	n/a	n/a
GETIN HOLDING	-0.76	-10.12*	Yes	DEE→DJ***
GSD HOLDING	-1.50	-5.08*	No	No
HANDLOWY	-0.90	-10.77*	No	No
ING BANK SLASKI BSK	-0.81	-12.45*	No	No
KOMERCNI BANKA	-1.11	-8.99*	No	No
KREDYT BANK	-0.32	-16.58*	No	KR↔DJ**
NATIONAL BK.OF GREECE	-0.68	-19.14*	No	DJ→NAT**
OTP BANK	-0.60	-12.32*	No	No
PEKAO	-0.80	-26.72*	No	DJ→PE***
BANK OF PIRAEUS	-0.29	-8.11*	No	BA↔DJ**;
PKO BANK	-0.78	-26.50*	No	No
PROTON BANK	-0.33	-10.58*	Yes	No
SBERBANK OF RUSSIA	-0.25	-7.71*	No	SB↔DJ**; SB↔DEE**
SEKERBANK	-1.05	-23.86*	No	No
TT HELLENIC POSTBANK	-0.85	-25.70*	No	TT→DJ*
TURK EKONOMI BANKASI	-0.94	-6.19*	No	TU→DJ*

TKI.GARANTI BKSI.	-1.55	-25.60*	No	TK→DJ***
TURKIYE IS BANKASI 'C'	-1.67	-25.34*	No	No
YAPI VE KREDI BANKASI	-1.70	-25.25*	No	No
BANK MILLENNIUM	-0.33	-25.94*	No	MI→DEE***

*1% significance level; **5% significance level, ***10% significance level. In the case where cointegration is found (EFG EUROBANK ERGASIAS, GETIN HOLDING, and PROTON BANK, the Engle and Granger pair wise test for cointegration is applied in order to identify which variables are cointegrated. Our interest is based in cointegration relationships between the individual banks and the DJ Stoxx Indices. Taking this fact into consideration we confirm that there is a cointegration relationship in the case of GETIN HOLDING and the DJ Stoxx 600 Banks Index. As a consequence the ECM is applied in this case, and the result is significant at the 1% significance level, indicating the existence of a short-relationship between the two variables. Thus when implementing the Granger Causality test the ECM was also incorporated in the test in order to avoid spurious results.

Ordinary Least Squares Results

Table 3: Ordinary Least Squares-Market Integration

Variables	2006		2007		2008	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Size	19890363	0.00	23770951	0.00	30303247	0.00
Liquidity	-11029575	0.55	-15292334	0.53	-1704923	0.95
Capitalization	48021707	0.61	62411589	0.59	136000000	0.33
Intangibles	274000000	0.21	422000000	0.11	539000000	0.18
Market Integration	-4393563	0.50	-2616428	0.74	-7166498	0.52

Table 4: Ordinary Least Squares-Regional Integration

Variables	2006		2007		2008	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Size	18861472	0.00	23050798	0.00	30607485	0.00
Liquidity	-17128407	0.36	-22459276	0.37	-5933776	0.85
Capitalization	24856313	0.79	34554278	0.77	138000000	0.33
Intangibles	352000000	0.11	494000000	0.07	560000000	0.18
Regional Integration	10103144	0.28	11179319	0.35	3548897	0.85

Logit Model Results

Table 5: Logit Analysis-Market Integration

Variables	2006		2007		2008	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Risk	0.0000	0.47	0.0000	0.69	0.0000	0.18
Size	1.2317	0.20	0.6819	0.44	6.0877	0.12
Liquidity	1.0016	0.80	1.6429	0.70	5.4866	0.28
Capitalization	9.2006	0.58	1.9120	0.90	19.3778	0.36
Intangibles	-19.0781	0.65	-9.7173	0.80	-14.5853	0.79

Table 6: Logit Analysis-Regional Integration

Variables	2006		2007		2008	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Risk	0.0000	0.30	0.0000	0.52	0.0000	0.95
Size	-0.3918	0.79	-0.3853	0.79	-0.3300	0.92
Liquidity	12.2651	0.19	19.4943	0.14	15.6230	0.23
Capitalization	5.7264	0.81	25.3217	0.31	18.2629	0.43
Intangibles	-183.9216	0.21	-90.7429	0.25	-46.2666	0.62