No.77/ June 2005

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IIIS Discussion Paper No. 77

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(May 2005)

Abstract

This paper examines banking and financial sector return co-movements between the three largest Central and Eastern European countries to have recently joined the European Union, namely the Czech Republic, Hungary and Poland. In order to build up an understanding of the soundness and stability of the banking systems of these new member states, we try to determine whether it is contagion, or interdependence that is driving the co-movements between these markets. Employing various different tests of propagation and controlling for own-country news and other fundamentals, we find evidence of cross-border banking sector contagion and determine that it is regional rather than international shocks that are driving the market movements.

JEL classification: F30, F40, G15
Key words: Contagion, Macroeconomic news, Banking sector, Stock returns

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[♦] We would like to thank the Government of Ireland through the Program for Research in Third Level Institutions (PRTLI) for financial support for this project.

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Introduction

The trend towards market integration, both internationally as well as in the newly enlarged European Union (EU), has highlighted the reality that international markets have progressively more influence on each other and are moving ever more closely together. Such co-movement according to Forbes and Rigobon (1999) can be attributed either to contagion, or merely to strong real linkages between the economies, something they define as interdependence.

Banking crisis is hardly a new phenomenon. In fact, the development of the international banking sector has consistently been marred by crises, generating a diverse array of mechanisms to reduce their strength and impact. In more recent times, the incidence of banking and financial sector crises has intensified and their effect on the domestic and international economy has become even more profound[1]. Understanding both the nature and the causes of dramatic co-movements, between the banking sectors of differing economies with a view to gaining insight into market linkages, has consequently become a major research topic in international finance.

With the recent enlargement of the European Union (EU), the importance of extending banking and financial sector understanding to include the new member states becomes imperative. As they move towards monetary union, their role in maintaining the strength of the euro area banking system is amplified. This paper therefore serves to examine whether contagion can be identified as a source of co-movement between the banking sectors of the three largest Central and Eastern European Countries (CEECs) to have recently joined the EU namely the Czech Republic, Hungary and Poland. The concept of contagion has been largely disputed in the literature and as pointed out in Section II, defined in various different ways. In this paper, we consider contagion as the significant increase in cross-country linkages after a shock to one country (or group of countries). We aim to study the nature and existence of these co-movements, and as a second step move towards understanding their pass-through.

The remainder of the paper is organized as follows: Section II outlines the importance of contagion and reviews the traditional methods for identification. Section III briefly describes the evolution of the banking systems of the CEECs. Section IV outlines the data we adopt for our study. Section IV tests for the existence of contagion between the Czech Republic, Hungary and Poland and presents the results found. In Section VI we attempt to estimate the different channels through which shocks are propagated. Finally, Section VII concludes.

[1] e.g. The Mexican crisis (1994), Asian and Russian (1997-1998) crises.

Section II Contagion and Identification

Contagion has been defined in many different ways in the literature, including the transfer of any shock across countries (Edwards 2000). Eichengreen and Rose (1999) and Kaminsky and Reinhart (1999) define contagion as the situation where the knowledge of crisis in one country increases the risk of crisis in another country. Edwards (2000) goes on to restrict the term economic contagion to those situations where the magnitude with which a shock is transmitted exceeds what was expected on the ex ante basis of 'fundamentals'. Despite the inability of authors to agree on an exact definition of contagion, evaluating whether it occurs across countries or regions is important for several reasons.

A critical assumption of investment strategy is that most economic disturbances are country specific. Markets in different countries should therefore display relatively low correlations, and consequently a role for international diversification should be expected. If however, either positive or negative contagion does occur after a shock to the system, then market performance would either increase or decrease depending on the nature of the contagion, undermining the rationale for international diversification. Positive contagion in this sense refers to an increase in the correlation coefficient during a crisis period when compared to the tranquil time. In the case of negative contagion, the opposite is true; the correlation coefficient of the crisis period is significantly lower than the coefficient during the pre or post crisis phase. While more recent literature distinguishing between positive and negative contagion explicitly allows for the case that other markets might benefit from a crisis in one country (Bayoumi et al. 2003 and Linne 1999), many international institutions and policy makers remain concerned that a negative shock to one country can have a negative impact on financial flows to another country. Such an impact can arise irrespective as to whether or not the fundamentals of the second economy are strong and whether there are any real sector linkages between the two countries. While the effect may only be temporary, it could lead to a financial crisis in the second country, a crisis completely unwarranted by the country's fundamentals and policies. For all of these reasons, it is important to determine if, and under what circumstances, contagion occurs.

Much of the theoretical work on the international propagation of shocks can be broadly categorized into three different categories: aggregate shocks which affect the economic fundamentals of more than one country, country-specific shocks which affect the economic fundamentals of other countries, and shocks which are not explained by fundamentals and are categorized as pure contagion. Empirical research in this field largely focuses on testing for the

existence of contagion and subsequently estimating the different channels through which shocks are propagated throughout the international financial system.

The most widely used procedures for testing for contagion are based on simple OLS regressions (Andersen & Bollerslev, 1998 and Andersen et al, 2003), Principal Component analysis (Kaminsky & Reinhart, 2000) and Correlation Coefficient analysis (Bennett & Kelleher, 1988; King & Wadhawani, 1990; Calvo & Reihart, 1996; Edwards, 1998; and Baig & Goldfajn, 1999). Tests using correlation analysis assume that changes in the underlying coefficients imply a shift in cross-country/market correlations. This technique has been widely adopted in the literature due to its simplicity; it does however fail to recognize a bias that is brought about by the unadjusted coefficient being conditional on market movements over the time period under consideration (Forbes & Rigobon, 1999). Forbes and Rigobon highlight the importance of distinguishing between contagion and interdependence whereby the former relates to cross-market linkages being fundamentally different after a shock to one market, while the later implies no significant changes in relationships despite shocks hitting the recipient market. Favero and Giavazzi introduce a further test of contagion, testing for non-linearities in the propagation mechanism of country-specific shocks. Through the use of the term 'non-linearities' they stress that contagion refers to a significant reinforcement of linkages during crisis periods, thereby additionally classifying significant reductions in these relationships as contagion. Much of the work to date fails to distinguish between the two, the notable exception being Tai (2004a, 2004b) who tests whether contagion can occur at the industry level, in particular in the banking industry during the Asian crisis.

The second part of this literature focuses on estimating the different channels through which shocks are propagated across countries. From an empirical point of view, only very few varying techniques have been employed, namely Logit-Probit models (Eichengreen, Rose & Wyplosz, 1997; and Kaminsky & Reinhart, 1999), OLS regressions (Baig & Goldfajn, 1999, 2000; De Gregario & Valdes, 2001; Favero & Giavazzi, 2000; Gelos & Sahay, 2000; Glick & Rose, 1998; Van Rijckeghem and Weder, 2000) and Principal Component Analysis. Very few papers have attempted to use news as the identifying condition for the propagation of shocks. Eichengreen, Rose and Wyplosz (1997) studied the collapse of fixed exchange rates in the ERM at the end of 1993, with one country's collapse taken as the exogenous event. They subsequently calculate the probability of a country's crisis affecting the probability of other countries facing a similar crisis. Baig and Goldfajn (1999) studied the impact of daily news in one country's stock market (exogenous event) on other countries' markets during the East Asian crisis. They find that a substantial proportion of a country's news impacts neighboring economies.

Section II Central and Eastern European Banking Systems

Having endured over a decade of substantial reform and stabilization, financial sector development in the Czech Republic, Hungary and Poland finds itself in the final stages. The privatization of the large banks has ultimately been completed, and foreign strategic owners, most of them EU-based banks, dominate the banking sector. After an enormous clean up of portfolios, the standardization of banking sector regulations along with the new ownership structures, the Czech Republic, Hungary and Poland are finally facing the same issues challenging most industrialized nations.

Much of the 1990s however was a period of stagnation with all countries experiencing a decade of transition. The Czech Republic, in particular, emerging as a single economy after the fall of the communist regime in the early 1990s, was faced with massive economic restructuring. The early phase of transition for all three countries was generally characterized by banking crisis and recapitalization programs as well as by a considerable change in structural ownership. Having inherited underdeveloped, undercapitalized and badly managed banks from the past, these economies further faced serious exogenous and institutional shocks, keeping the levels of financial intermediation at very low levels. Such shocks included high and persistent inflation, banking sector distress coupled with financial and currency crisis taking place both at home and abroad.

Considering the recapitalization programs undertaken, Table I shows that the Czech Republic had concluded a large set of measures by 1997, however, substantial additional funds had to be put up to prepare the countries largest banks for privatization. Poland was the most successful in its reform, with cumulated costs below 1.5% of GDP in 2000. Both Hungary and Poland managed to stabilize their banking systems by 1997 with the help of recapitalization programs, the Czech Republic however continued to face problems up until the new millennium. A rough estimate of these costs is shown in Table I, where we report the fiscal cost of the bank recapitalization programs.[2] (Capiro and Klingebiel, 1999; and Barth et. al., 2000).The evolution of the banking sector indices for the Czech Republic, Poland and Hungary, can be seen in Table II and Table III as well as in Figure I, Figure II and Figure III respectively.

In our analysis, we define the period between 1994 and end 1999 as a period of economic stagnation or reform.

[2] Costs include the cost of recapitalization and losses incurred through protecting deposits either implicitly or explicitly through government deposit insurance schemes. Sometimes costs of corporate restructuring are also included. For this reason, fiscal costs are not always directly comparable.

Section III Data

Modern finance theory generally assumes that banks are considered as institutions that help to solve market failures, while playing a compensating role for the limitations of financial markets (Allan and Gale, 2001; Mishkin, 2001). The banking and financial sectors of these economies are thus a natural focal point when considering market co-movements between these countries.

For our empirical analysis, we make use of nine and a half years of daily data (July 1994 to end 2004). We adopt the DataStream banking and financial sector indices[3] for the Czech Republic, Hungary and Poland, as well as for the United Kingdom (UK), United States (US) and EU. Adopting DataStream indices provides a comparative index for each country, which captures more than 75% of the total market. The DataStream indices are value weighted indices based on key publicly-quoted banks in the each country. The weighting is based on the market capitalization of each bank. The larger the market cap, the greater the weighting, giving an accurate reflection of the banking sector.

These indices were obtained in US dollar terms, their per cent changes and natural logs were subsequently calculated. The US series employed was lagged by one day in order to account for time differences.

III.I Creation of Dummy Variables

As no high frequency variables (e.g. daily data) that can approximate the fundamentals in each country exist for our estimations in Section V, we employ an approach whereby we create a set of dummy variables constructed from macro-economic news announcements. Such dummy series were created via the collection of daily news releases either from the central bank or national statistical office for the UK, EU[4] and US, or where official figures were unavailable we employed the LexisNexis news databank.[5] The searches were conducted focusing both on central bank and national statistical office releases as well as on the individual variables we wished to include. The variables of interest were: unemployment, short-term interest rates, consumer price index, terms of trade (or an indicator of market openness when not available), real gross domestic product (GDP), current account deficit. These indicators are largely considered to be of most

[3] Analysis was conducted on both the bank and financial sector indices for all countries, however due to the largely similar results obtained only the banking sector results are presented. This similarity is hardly surprising considering that between 85-88% of total assets of the financial system are held by banks for all three countries under analysis.
[4] The EU variable was created by combining data for Germany before 1999 with EU data after 1999.
[5] Our sources were limited due to lack of alternatives on LexisNexis, we made use of MTI Econews for Hungary, CTK for the Czech Republic and the Polish News Bulletin for announcements in Poland.

importance in the assessment of macro-economic influence on the banking system stability in the literature (Huchinson, 1999; Demirgűç-Kunt & Detragiache, 1998; Timmermans, 2001). For Hungary, Poland and the Czech Republic, we also included various other announcements; such as a change in exchange rate regime, a change in the country's credit rating by a major rating agency, namely Standard & Poor's, Moody's or Fitch, or the decision by the central bank to intervene in the foreign exchange market.

Following Baig and Goldfjn (1999), we distinguished between 'good' and 'bad' news by using simple guidelines - any credible attempt to restructure or improve the economic situation was deemed as 'good', whereas news that indicated a further decline of the real or financial sector was deemed 'bad'. The good (bad) news dummy series was assigned a '1' on the release of favorable (unfavorable) macro-economic news.

A fall in inflation, better GDP growth, and an improvement in the terms of trade were all assigned a 'good' news dummy, as were a fall in the consumer price index, lower unemployment figures, and a reduction in the current account deficit. Finally, we assumed that the central banks followed a price stability or inflation targeting strategy and assigned a 'good' news dummy to a decrease in the short-term interest rate, as set by the central bank. For the Czech Republic, Hungary and Poland, we further considered any news of the country's move towards EU membership as 'good', together with an increase in the country's credit rating by one of the major ratings agencies. Furthermore, we considered any move in exchange rate regimes towards a free-float as being positive and any rescue packages or funding given to the country by international organizations as favorable.

While the privatization of state-owned banks can in principle have benefits as well as costs, the overall general considerations of the incentive effects of private ownership, as well as empirical evidence on this issue support the view that the benefits outweigh the costs (EBRD, 1997). Private ownership generally provides better incentives for more disciplined risk taking of managers along with the limitation of government intervention into the allocation of credit. Furthermore, it enhances the incentives for more effective monitoring and screening of banking institutions, ultimately improving the general stability and soundness of the banking system in which they operate. For this reason, we further considered any increase or speeding up of the privatization process as being positive.

For 'bad' news the opposite was true. We assigned a 'bad' news dummy variable when the rate of inflation increased, GDP growth declined or the terms of trade index worsened. Furthermore, a rise in consumer prices, an increase in unemployment or a fall in the interest rate was considered bad for the economy. Although very general, we assumed that a rise in interest

rates would signal non inflationary pressures and concerns of deflation resulting in notably below trend GDP growth and consequently a worsening economic situation. Again, for the Czech Republic, any delay in EU membership was considered 'bad', as was a fall in the country's credit rating. We further considered a delay in the privatization process for banks operating in the Czech Republic, Hungary or Poland, as negative.

Once all the good and bad news series were created for each variable separately, we aggregated the series to obtain a 'good' and a 'bad' news dummy series for each country. These aggregated series were employed for our regression analysis in Section VI.

Section IV Testing for Contagion: Methodology and Empirical Results

IV.I Banking Sector Correlations

In order to obtain evidence on the extent of banking sector co-movements in these countries, we begin by estimating the unadjusted correlation coefficients of the daily changes in the banking sector indices of Hungary, Poland and the Czech Republic. The sample period begins on the 19th of July 1994[6] and spans till the end of December 2004. We estimate the correlations in the overall sample period, and subsequently apply the Likelihood ratio test for the significance of group-wise correlations following Baig and Goldfajn (1999), Valdés (1995), as well as Pindyck and Rotemberg (1990) testing the null hypothesis of no group-wise correlation.[7] The unadjusted correlations are calculated according to the standard definition of the correlation coefficient:

$$\rho = \frac{\sigma_{x,y}}{\sigma_x \sigma_y} \qquad (1.)$$

Where σ_x and σ_y represent the variances of the daily changes in banking sector and total market indices of two distinct countries.

The results for the total sample banking sector cross-country correlations are presented in Table IV. All pairs demonstrate positive coefficients ranging between 0.19 for Poland and the Czech Republic, and 0.27 for both Hungary and Poland and Hungary and the Czech Republic. It is interesting to note that the full sample correlations between the Czech Republic and Poland are particularly affected by the sizeable turmoil that had an impact on the Czech Republic for much of the 1990s, while hardly any of this influence is evident in the relationship between the Czech Republic and Hungary.

As contagion is often defined as a significant increase in cross-market linkages after a shock to an individual country or group of countries, we further split our data into a reform, or stabilization period and a tranquil period as defined in Section II.[8] Again we calculate the correlation coefficients. At a first glance, we see that the reform period correlations for all pairs are larger when compared to both the total sample and tranquil periods. It is interesting to note

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[6] The first date on which data was available for all three markets.

[7] The test statistic: $-N \log|R|$ is distributed as x^2 with $\left(\frac{1}{2}\right)p(p-1)$ degrees of freedom, where $|R|$ is the determinant of the correlation matrix, N, the number of observations and p the number of series being tested.

[8] Stabilization period stems from 19th July 1994 to end 1999, tranquil period: January 2000 to end 2004.

that the correlation coefficient between the Czech Republic and Poland remains the lowest of the pairs at 0.29, while the coefficients for the Czech Republic and Hungary, and Hungary and Poland are very similar in magnitude, 0.33 and 0.31 respectively. During the tranquil period, the coefficient between the Czech Republic and Poland falls to 0.15, while the remaining coefficients continue to demonstrate rather strong correlations of 0.25 and 0.26 respectively. This finding is in line with our expectations.

IV.II Rolling Correlations

The problem that exists with applying the full sample for correlation analysis is such that it smoothes out much of the shorter duration interactions between markets. For instance, while it is evident from the fall in correlation that events in the Czech Republic during the reform period had a substantial impact on its neighboring Hungary and Poland, it is impossible to disentangle these movements as they become diminished via the use of the entire sample. To further investigate co-movements during the period of turmoil, we repeat the exercise for sub-samples consisting of three-month windows, rolling them till the end date. We calculate rolling correlations covering the entire sample, however, for brevity only the results for the period February 1997 to November 1999 are shown in Table V[9]. It is interesting to note that the correlations between the Czech Republic and Poland are highly volatile, fluctuating between positive and negative correlations. While also demonstrating a degree of volatility, the coefficients for the Czech Republic and Hungary are far more stable and steadily correlated. Hungary and Poland, on the other hand, have consistent high positive correlations throughout, and at times demonstrate cross-country coefficients as high as 0.51. Furthermore, it is remarkable how quickly and abruptly the correlations increase (to 0.50 for the Czech Republic and Hungary, 0.38 for the Czech Republic and Poland) between August 1998 and February 1999, when for the first time the Czech Republic demonstrated signs of improvement.

IV.III Likelihood Ratio Test

While the full sample and the rolling correlations help to determine the patterns of co-movements between markets, they are not useful for gaining an understanding as to whether there is a significant difference in these market correlations during turbulent and tranquil times. We follow Forbes and Rigobon (1999) whereby we try to determine whether market movements can be attributed to contagion or to interdependence. To address this issue, we apply a two-sample,

[9] Results for the other periods are available on request. Correlations during these periods are largely stable with very little degree of volatility evident for all pairs.

heteroskedastic *t*-test, and examine whether a significant increase in correlations in the stabilization period is evident. If the correlations increase significantly, then there are grounds for believing that these markets have moved away from relationships dictated by traditional movements of fundamentals. On the other hand, if the increases are not significant, then it is possible to assume that these markets are simply reacting to shocks that are common-cause or spill over generated.

Applying the likelihood ratio test, we examine the null hypothesis that the tranquil period correlations are greater or equal to the correlation during reform against the alternative hypothesis that cross-country correlation is greater during the turbulent period:

$$H_0 : \rho_{i,j}^0 \geq \rho_{i,j}^1$$

$$H_1 : \rho_{i,j}^0 < \rho_{i,j}^1$$

where $\rho_{i,j}^t$ is the correlation coefficient between country *i* and country *j* over period *t*. The tranquil period is denoted '0' and stabilization period as '1'.

The correlation coefficients are transformed using a Fisher transformation, so that they are approximately normally distributed with a mean μ_t and variance σ_t^2:

$$\mu_t = \frac{1}{2}\ln\left[\frac{1+\rho_{i,j}^t}{1-\rho_{i,j}^t}\right] \tag{2.}$$

and

$$\sigma_t^2 = \frac{1}{n_t - 3} \tag{3.}$$

The test statistic is derived as follows:

$$U = \frac{\bar{X}_0 - \bar{X}_1}{\left(\frac{S_0^2}{n_0} + \frac{S_1^2}{n_1}\right)^{\frac{1}{2}}} \tag{4.}$$

where X_t and S_t^2 are the estimated sample mean and variance following the Fisher transformation. The test statistic follows the *t*-distribution. The degrees of freedom are calculated as follows:

$$\frac{\left(S_0^2/n_0 + S_0^2/n_0\right)^2}{\frac{\left(S_0^2/n_0\right)^2}{n_0 - 1} + \frac{\left(S_1^2/n_1\right)^2}{n_1 - 1}} \tag{5.}$$

The results for the heteroskedastic *t*-test are presented in Table VI. For all pairs, the reform period correlations are greater than the corresponding tranquil period coefficients within a 1 per cent level of significance. Due to these fundamental differences in cross-country linkages, we can infer the existence of contagion for all pairs during the period under analysis. The Log likelihood ratio test statistics (LR) are presented at the top of each table respectively. The test aims to reject that all pair wise correlations are zero; we find evidence of this at the 1 per cent level of significance for all tests.

IV.IV Bias in the Correlation Coefficient

While the simple test of contagion based on correlation analysis above appears to show evidence of contagion between both the banking sector indices of the CEEC economies, recent literature has highlighted a bias in the correlation coefficient central to this analysis. (Forbes & Rigobon, 1999). This bias proves to be especially large during periods of market turmoil which, in effect, is the focus of this test.

The use of the unadjusted (or conditional) coefficient assumes the bilateral analysis of markets, *x* and *y*, and a division of the data sample into a high variance (*h*) and a low variance (*l*) group, representing stabilization and tranquil periods respectively. We start by estimating the correlation coefficient of the reform period according to the standard definition (1.) and adjusting to account for higher volatility of returns during periods of turmoil.

The adjustment takes the form:

$$\gamma_y = \frac{\rho_y}{\sqrt{1+\left(\frac{(\sigma_{y,i}^2 - \sigma_{x,i}^2)}{\sigma_{x,i}^2}\right)\left(1-\rho_y^2\right)}} \tag{6.}$$

where ρ_y is the stabilization period correlation between *x* and *y*, $\sigma_{x,i}^2$ and $\sigma_{y,i}^2$ are the variance of asset returns in the stabilization and calmer periods of the reforming country's asset returns respectively.

$$FR = \frac{\frac{1}{2}\ln\left(\frac{1+\gamma_y}{1-\gamma_y}\right) - \frac{1}{2}\ln\left(\frac{1+\rho_y}{1-\rho_y}\right)}{\sqrt{\frac{1}{T_y-3}+\frac{1}{T_x-3}}} \tag{7.}$$

Where ρ_x is the correlation between x and y during the tranquil period, γ_y is the corresponding correlation coefficient in the turbulent period as obtained above.

As discussed above however, it is possible that these increases in the correlation coefficient result from a bias due to market volatility during this time rather than purely from contagion. To assess whether this bias affects our tests of contagion we repeat the analysis, this time using the adjustment seen in (6.). We estimate the tests using the unconditional rather than the conditional coefficient and analyse each banking sector individually as the source of contagion. These results are presented in Table VIII.

In adjusting for an increase in market volatility, we find a significant difference in the results obtained. When assigning either Hungary or Poland as the reforming country, we find that while these markets are highly correlated, this co-movement can be attributed to close linkages through economic fundamentals rather than to the existence of contagion.

On the other hand, looking at the Czech Republic as the reforming country, we find that when controlling for an increase in volatility during turbulent times, our results are unaffected. In this case we are able to infer that during the period under analysis, the Czech Republic is identifiable as the primary source of banking sector contagion between these three markets.

IV.V Vector Autoregression Analysis

The 1990s were marked by periods of chaos in the Eastern European countries when economic uncertainty together with a general lack of capital and skills in the banking sector ultimately resulted in a banking crisis. The Czech Republic in particular suffered from various banking failures/ defaults having a significant negative impact on its neighboring Hungary and Poland.

In order to try to understand the patterns of banking sector pressure, we make use of the Vector Auto-regression (VAR) methodology as it recognizes the endogeneity of all the variables in the system. Furthermore, it allows us to incorporate lagged values of the variables and to move away from contemporaneous correlations.

The VAR model takes the form of:

$$A(L)x_t + By_t = u_t \tag{8.}$$

with

$$A(L) = 1 - A_1 L - A_s L^2 - \ldots - A_p L^p$$

$$E(u_t) = 0,\ E(u_t, u'_t) = \Sigma,\ E(u_t, u'_s) = 0,\ \textit{for } t \neq s,\ E(x_t, u_t) = 0,$$

$$x_t = (USbank_t, UKbank_t, EUbank_t, HUbank_t, PLbank_t, CZbank_t)$$

and

$y_t = (Const)$

In this standard VAR, *x* is a (1 *x* N) vector of variables, A is an (N *x* N) matrix of coefficients, *u* is an (N *x* 1) vector of white noise disturbance terms, and L represents the lag operator (for example, $L^i x_t = x_{t-1}$). The *x* vector contains the daily change in the bank indices for the US (*USbank*), UK (*UKbank*), EU (*EUbank),* Hungary *(HUbank),* Poland *(PLbank)* and the Czech Republic *(CZbank)*. This equation consequently allows us to analyze the full range of interaction between the banking sector indices for all of the six countries.

We run the six variable VAR for each of the countries under analysis and obtain the impulse response functions for the shock originating from the given country. We chose a lag length of two according to both the Schwarz and Hannan-Quinn information criterion, and repeat the exercise for each of the countries. Testing for autocorrelation of residuals we find that all autocorrelations and partial autocorrelations at all lags are nearly zero, and all Q-statistics are insignificant with large p-values. This finding is consistent with no serial correlation in the residuals.[10] The graphs for the banking sector total, reform and tranquil periods are shown in Figure IV-*a, b, c*; V-*a, b, c* and VI- *a*, *b* and *c*. Only the responses of the Czech Republic, Hungary and Poland are presented, and country responses to own shocks are omitted. Only shocks originating from the US appear to be significant for all three time frames, while the UK has a significant negative impact on Poland in the tranquil period. All shocks seem to be absorbed within four to five days.

In all cases, we see a shock from the US resulting in an immediate increase in the respective bank index, followed around three days later by a sharp fall. The effect of a shock originating in the UK in the tranquil period, results in an immediate fall in the Polish index, followed by a slight recovery in day three. In all cases the shock has died by the sixth day.

In Table IX we present the proportion of the idiosyncratic variance of each country explained by a shock from the US banking sector. We show the percentages of movement in each sectoral index explained by a shock from the US. It is interesting to note how these effects vary between the turbulent and calmer periods.

[10] These results are not presented here, but are available from the authors on request.

Section VI Determining the Nature of Propagation

VI. I The Impact of Macro-economic News Announcements

Domestic News

Following Baig and Goldfajn (1999), Ganapolsky and Schmukler (1998) and Kaminsky and Schmukler (1998) who estimate the impact of various news announcements on the movements of various markets, we expand our analysis further to attempt to discover whether the banking sectors of the Czech Republic, Hungary and Poland are receptive to macro-economic news released both domestically and internationally. In a first step, we run a simple regression including domestic good and bad news dummies for each of the three banking indices, with the objective of discovering the impact that good and bad news releases have on the indices during the total sample, stabilization and tranquil periods.

The regression takes the following form, and is run with robust coefficients controlling for heteroskedasticity:

$$R_{i,t} = \alpha_i + \beta R_{t-1} + \sum \beta Dummies + \varepsilon_t \qquad (9.)$$

Where $i = 1, 3; t = 1,....T$ *and* $\{\varepsilon_i\} \approx N10, \vartheta_t^2$

As the variables all demonstrate autocorrelation of order 1 the regressions were consequently run including two lags of the dependent variable. Including the lagged variables in the regressions however, proved to over-ride the effects coming from the news dummies. As a second step, we ran the regressions with the dependent variable set equal to the residual of equation (9.). The regression this time took the form:

$$\varepsilon_t = \gamma + \sum \beta Dummies + e \qquad (10.)$$

Where $i = 1, 3; t = 1,....T$ *and* $\{\varepsilon_i\} \approx N10, \vartheta_t^2$

The results were largely similar to those obtained under equation (9.) and hence only results excluding lagged variables are reported. Regressions including lagged variables of the dependent variable are available on request. A summary of the results for the domestic dummy regressions are presented in Table X, while the full results can be seen in Tables XI-Panel *a*, XI-Panel *b*, and XI-Panel *c* for total reform period, and tranquil period sub samples respectively.

In analyzing the total sample period (Table XI-Panel *a*), we see that unfavorable domestic announcements had a significant downward effect on the banking sector of the Czech Republic. The index of Hungary, on the other hand, rises on the release of unfavorable news, possibly resulting from the desire of investors to move away from the troubled Czech Republic into 'safer' alternatives in its neighboring Hungary. No significant results are apparent for Poland.

The associated residuals from these regressions act as a further measure of contagion, this time controlling for fundamentals. Comparing the correlations of these residuals to those presented in Table IV, we see a substantial increase. The LR test demonstrates statistically significant group-wise correlations allowing us to conclude that contagion persists well above and beyond the identified fundamentals over the entire sample period.

Looking at the reform period (Table XI-Panel *b*), we see that unfavorable domestic news in the Czech Republic resulted in a significant fall in the country's banking index. No significant results were found for either Hungary or Poland.

Controlling for fundamentals, we see a substantial increase in the coefficients between Poland and Hungary, while those for Poland and the Czech Republic remain unchanged. Even though the residual correlations between Hungary and the Czech Republic demonstrate a negative relationship, the LR test statistic is still significant, revealing statistically significant group-wise correlations between the banking sector indices of these countries, thus providing further evidence of contagion during this period.

Finally, for the tranquil period (Table XI-Panel *c*), unfavorable domestic news in the Czech Republic continues to demonstrate a significantly adverse impact on the domestic banking sector, with the index falling on a negative announcement. We see Hungary's index rising on the receipt of good news and falling significantly on bad news. Surprisingly, the banking sector of Poland falls significantly on the announcement of both good and bad domestic news. A possible reason for this could be the jittery sentiment clouding the countries of Eastern Europe so soon after the turmoil that troubled the Czech Republic for much of the previous decade which could be picked by via the use of sub-period analysis.

The residual correlation matrix shows a substantial increase in all pair-wise coefficients when compared to those in Table IV. Statistically significant group-wise correlations are revealed via the LR test, implying the persistence of contagion effects between the analyzed markets. We can therefore conclude that during stabilization and tranquil periods as well as over the total period, contagion persists between these markets above and beyond the identified fundamentals.

International News

To extend the analysis further, we ran the regressions again, this time including the complete set of news dummies on the right hand side. These regressions serve to aid the understanding of the impact of cross-border news on respective banking sectors. The results are presented in Table XII-Panel *a*, *b* and *c*.

Looking first at regional effects, we see that over the entire sample period, bad news from the Czech Republic has a significant downward effect on the markets of Hungary, Poland and the Czech Republic. Surprisingly, bad news originating in Hungary significantly increases the indices of all three countries. Adverse macro news announcements in Poland have a significantly negative impact on the Czech market. This movement is however, not unexpected when we consider the high degree of correlation between these markets as demonstrated in Table IV.

Internationally, both good and bad news originating in the EU has a significant negative influence on all three markets, with the good news dummy slightly more significant than the bad news dummy. Such an effect quite possibly demonstrates that an improvement in the general economic conditions in the EU results in a movement of investors towards the new market. Finally, adverse news announcements stemming from the UK positively affect the indices of both the Czech Republic and Hungary. While these findings are puzzling, it is possible due to the large degree of foreign ownership in both the Czech Republic and Hungary, investors might chose to move away from the UK on release of bad news and concentrate on investments within these countries instead. Alternatively, foreign investors might wish to have European exposure, and on the release of bad news in the UK, they may move to Hungary and the Czech Republic as substitutes. There are no significant results for news released from the US.

Taking a closer look at the unexpected effects of unfavorable news coming from both Hungary and the UK, we analyze the individual components of bad news in order to pin point the reason for this movement. These findings are presented in Table XIII, panel *a*. We see that an increase in unemployment in the UK causes a significant increase in the banking sector indices of the Czech Republic, and Hungary, while a rise in inflation appears to further cause an increase in the index of Hungary. Moving to the bad news originating in Hungary, again we see that a rise in inflation causes an increase in the indices of Poland and Hungary as does an interest rate hike in Hungary. The Hungarian market index appears to be reacting to Polish unemployment figures, while we find no significant results for the movement caused by good news from Poland. We further implement the CUSM test of stability which is based on the cumulative sum of the recursive residuals; we find that all parameters demonstrate stability.[11]

[11] These results are not presented here for brevity, but are available from the authors on request.

Assessing the reform period, we observe that all countries reacted negatively to bad news originating in the Czech Republic. Bad news originating in Hungary has a further significant positive impact on the index of all countries. Negative news released from Poland results in a significant fall of the Czech index.

Both good and bad news from the UK impacts the Czech banking sector negatively. This is hardly surprising considering the generally negative economic situation in the Czech Republic during the time of analysis, encouraging investors to move out and into more stable environments. Furthermore, good news coming from the UK has a positive effect on the index of Hungary. Considering the banking crisis that the country experienced during this time it is not surprising that we see the bank index in the Czech Republic typically falling to all news announcements. No significant impact from news released in the US is evident.

During the tranquil period, adverse macro news coming from the Czech Republic has a significant downward impact on all three markets. It is interesting to note that bad news originating in the Czech Republic is again significant in all three markets; however, it affects Hungary and Poland in the opposite direction than during the reform period. This impact is hardly unusual considering the combination of the high degree of correlation between the markets, coupled with the instability that affected the country for most of the 1990s. All Polish news, both good and bad has a negative impact on the banking sectors of all three markets while the movement resulting from adverse news is slightly more significant. Taking a closer look at these results, we see that the Hungarian index falls on news of reduced inflation, while Poland reacts to current account news. There are no significant results for the Czech Republic. These results are presented in Table XIII, panel *b*. Favorable news from Hungary negatively affects all three banking markets. Looking closer at these results, we see that the Czech Republic reacts negatively to an increase in Hungarian unemployment figures while the Polish index falls on news relating to the current account. The Hungarian index, on the other hand, is reacting most significantly to both interest rate news as well as a fall in unemployment figures and slightly less significantly to current account data releases. Again we implement the CUSUM test and find stability in all parameters. Bad news stemming from Hungary results in an increase in the banking indices in all markets. Looking closely at these results, we find that both the Czech Republic and Poland react positively to poor GDP figures, while the Hungarian banking sector rises as unemployment figures fall. We see an increase in the significance of both good and bad news coming from the EU during this time, when compared to the tranquil period. As the tranquil period coincides with the creation of the EU, such an increase in significance could perhaps demonstrate the new investment opportunities that have opened up to markets in Central and

Eastern Europe. Good news coming from the newly created monetary union has a significant negative impact on the banking sectors of all countries. Again all parameters appear to be stable.

Bad news from the EU has a significantly negative impact on the bank index of both Hungary. With the overall economic situation in the EU improving, companies and businesses are in a better situation to make more money. As a result, investors' expectations are such that share prices and dividends will go up more in manufacturing and service industry shares than in more conservative banking shares, thus the fall in the banking price indices of the analyzed countries. It is clear from the analysis, that during the tranquil period, the Czech Republic is still very nervous; any bad news has a highly significant influence on its banking sector index. News released in both the UK and the US has no significant impact on the indices of the Czech Republic, Hungary or Poland during this time.

V.II Modeling the Volatility of Shocks

A further test of contagion is based on modeling increases in volatility during turbulent periods in one country's index by extreme movements in the other country's index. Following Favero and Giavazzi (2002), the process begins by considering a bivariate version (N=2) of the turbulent period. This reduced form model is simply a VAR specification which takes the familiar form as presented in Section IV.V. According to both the Schwarz and Hannan-Quinn information criterion the optimal lag length for our model is two.

In order to identify country-specific shocks, we calculate the residuals $u_{i,t}$ and $u_{j,t}$ of the estimated VAR which are heteroskedastic and contain information on episodes of market turbulence. A dummy variable is subsequently assigned to the residuals which lie above a certain threshold, in this case equal to three times the residual standard deviation of the VAR, capturing regional and country specific events. The choice of three standard deviations as a threshold is motivated by previous research. Gindraux (2000) provides a detailed sensitivity analysis for threshold values and finds that typically dummies selected with a threshold of three survive the testing-down procedure to over-identify the structural system of equations in the second step of the methodology.

$$d_{i,t} = \begin{cases} 1 : |u_{i,t}| > 3\sigma_i \\ 0 : otherwise \end{cases}$$

(11.)

$$d_{j,t} = \begin{cases} 1 : |u_{j,t}| > 3\sigma_j \\ 0 : otherwise \end{cases}$$

Residuals larger than the assigned threshold are considered as country-specific or local shocks. Dummy variables are created at the local (country-specific), regional (i.e. CZ,HU,PL or US,UK,EU) and global level (across all markets), and represent points in time when a combination of markets simultaneously experience extreme movements allowing for the eradication of hetroskedasticity and non-normality.

The stabilization period equations as defined by:

$$y_{i,t} = \lambda_i w_t + \delta_i u_{i,t} \tag{12.}$$

$$y_{j,t} = \lambda_j w_t + \delta_j u_{j,t} + \gamma u_{j,t} \tag{13.}$$

are subsequently re-written and replaced with the dummy variables created in (11.)

$$y_{i,t} = \lambda_i w_t + \delta_i u_{i,t} \tag{14.}$$

$$y_{j,t} = \lambda_j w_t + \delta_j u_{j,t} + \gamma_i d_{i,t} + \gamma_j d_{j,t} \tag{15.}$$

where the test of contagion is given by $\gamma = 0$, in essence testing that the subset of parameters in y_i corresponding to the subset of $d_{i,t}$ that are exceedences but not co-exceedences are equal to 0.

The results obtained from the F-G test are presented in Table XV. After running the reduced form VAR as described above, we identified 260 local shocks broken down as follows:

CZ	*HU*	*PL*	*EU*	*UK*	*US*
48	26	61	43	39	43

It is interesting that Poland suffers the largest number of local shocks, while figures for the Czech Republic are almost double those seen in Hungary. On a more aggregated level, we were unable to identify any global shocks, or periods where turbulence existed simultaneously across the six countries. However, breaking the data into regional sections, we identified four events of extreme movements:

EASTERN EUROPE (CZ, HU, PL)	*INTERNATIONAL (EU, UK, US)*
2	2

Both shocks that occurred throughout Eastern Europe were negative in all three countries while one set of shocks at the international level proved positive and the other negative. A breakdown of the dates and types of shocks along with news announcements made on these days are presented in Table XIV.

Inputting these shocks as dummies into the model, we test for contagion, the results of which are presented in Table XV. Again, we find evidence of contagion between the banking sectors albeit to a differing extent and from varying origins. We find that local shocks originating in Poland, the EU and the US have a significant negative impact on the banking index of Hungary, while the international shock positively affects the Czech Republic.

Section VI Conclusion

Considerable co-movement appears to be present in the banking sectors of Hungary, Poland and the Czech Republic, indicating that the largest markets in Central and Eastern Europe have tended to move together, and have had substantial influence on one another.

Comparing unadjusted (conditional) correlations between the tranquil and turbulent periods, we see evidence in favour of substantial contagion during this time. Contagion in this sense was defined as a significant increase in the stabilization periods' correlation coefficients when compared to a more tranquil period. However, adjusting for an increase in market volatility during the reform period, we find that contagion is only evident when the Czech Republic is identified as the 'reforming' country. For other countries, interdependence was identified as the cause of co-movements. Finally estimating a VAR equation to determine the influence that domestic, regional and international banking system shocks have on these markets, we find that the US banking system has the largest consistent effect on the CEE markets, with these shocks generally absorbed within four to five days.

In attempting to identify the channel through which these shocks are propagated, we employ dummy variables to capture news announcements in various economies, and show that after controlling for own country news and other fundamentals, the cross-country correlations remain large and significant, and that consequently contagion between these markets exists. We show that macro-economic shocks originating in neighbouring countries had the largest significant impact on these markets, with the EU becoming increasingly more important with time. Shocks originating in the US were not significant during any period for any of the three economies. Finally we model increases in volatility during the reform period in one country's banking sector by movement in another country's index. We again find evidence of contagion.

Throughout our analysis, it is unclear whether the increase in importance of the EU markets can be attributed to integration, or merely due to the coincidence that the economic union was created at this time and has since become a major influence for these countries. As data becomes available, further research into this may be useful.

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Table I: Fiscal Costs of Bank Recapitalization

	Czech Republic *1997*	***Hungary*** *1994*	***Poland*** *1996*
Main part of the recapitalization program completed in fiscal costs up to the year indicated in % of GDP of that year	8.9%	7.2%	1.6%
Fiscal costs of the recapitalization program up to The year 2000 in % of GDP in 2000	11.8%	6.8%	1.4%

Source: IMF (1998), Kawalec (1999), National Central Banks

Table II: Evolution of Eastern European Banking Sectors

	1994	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
Market value of banking index (US$)							
Czech Republic		1515	1138	1824	927	470	1433
Hungary		23	202	532	1058	1362	1627
Poland		998	1354	2849	3517	6152	8472
Foreign ownership (% of net assets)							
Czech Republic		23	24	30	39	48	55
Hungary		79	83	93	89	91	91
Poland	3	4	14	15	17	47	70

Source: National Central Banks

Table III: Banking Sector Of The Czech Republic, Poland And Hungary

	CZECH REPUBLIC				***HUNGARY***				***POLAND***			
	1991	*1994*	*1997*	*2000*	*1991*	*1994*	*1997*	*2000*	*1993*	*1994*	*1997*	*2000*
# Active banks	24	52	53	40	36	43	44	39	104	82	83	74
% Total domestic controlled	83	65	57	35		84	37	31	55	51	47	27
% Total foreign controlled	17	35	43	65		16	63	69	45	49	53	73

Source: National Central Banks

Table IV: Correlations of the CEECs Banking Index Returns

*Total sample: LR Test 202.65 ****			
	CZ	***HU***	***PL***
CZ	1	0.27	0.19
HU	0.27	1	0.27
PL	0.19	0.27	1
*Reform period (1994-end 1999): LR Test 87.52****			
	CZ	***HU***	***PL***
CZ	1	0.33	0.29
HU	0.33	1	0.31
PL	0.29	0.31	1
*Tranquil period (2000- end 2004): LR Test 148.84****			
	CZ	***HU***	***PL***
CZ	1	0.25	0.15
HU	0.25	1	0.26
PL	0.15	0.26	1

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
LR Test attempts to reject the null hypothesis that all pair wise correlations are 0.
Each pair wise correlation is tested for the null that the correlation is 0.

Table V: Banking Sector Index Rolling Correlations

*03/02/1997 to 30/04/1997: LR Test 4.93****				*03/08/1998 to 30/10/1998: LR Test 16.73****			
	CZ	***HU***	***PL***		***CZ***	***HU***	***PL***
CZ	1	0.30	0.22	***CZ***	1	0.50	0.38
HU	0.30	1	0.25	***HU***	0.50	1	0.49
PL	0.22	0.25	1	***PL***	0.38	0.49	1
*01/05/1997 to 31/07/1997: LR Test 0.70****				*02/11/1998 to 29/01/1999: LR Test 14.64****			
	CZ	***HU***	***PL***		***CZ***	***HU***	***PL***
CZ	1	0.15	-0.01	***CZ***	1	0.43	0.31
HU	0.15	1	0.02	***HU***	0.43	1	0.51
PL	-0.01	0.02	1	***PL***	0.31	0.51	1
*01/08/1997 to 31/10/1997: LR Test 8.52****				*01/02/1999 to 30/04/1999: LR Test 6.77****			
	CZ	***HU***	***PL***		***CZ***	***HU***	***PL***
CZ	1	-0.12	0.03	***CZ***	1	0.24	0.10
HU	-0.12	1	0.49	***HU***	0.24	1	0.40
PL	0.03	0.49	1	***PL***	0.10	0.40	1
*03/11/1997 to 30/01/1998: LR Test 11.58****				*03/05/1999 to30/07/1999: LR Test 1.18****			
	CZ	***HU***	***PL***		***CZ***	***HU***	***PL***
CZ	1	0.32	0.22	***CZ***	1	0.12	-0.05
HU	0.32	1	0.51	***HU***	0.12	1	0.15
PL	0.22	0.51	1	***PL***	-0.05	0.15	1
*02/02/1998 to 30/04/1998: LR Test 1.72****				*02/08/1999 to 29/10/1999: LR Test 6.43****			
	CZ	***HU***	***PL***		***CZ***	***HU***	***PL***
CZ	1	0.18	-0.07	***CZ***	1	0.20	0.04
HU	0.18	1	0.14	***HU***	0.20	1	0.41
PL	-0.07	0.14	1	***PL***	0.04	0.41	1
*01/05/1998 to 31/07/1998: LR Test 6.28****							
	CZ	***HU***	***PL***				
CZ	1	0.17	0.29				
HU	0.17	1	0.34				
PL	0.29	0.34	1				

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
LR Test attempts to reject the null hypothesis that all pair wise correlations are 0.
Each pair wise correlation is tested for the null that the correlation is 0.

Table VI: Heteroskedastic *t*-Test: Banking Sector

*Reform periods (1994-end 1999): LR Test 90.58****			
	CZ	***HU***	***PL***
CZ	1	0.33***	0.29***
HU	0.33***	1	0.31*
PL	0.29***	0.31***	1
*Tranquil period (2000- end 2004): LR Test 151.04****			
	CZ	***HU***	***PL***
CZ	1	0.25***	0.15***
HU	0.25***	1	0.26*
PL	0.31***	0.26***	1

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
LR Test attempts to reject the null hypothesis that all pair wise correlations are 0.
Each pair wise correlation is tested for the null that the correlation is 0.
The Heteroskedastic t-test attempts to reject the null of equal correlations.

Table VII: Unadjusted Correlations

Relationship	***Reform period***	***Tranquil period***	***Total sample***	***Test stat***	***Contagion?***
CZ-HU	0.33	0.25	0.27	5.73***	Yes
CZ-PL	0.29	0.15	0.19	3.79***	Yes
PL-HU	0.31	0.26	0.27	1.51**	Yes

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*

Table VIII: Adjusted Correlations

Contagion source	***Country***	***Tranquil period***	***Test stat***	***Contagion?***
CZ	HU	0.19	3.81***	Yes
CZ	PL	0.17	3.32***	Yes
HU	CZ	0.21	1.13	NO
HU	PL	0.26	1.41	NO
PL	CZ	0.25	1.12	NO
PL	HU	0.27	1.22	NO

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*

Table IX: Variance Decomposition

days	1	2	3	4	5	6	7	8	9	10
The Czech Republic										
Total period	0.0	0.7	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Reform period	0.1	1.0	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.9
Tranquil period	0.0	0.6	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Hungary										
Total period	0.0	0.8	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Reform period	0.0	1.9	6.6	6.7	6.8	6.8	6.8	6.8	6.8	6.8
Tranquil period	0.0	0.6	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Poland										
Total period	0.0	1.1	6.2	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Reform period	0.0	0.8	10.3	10.7	10.7	10.7	10.7	10.7	10.7	10.7
Tranquil period	0.0	1.5	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3

Table X: Summary of Own Country Dummies

	Good News	*Bad News*
Total period		
CZ		- ***
HU		+ ***
PL		
Reform period		
CZ		- **
HU		
PL		
Tranquil period		
CZ		- ***
HU	- ***	+ **
PL	- **	- ***

*Note: ***, ** and * denote significance at the 1, 5 and 10 % levels respectively. Only significant results are shown.*

Table XI: Regression Results With Own Country Dummies

Panel a: Total period (1994- end 2004)			
	CZ	***HU***	***PL***
Constant	1.73 *(0.8884)*	3.72 *(0.6467)*	-0.59 *(1.0705)*
Good News	0.00 *(0.0097)*	0.05 *(0.2300)*	-0.59 *(1.0107)*
Bad News	-0.22 *(4.2552)***	0.85 *(2.9776)***	-0.42 *(0.7720)*
Adjusted R^2	0.005	0.004	0.001
Number of Obs.	2729	2729	2729
Residual Correlation Matrix: *LR Test 3673.00****			
	CZ	***HU***	***PL***
CZ	1	0.81	0.83
HU	0.81	1	0.92
PL	0.83	0.92	1
Panel b: Reform period (1994- end 1999)			
	CZ	***HU***	***PL***
Constant	1.29 *(0.9640)*	1.65 *(1.0747)*	16.78 *(0.8904)*
Good News	0.01 *(0.2601)*	0.07 *(0.7573)*	-0.42 *(0.9312)*
Bad News	-0.11 *(2.8541)***	0.12 *(1.1731)*	0.08 *(0.1717)*
Adjusted R2	0.005	0.001	0.001
Number of Obs.	1424	1424	1424
Residual Correlation Matrix: *LR Test 108.84****			
	CZ	***HU***	***PL***
CZ	1	-0.65	0.17
HU	-0.65	1	0.51
PL	0.17	0.51	1
Panel c: Tranquil period (2000- end 2004)			
	CZ	***HU***	***PL***
Constant	2.19 *(0.9172)*	6.15 *(1.1049)*	27.73 *(0.5304)*
Good News	0.08 *(0.7615)*	0.85 *(3.24097)****	-1.36 *(1.8547)***
Bad News	-0.30 *(3.1755)****	-0.80 *(2.0085)***	-2.63 *(3.5713)****
Adjusted R2	0.005	0.008	0.010
Number of Obs.	1305	1305	1305
Residual Correlation Matrix: *LR Test 250.05****			
	CZ	***HU***	***PL***
CZ	1	0.94	0.95
HU	0.94	1	0.93
PL	0.95	0.93	1

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
LR Test attempts to reject the null hypothesis that all pair-wise correlations are 0.
Absolute value of t-statistics in parenthesis.
National Bank Index set as dependant variable.

Table XII: Regression Results with International Dummies

Panel-a : Total sample (1994- end 2004)			
	CZ	***HU***	***PL***
Constant	1.76 *(0.6176)*	3.84 *(1.1034)*	21.91 *(1.1969)*
Czech Good news	0.00 *(0.0365)*	-0.13 *(0.6357)*	-0.11 *(0.2204)*
Czech Bad news	-0.21 *(4.0917)***	-0.37 *(2.2754)***	-0.69 *(1.6972)**
Hungarian Good news	-0.01 *(0.1737)*	0.09 *(0.4803)*	0.44 *(0.9684)*
Hungarian Bad news	0.16 *(1.3040)**	0.82 *(2.9019)****	1.49 *(2.2285)****
Polish Good news	-0.08 *(1.2967)*	-0.27 *(1.2174)*	-0.72 *(1.3063)*
Polish Bad news	-0.17 *(2.5480)****	-0.11 *(0.5054)*	-0.37 *(0.6810)*
European Good news	-0.30 *(4.9929)****	-0.97 *(5.9737)****	-2.47 *(5.0447)****
European Bad news	-0.12 *(1.6836)**	-0.62 *(3.0954)****	-1.12 *(1.9973)***
UK Good news	-0.06 *(0.9931)*	0.07 *(0.3632)*	0.08 *(0.1631)*
UK Bad news	0.18 *(1.8224)***	0.92 *(2.9585)****	1.98 *(0.6502)*
US Good news	0.03 *(0.4491)*	0.02 *(0.0922)*	0.18 *(0.2954)*
US Bad news	-0.03 *(0.3752)*	0.34 *(1.1877)*	0.83 *(1.2394)*
Adjusted R^2	0.018	0.018	0.015
Number of Obs.	2729	2729	2729
Panel-b : Reform period (1994- end 1999)			
Constant	1.31 *(1.0005)*	1.58 *(0.5918)*	16.60 *(0.3824)*
Czech Good news	0.01 *(0.1869)*	0.06 *(0.7960)*	0.45 *(1.4115)*
Czech Bad news	-0.11 *(2.8579)****	0.24 *(3.5302)****	0.79 *(2.5813)****
Hungarian Good news	0.03 *(0.5970)*	0.06 *(0.6862)*	0.41 *(1.0377)*
Hungarian Bad news	-0.12 *(2.0696)***	0.10 *(1.0248)*	-0.69 *(1.5484)*
Polish Good news	0.05 *(1.0859)*	-0.07 *(0.7449)*	-0.39 *(0.8582)*
Polish Bad news	-0.07 *(1.1883)*	0.13 *(1.2690)*	0.08 *(0.1764)*
Good news	-0.05 *(1.0095)*	0.11 *(1.1954)*	-0.02 *(0.0552)*
Bad news	0.02 *(0.2496)*	0.04 *(0.3944)*	0.20 *(0.4820)*
UK Good news	-0.08 *(1.7365)***	0.14 *(1.7893)***	0.07 *(0.2011)*
UK Bad news	-0.15	0.05	-0.44

	*(2.1297)***	*(0.3730)*	*(0.7888)*
US Good news	0.04 *(0.7011)*	-0.02 *(0.2446)*	0.06 *(0.1365)*
US Bad news	-0.08 *(1.2010)*	0.10 *(0.8793)*	0.32 *(0.6594)*
Adjusted R^2	0.017	0.016	0.010
Number of Obs.	1424	1424	1424
Panel-c : Tranquil period (2000- end 2004)			
Constant	2.30 *(0.0017)*	6.52 *(0.4170)*	28.24 *(1.0748)*
Czech Good news	0.11 *(0.9749)*	0.26 *(0.7512)*	0.66 *(0.8739)*
Czech Bad news	-0.28 *(2.9731)****	-0.83 *(3.1234)****	-1.78 *(2.8989)****
Hungarian Good news	-0.23 *(2.5517)***	-0.86 *(3.2782)****	-1.83 *(3.0696)***
Hungarian Bad news	0.23 *(0.8600)*	0.71 *(1.8349)***	1.65 *(2.0206)***
Polish Good news	-0.26 *(2.3149)***	-0.66 *(1.9675)***	-1.48 *(1.9853)***
Polish Bad news	-0.41 *(3.8613)****	-1.04 *(3.3450)****	-2.51 *(3.4392)****
European Good news	-0.47 *(3.6069)****	-1.47 *(5.0503)****	-3.31 *(3.8590)****
European Bad news	-0.17 *(1.2523)*	-0.87 *(2.6204)****	-1.29 *(1.5004)*
UK Good news	-0.12 *(1.0646)*	-0.36 *(1.1055)*	-0.77 *(1.0569)*
UK Bad news	0.18 *(1.3415)*	0.47 *(1.1490)*	1.08 *(1.1990)*
US Good news	0.02 *(0.1225)*	0.05 *(0.1305)*	0.20 *(0.2414)*
US Bad news	-0.15 *(1.1528)*	-0.27 *(0.6632)*	-0.69 *(0.7783)*
Adjusted R2	0.030	0.029	0.038
Number of Obs.	1305	1305	1305

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
Absolute value of t-statistics in parenthesis.
National Bank Index set as dependant variable.

Table XIII: Breakdown of Results

Panel-a : Total sample (1994- end 2004)			
	CZ	***HU***	***PL***
bad news from UK			
constant	0.17 *(1.0775)*	3.76 *(1.0924)*	
inflation	0.19 *(1.5901)*	0.78 *(1.9823)***	
current account	0.22 *(0.8493)*	0.74 *(0.8494)*	
interest rate	-0.63 *(2.8294)****	-1.05 *(1.3822)*	
gdp	-0.06 *(0.1423)*	0.9 *(0.6446)*	
terms of trade	-0.11 *(0.5304)*	-0.02 *(0.0306)*	
unemployment	0.48 *(2.0272)***	1.75 *(2.2024)***	
bad news from HU			
constant		3.729689 *(2.6394)****	21.7 *(3.5208)****
inflation		0.78 *(2.0187)***	1.59 *(1.7063)**
current account		0.57 *(0.7549)*	0.947609 *(0.5172)*
interest rate		1.55 *(2.6468)****	3.71 *(2.6188)****
gdp		-1.14 *(0.3304)*	-4.91 *(0.5888)*
terms of trade		2.02 *(1.5424)*	4.25 *(1.3412)*
unemployment		0.58 *(1.0736)*	1.13 *(0.8575)*
Panel-b : Tranquil period (1994- end 1999)			
good news from PL			
constant	2.07 *(0.9699)*	5.74 *(0.5392)*	26.68 *(1.1333)*
inflation	-0.19 *(1.0599)*	-0.77 *(1.7316)***	-0.87 *(0.7071)*
current account	-0.40 *(1.5724)**	-0.97 *(1.4779)**	-3.10 *(2.0309)***
interest rate	0.26 *(0.4325)*	2.25 *(1.2176)*	2.82 *(0.7856)*
gdp	0.09 *(0.2899)*	0.23 *(0.2847)*	0.45 *(0.2344)*
terms of trade	-0.38 *(0.9063)*	-0.25 *(0.1933)*	-2.22 *(0.7271)*
unemployment	-0.08 *(0.1979)*	-0.35 *(0.3839)*	0.47 *(0.1858)*
good news from HU			
constant	2.17 *(0.7575)*	6.153416 *(1.0332)*	26.68 *(1.1333)*

inflation	-0.09 *(0.26071)*	-0.64 *(0.7161)*	-0.87 *(0.7071)*
current account	-0.48 *(1.5219)**	-1.36 *(1.6884)***	-3.10 *(2.0309)***
interest rate	-0.20 *(4.8302)****	-0.90 *(6.7860)****	2.82 *(0.7856)*
gdp	0.21 *(0.9741)*	0.54 *(0.7806)*	0.45 *(0.2344)*
terms of trade	1.04 *(3.8636)****	1.43 *(1.6543)**	-2.22 *(0.7271)*
unemployment	-0.52 *(3.1563)****	-1.57 *(3.7600)****	0.47 *(0.1858)*
bad news from HU			
constant	0.17 *(0.3485)*	0.13 *(1.0264)*	0.09 *(0.2244)*
inflation	-0.04 *(0.0596)*	0.03 *(0.1143)*	-2.11 *(0.9767)*
current account	-0.79 *(1.0434)*	0.17 *(0.4071)*	-0.65 *(1.849)***
interest rate	-0.18 *(0.2357)*	0.40 *(0.9096)*	0.05 *(0.1237)*
gdp	3.68 *(5.2967)****	-4.20 *(72.6787)****	0.86 *(19.7247)****
terms of trade	0.22 *(0.2415)*	0.21 *(0.5671)*	0.17 *(0.8351)*
unemployment	0.26 *(0.3616)*	0.78 *(1.8686)***	-0.09 *(0.8351)*

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
Absolute value of t-statistics in parenthesis.
National Bank Index set as dependant variable.

Table XIV: Regional Shocks

REGION	*DATE*	*COUNTRY*	*TYPE*	*NEWS*
International	9/4/1998	EU	+	-Tietmeyer sees 'no need' to cut German interest rates. -Euro zone growth to be driven by domestic demand: Trichet.
		UK	+	- Chief executive of British Aerospace PLC, welcomed moves towards a single
		US	+	European currency. - The Federal Reserve Bank of New York added reserves to the banking system through a round of four-day system repos.
International	9/13/2001	EU	-	- War on the world: the silence; millions to
		UK	-	pay respects on world-wide day of mourning.
		US	-	
Eastern Europe	10/18/2004	CZ	+	-State will receive billions of Czech Crowns from dividends. -President Klaus signs three new economic
		HU	+	laws today. -Hungary central bank cuts key interest. - Forint strengthens on rate cut.
		PL	+	-Top bank PKO BP sells more shares to first-time individual investors in IPO. -Rapid growth continues to drive Polish fiscal consolidation.
Eastern Europe	10/28/2004	CZ	+	-Central bank governor protests planned changes to bank law.
		HU	+	-Forint firms on interbank market.
		PL	+	- Central Bank holds Polish interest rates steady.

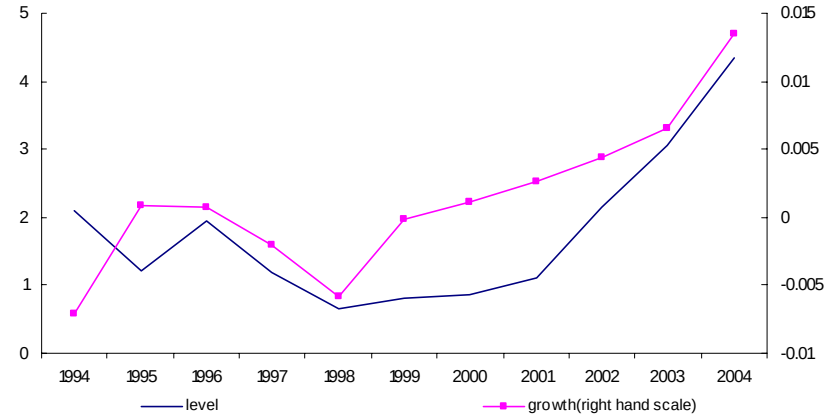
Table XV: Modeling Volatility

	CZ	***HU***	***PL***
constant	0.00 *(0.1417)*	-0.08 *(0.3172)*	-0.06 *(1.1038)*
local shocks			
CZ	0.00 *(1.1883)*	0.00 *(0.5589)*	0.00 *(0.1478)*
HU	0.00 *(0.5088)*	0.00 *(0.6125)*	0.00 *(0.7725)*
PL	0.00 *(1.0691)*	-0.01 *(2.2367)***	0.00 *(0.5908)*
EU	0.00 *(0.8594)*	-0.01 *(2.0484)***	0.00 *(1.2383)*
UK	0.00 *(0.1380)*	0.01 *(1.1135)*	0.01 *(2.0160)*
US	-0.01 *(1.6165)*	-0.01 *(3.3350)****	0.00 *(0.9895)*
regional shocks			
Eastern Europe *(CZ,HU,PL)*	0.00 *(0.2769)*	0.02 *(1.3148)*	0.00 *(0.0105)*
International *(EU,US,UK)*	0.06 *(3.4509)****	0.01 *(0.6016)*	0.01 *(0.5564)*

*Note: *, ** and *** denote rejection at the 10%, 5% and 1% levels respectively.*
Absolute value of t-statistics in parenthesis.
National Bank Index set as dependant variable.

Figure I: The Czech Banking Sector

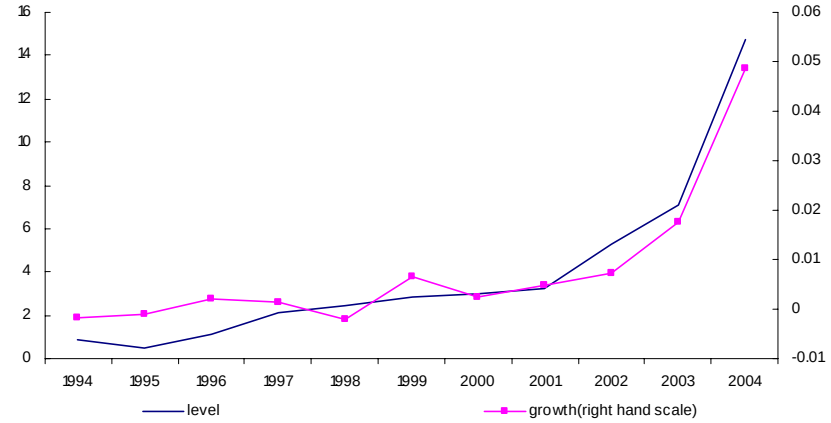
Daily price index, USD



Source: Datastream International

Figure II: The Hungarian Banking Sector

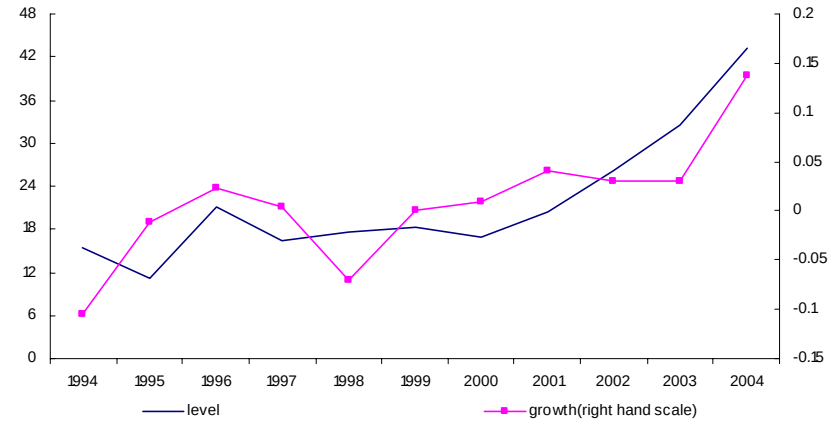
Daily price index, USD



Source: Datastream International

Figure III: The Polish Banking Sector

Daily price index, USD



Source: Datastream International

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