International Investor Sentiment and Emerging Equity Markets in Central and Eastern Europe

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Abstract: This paper uses the vector Markov switching method of Hamilton (1990) to measure market sentiment in a group of countries. We investigate the apparent co-movement of equity returns in the Czech Republic, Hungary and Poland. We argue that the main underlying forces moving stock returns in small open emerging markets are of an exogenous nature. The main factor driving prices in the region is modeled as an unobservable variable labeled "international investor sentiment". This latent variable is represented as a two-state Markov chain and makes stock returns switch from a growth regime to a depression regime, or in the opposite direction. In such a framework, the stock return process comes from a mixture of two multivariate normal distributions. The estimated latent variable shows significant correlation with a number of data series on global capital flows, mutual fund flows, regional emerging and developed markets' equity returns as well as with other popular market sentiment or economic uncertainty indicators. It does not show a strong association with a comprehensive set of contemporaneous local economic factors with the exception of the quarterly change in industrial production.

Keywords: Markov Switching Models, Emerging Markets, Central and Eastern Europe, Capital Inflows.

1. INTRODUCTION

This paper investigates the apparent co-movement of equity prices in a group of emerging markets. It argues that an important underlying force moving stock prices in small open emerging markets is of exogenous nature. This force is modeled as an unobservable variable and is labeled as international investor sentiment. The latent variable is represented as a two-state Markov chain and makes the stock returns switch between the growth and depression regimes. The stock return process is assumed to be generated by a mixture of two normal distributions. This model is estimated using the vector Markov switching method of Hamilton (1989, 1990). The apparent co-movement in equity prices could be caused by a range of factors, including co-movement in economic fundamentals, global liquidity cycles or surges and contractions in international portfolio flows. After estimating the latent variable we investigate the influence of financial and economic factors on the estimated process. We split the examined variables into global and local influences. We are motivated by papers that investigate factors affecting portfolio flows into developing countries and find that the flows are particularly influenced by external "push" forces rather than the internal "pull" influences, c.f. Fernandez-Arias (1996), Chuhan *et al*. (1998) and more recently Fratzscher (2012). The estimated probability of the stock market growth regime shows significant correlation with a number of data series on global capital flows as well as with emerging and developed markets' benchmark indices and global "fear factors". In contrast, the growth regime does not show a strong association with a comprehensive set of local economic factors, with the exception of the growth in industrial production. The strength of association increases if the industrial production growth is led by one quarter. This result is consistent with literature documenting equity returns as an excellent leading indicator of economic activity (recently, Allen, Bali and Tang, 2012).

The group of emerging markets is not homogenous in terms of the length of operation of their stock exchanges, trading mechanism, market capitalization, economic and industrial structure of the economy. This paper offers an empirical model of price dynamics in open, small (and usually thin) emerging markets. Examples of such markets can be found in the countries of Central and Eastern Europe (CEE).

The contribution of the paper is twofold. First, we offer a new application of the vector Markov switching technique to measure the market sentiment in a number of countries. This in turn allows us to contribute to a discussion about emerging market integration/segmentation and susceptibility to global shocks.

The paper is organized as follows: Sections 2 and 3 review the related literature and briefly describe the markets. In Section 4, the empirical market sentiment

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model is presented. Section 5 describes the data and gives results of estimation of the model. This is followed by an attempt to identify variables associated with the estimated unobservable process. The conclusion is offered in Section 7.

2. LITERATURE REVIEW

The co-movement of asset returns in Central and Eastern Europe has been mainly investigated within the cointegration framework[1]. The disparity in the reported findings of significant cointegration (Voronkova, 2004) or lack of cointegration (Gilmore, Lucey and McManus, 2008) may partly depend on the choice of the analyzed time period. Another strand of literature on equity markets in the region concerns their integration into the global financial system, contagion and volatility spillovers. Gelos and Sahay (2001) study market spillovers. The authors construct exchange market pressure indices and find them to be unrelated to market fundamentals, with an exception of series on trade linkages. Gelos and Sahay also conduct a VAR analysis of transmission of shocks between Eastern European stock markets using daily data, but only for major crises periods. Rockinger and Urga (2001) build an econometric model with time-varying parameters to study the changing efficiency of the markets in the region. The authors are interested whether convergence has occurred between several East European markets and mature markets. They conduct estimation for pairs consisting of one emerging and one developed ("dominant") market at a time, and do not investigate direct co-movement between markets in CEE. Serwa and Bohl (2005) do not find any significant difference in the degree of susceptibility to financial contagion between markets in CEE and the developed European markets. Egert and Kocenda (2011) analyze intraday data and conclude that the volatility linkages between the equity markets in CEE and between them and leading developed markets are very weak. A possible explanation of their surprising finding could be that their study comprised years 2003 to 2006 - a very quiet period in global financial markets, characterized by a vigorous growth of stock prices in CEE (see, Figure **1**).

Studies that adopted the Markov switching technique of Hamilton (1989, 1990) to model stock returns include Hamilton and Susmel (1994), Schwert (1989) and Turner, Startz and Nelson (1989). These authors investigated daily or weekly equity returns in developed markets. Our paper examines quarterly observations, where volatility clustering is largely absent. The nature of the markets in question as well as the chosen data frequency give rise to emphasis on modeling means, rather than variances of equity returns. Univariate Markov switching technique has also been used to identify bear and bull regimes in asset markets; for example, Maheu and McCurdy (2000) build a duration dependent univariate Markov chain model.

3. BRIEF MARKET DESCRIPTION

This paper concentrates on examination of co-movement in stock prices in three Central European countries: the Czech Republic, Hungary and Poland. Figures **1** and **2** display indices and equity returns in these markets in the period between the last quarter of 1993 and the first quarter of 2011.

Although the paths of equity index development in the three analyzed countries are not identical, the periods of general decline and general growth in prices strongly coincide. Most markets in the region, including the three examined here, went through a violent "bubble" period at the turn of 1993/1994. Stock prices went up by as much as several hundred percent in dollar terms and then fell very abruptly. This was followed by a depression in stock prices. Prices rose again from the beginning of 1996. These cycles were of amplitude that is unheard of in developed markets. Since the Asian crisis, i.e. since approximately July-September 1997, the stock markets in CEE appear to move even more closely together than before (cf. Figures **1** and **2**).

The Budapest and the Warsaw Stock Exchanges (BSE and WSE) were created in 1990 and 1991, respectively. They were very small – with a handful of companies trading (one for Budapest and five for Warsaw) and for this reason they did not at first attract foreign capital. As the exchanges developed, they gradually started to attract foreign (and local) interest.

The Prague Stock Exchange (PSE) was opened in April 1993, with only seven issues traded. Shortly afterwards, however, the first and the second waves of the Czech privatization voucher program were introduced and the number of equities traded had jumped to over 1700 by 1995. Most companies traded on the less regulated Free Market segment of the PSE and most of them were delisted in 1997 and the

[1]Cointegration techniques were introduced by Engle and Granger (1987).

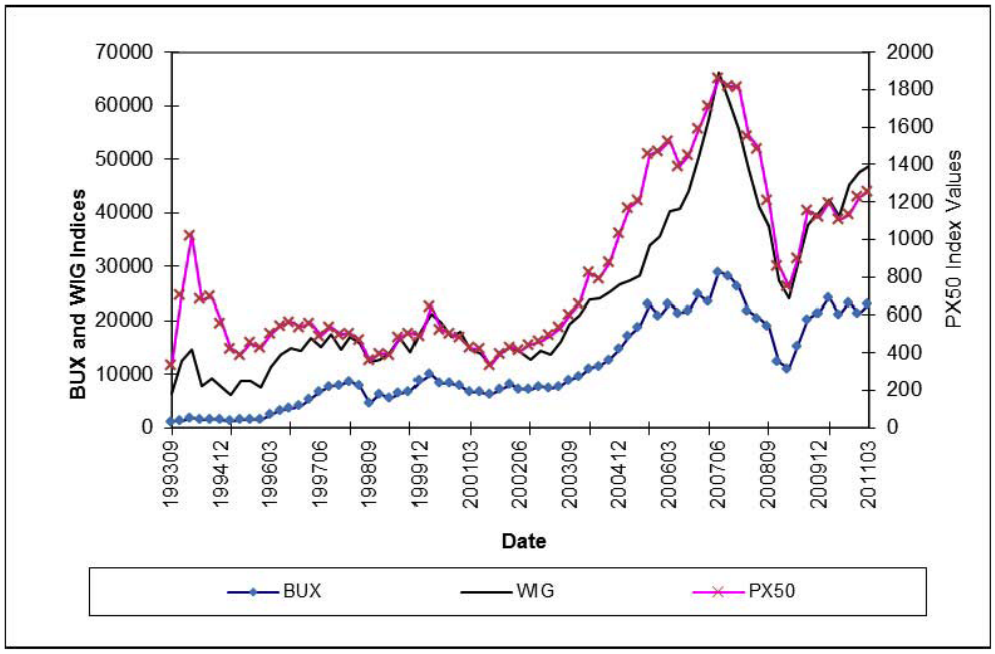

Figure 1: Stock Indices for the Budapest, Prague and Warsaw Stock Exchanges in the Period 4th quarter 1993 – 1st quarter of 2011.

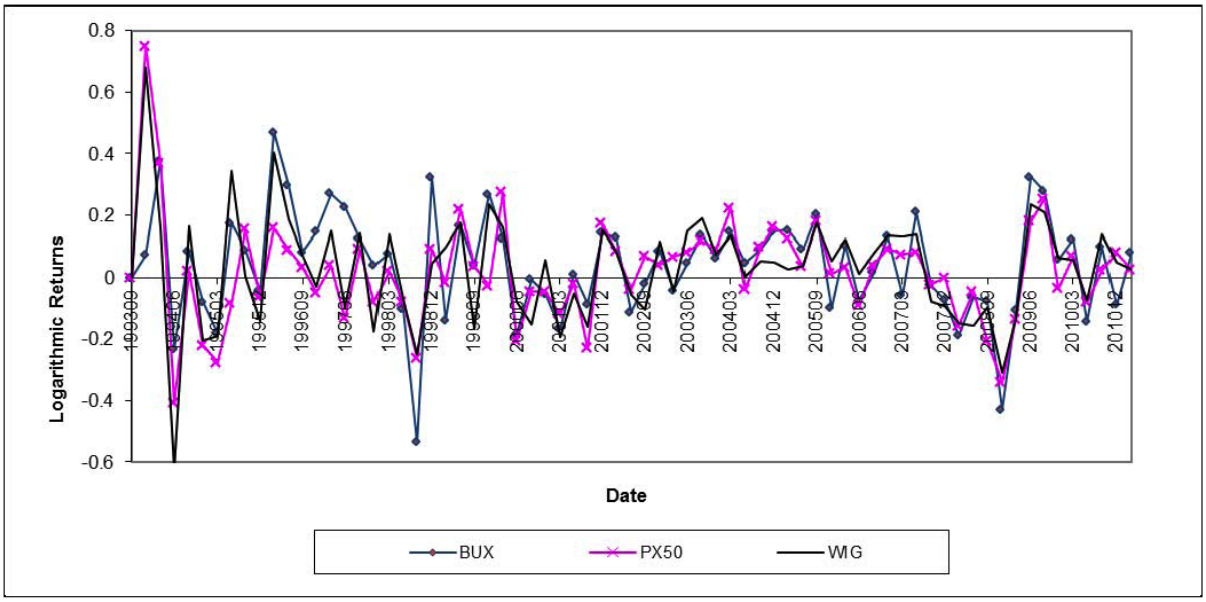

Figure 2: Logarithmic Quarterly Returns on Stock Indices for the Budapest, Prague and Warsaw Stock Exchanges in the Period 4th quarter 1993 – 1st quarter of 2011.

following years due to their very low liquidity. As a matter of fact, most small or medium cap companies were controlled by voucher funds, and were hardly traded at all.

In 1996 the average capitalization of the Polish market was around 7 billion US dollars and the daily trading volume amounted to 38 million US dollars (see WSE (1997)). Volume and liquidity in Prague and Budapest were even smaller. Such figures do not allow for big purchases that do not substantially raise prices. Hence willingness to buy shares is usually connected with considerable patience. The implication of this is that the long-term investors' interests are focused on a handful of big companies with large capitalization and substantial liquidity.

In 2011 foreign investors generated 47% and more than 45% of shares' turnover in Warsaw and Budapest, respectively (see, CEESEG, 2012 and WSE, 2012).

Egert and Kocenda (2011, p. 396) report that foreign investors accounted for 55-60% of traded volume of equities on the Prague Stock Exchange.

4. METHODOLOGY

We propose the following explanation of the similar turning points in the stock index movements in the Czech Republic, Hungary and Poland. We argue that the main underlying force moving stock prices in the emerging markets of Central Europe are of exogenous nature. We suggest that the inflow and outflow of foreign portfolio capital acts as an impact variable. In a thin market with small capitalization, even a slight increase in foreign investment can move the prices up. The inflow can be caused by increased interest in the given country, a group of countries, or because of globally improved investment mood. In absolute terms, funds directed to the countries of Central Europe are very small. Nevertheless, taking into account the smallness (thinness) of these markets, this immediately causes prices to go up. This is equally true of the market as a whole as well as of particular companies.

As argued by Kon (1984), financial data may be successfully modeled by a discrete mixture of normal distributions. This paper adopts the Markov switching model of Hamilton (1989, 1990) and Engel and Hamilton (1990). Stock returns are generated by a vector-valued stochastic process ($\boldsymbol{y}_1,..., \boldsymbol{y}_T$):

$$\boldsymbol{y}_t = \boldsymbol{\mu}_0(1-s_t)+\boldsymbol{\mu}_1 s_t + \boldsymbol{\varepsilon}_t, \quad \boldsymbol{\varepsilon}_t \sim N(\boldsymbol{0},\boldsymbol{\Omega}_{s_t}),$$

where s_t is an unobservable variable representing international investor sentiment. Variable s_t takes integer values {0,1} and follows a two-state Markov chain. When s_t =0, equity returns $\boldsymbol{y}_t$ are drawn from a $N(\boldsymbol{\mu}_0,\boldsymbol{\Omega}_0)$ distribution, when s_t = 1, returns come from $N(\boldsymbol{\mu}_1,\boldsymbol{\Omega}_1)$. In our implementation the variance-covariance matrix is restricted to be the same for both states, i.e. $\boldsymbol{\Omega}_0 = \boldsymbol{\Omega}_1 = \boldsymbol{\Omega}$. The first state represents favorable global investment climate. A net inflow of foreign investment to a small and thin market will increase stock prices. The second regime is associated with a worsening international investment climate, which results in falling prices. It is assumed that s_t is a single variable common for the three examined markets.

The transition probability - the probability that state *i* will be followed by state *j*, does not change and is given by:

$$p(s_t = j \mid s_{t-1} = i,\, s_{t-2} = k,...) = p(s_t = j \mid s_{t-1} = i) = p_{ij} \qquad (1)$$

For a first order Markov chain, we have:

$$p(s_t = 0 \mid s_{t-1} = 0) = p_{00}$$

$$p(s_t = 1 \mid s_{t-1} = 0) = p_{01} = 1 - p_{00}$$

$$p(s_t = 0 \mid s_{t-1} = 1) = p_{10} = 1 - p_{11}$$

$$p(s_t = 1 \mid s_{t-1} = 1) = p_{11} \qquad (2)$$

Hamilton (1990) proposes a two-stage statistical inference for the model. The procedure starts with the estimation of a vector of population parameters - $\boldsymbol{\theta}$, which contains the following elements:

$\boldsymbol{\mu}_j$ – a (3×1) vector of expected equity returns in state *j*,

$\boldsymbol{\Omega}$ – a (3×3) variance-covariance matrix (assumed to be identical for both states),

p_{ij} – a transition probability that state *i* will be followed by state *j* (assumed to be constant).

$\boldsymbol{\rho}$ – parameter values of a probability distribution that generated the initial states.

At the second stage, $\boldsymbol{\theta}$ is taken as given, and the probability that the process was in a particular state s_t at time *t* is calculated:

$$p(s_t \mid \boldsymbol{y}_1,...,\boldsymbol{y}_t;\theta) \qquad (3a)$$

This is the so-called filter probability, which is based on observations for $\boldsymbol{y}_t$ until time *t*. The smoothed probability is estimated using the entire sample:

$$p(s_t|\boldsymbol{y}_1,...,\boldsymbol{y}_T;\theta). \qquad (3b)$$

The model does not allow us to know regimes exactly; we can only make probabilistic inferences about unobserved regimes.

5. EMPIRICAL RESULTS

5.1. Data

Equity index data were obtained from Bloomberg. They consist of quarterly observations on local currency denominated stock market indices for the Czech Republic[2], Hungary and Poland in the period September 1993 – March 2011. The indices used are

[2]Although the official index for the Prague Stock Exchange started to be announced in April 1994, its values have been calculated back since September 1993. Data for the PX50 index prior to April 1994 were obtained from the PSE.

PX50, BUX and WIG. Data for Hungary and Poland stretch back to 1990 and 1991, respectively. Since the earliest date for which indices for all countries were available is September 1993, our analysis begins from this period. We examine logarithmic returns, i.e. take the logarithms of indices, first-difference them, and then multiply by 100.

5.2. Results

Table **1** presents results of estimating a vector Markov switching model for the three markets in question[3]. The (3×1) vector of observations includes equity returns on BUX, PX50 and WIG indices denominated in local currencies. The growth state (s_t = 0) is characterized by quarterly mean returns of 9%, 7% and 8% for the Budapest, Prague and Warsaw Stock Exchanges, respectively. State s_t=1 is connected to negative returns with means –13%, –15% and –14% a quarter for the BSE, PSE and WSE, respectively. All mean estimates are statistically significant at the 5% level. The variance estimates are also significant for the three exchanges. Transition probabilities show that the growth state is very persistent and lasts on average $1/(1 - p_{00})$ = 10 quarters. State s_t = 1 tends to be much more short-lived (with an average persistence of $1/(1 - p_{11})$ = 2.8 quarters). This result is consistent with a common observation that financial and macroeconomic data tend to exhibit prolonged and moderate periods of growth followed by sharp and often short-lived contractions.

Figure **3** displays the estimated filter and smoothed probabilities of a regime with higher means. We may observe that the examined markets went through an exuberant growth period at the turn of 1993/1994. Stock prices went up by as much as several hundred percent in the U.S. dollar terms and then fell very abruptly. This was followed by a depression in stock prices that also coincided with the global reverberations of the Mexican peso crisis. Prices rose again from the beginning of 1996. The growth regime was only shortly (but painfully) interrupted by the aftershocks of the Russian crisis in 1998. The estimation identifies the "bear" market that followed the bursting of the internet bubble in the US, 9/11 terrorist attacks. The Great Financial Crisis is also associated with zero or near zero probability of the growth state s_t = 0.

[3]We wish to thank James Hamilton for his computer program for the estimation of the Markov switching model with the EM algorithm.

Table 1: Results for the Vector Markov Switching Model for Stock Index Returns in Hungary (BUX), the Czech Republic (PX50) and Poland (WIG)

Parameter	Hungary	Czech Republic	Poland
μ_0	9.296	6.652	7.812
	(2.692)	(2.677)	(2.834)
μ_1	–13.361	–14.703	–14.153
	(5.841)	(5.433)	(6.289)

Parameter	Value		
p_{00}	0.900		
	(0.061)		
p_{11}	0.639		
	(0.206)		
Ω (3×3)	203.963	100.681	124.562
	(43.285)	(36.469)	(41.172)
	100.681	201.133	161.939
	(36.469)	(42.426)	(42.265)
	124.562	161.939	239.920
	(41.172)	(42.265)	(51.502)

Note: Standard errors are in parentheses, Ω denotes the variance-covariance matrix of parameters, μ_0 and μ_1 are the mean returns in state s_t=0 and s_t=1 respectively, p_{00} and p_{11} are the transition probabilities, Ω is a covariance matrix. Logarithmic equity returns are multiplied by 100.

6. IDENTIFICATION OF UNOBSERVABLE FACTORS

This section endeavors to find a set of economic and financial variables significantly correlated with the estimated unobservable process. This latent variable (LV) is argued to be an international investment sentiment, which influences an inflow of foreign portfolio investment to the capital markets of the three examined countries of Eastern Europe: the Czech Republic, Hungary and Poland as well as the behavior of domestic investors through a number of possible channels.

As an output from the vector Markov switching model, we obtained quarterly filter and smoothed probabilities of state s_t = 0 (see Figure **3**). The association between this estimated process and a number of economic and financial variables will be examined. In the following, the terms filter probabilities and LV will be used interchangeably.

The linear (product-moment, Pearson) correlation coefficient, *r*, is the most popular measure of association between variables. Under the normality

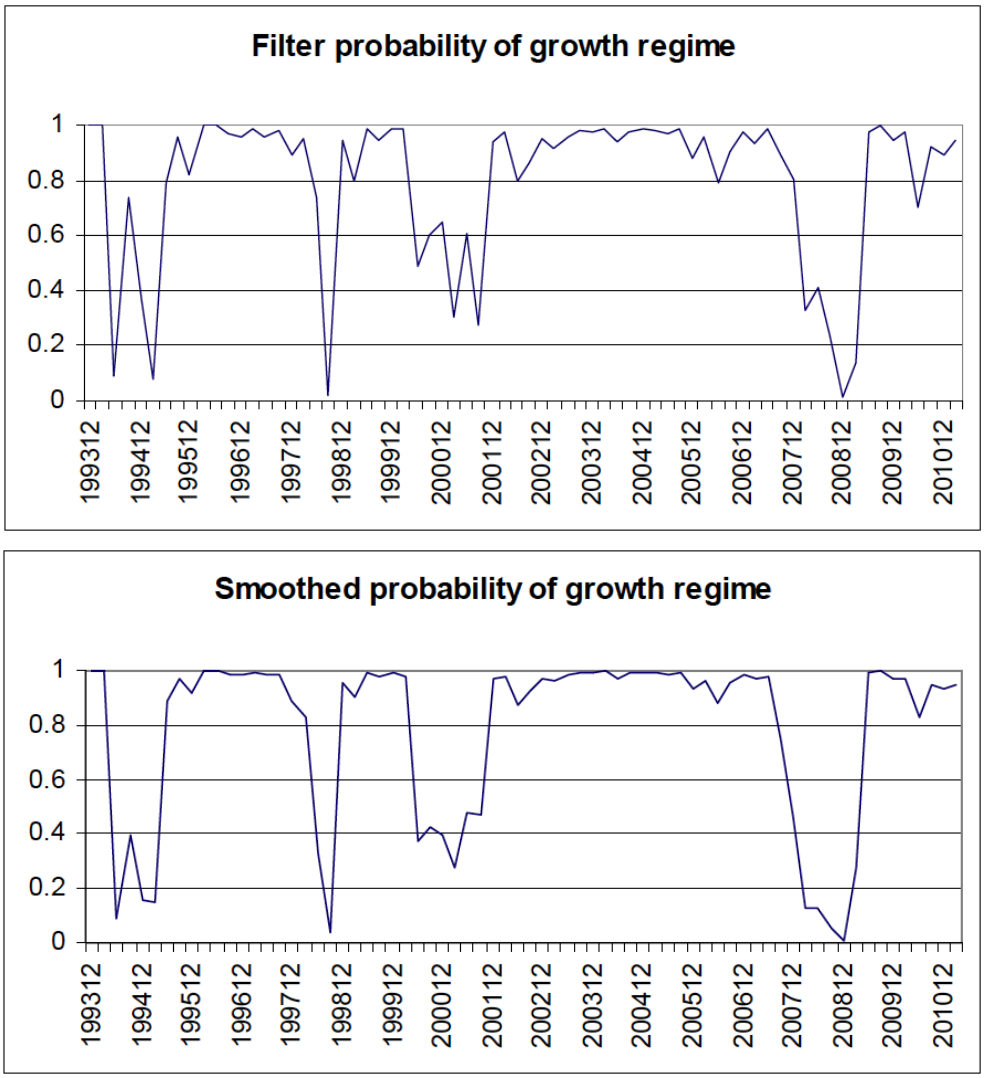

Figure 3: Filter and Smoothed probability of the Growth State from the Vector Markov Switching Estimation.

assumption, the statistic for the null hypothesis of H_0: ρ = 0 (where ρ denotes the population correlation coefficient) is given by:

$$t = r\sqrt{\frac{N-2}{1-r^2}} \tag{4}$$

Under the null hypothesis, (4) has a Student's *t*-distribution with (*N*–2) degrees of freedom. Kendall and Stuart (1979) demonstrate the robustness of the distribution of *r* when ρ = 0 to departures from normality. Therefore we continue to calculate the statistic (4) in the following analysis.

Since one of the series used in the correlation analysis is a probability (with values between 0 and 1), the assumption of bivariate normality is violated. For that reason we supplement our analysis with a distribution-free measure – the Spearman rank-order correlation coefficient r_s. The rank correlation is a more general measure of association than the product-moment coefficient, since it refers to the strength of a monotone (rather than linear) relationship. The ranks test is much less sensitive to outlying observations, has good power and does not require the variables to come from a bivariate normal population.

For the small and medium samples, r_s should be referred to Zar's table containing the most complete set of critical values for the Spearman rank correlation coefficient (see Zar (1972)). For large samples Zar(1972) recommends using (4) for hypothesis testing (where r is replaced by r_s).

6.1. Global Factors

Tables **2** and **3** show estimates of Pearson and Spearman rank order correlation coefficients between the estimated unobservable variable LV and a broad set of economic and financial variables. The following

Table 2: Correlation of Probabilities of State $s_t = 0$ with Financial and Economic Factors

Variable	Pearson coefficient	Spearman coefficient	Source
Equity Markets			
Logarithmic returns on:			
PX50 Prague Stock Exchange Index	0.742***	0.858+++	Bloomberg
BUX Budapest Stock Exchange Index	0.767***	0.858+++	Bloomberg
WIG Warsaw Stock Exchange Index	0.698***	0.762+++	Bloomberg
S&P/IFCI Asia	0.398***	0.501+++	Bloomberg
S&P/IFCI Europe and Mid-East	0.591***	0.508+++	Bloomberg
S&P/IFCI Latin America	0.669***	0.611+++	Bloomberg
S&P/IFCI Composite	0.629***	0.594+++	Bloomberg
S&P 500	0.574***	0.450+++	Bloomberg
MSCI World ex US	0.622***	0.555+++	Bloomberg
DAX	0.596***	0.609+++	Bloomberg
Mutual Fund Flows (NNCF)			
Emerging Market Funds	0.404***	0.500+++	ICI/Bloomberg
Global Funds	0.510***	0.459+++	ICI/Bloomberg
International Funds	0.520***	0.524+++	ICI/Bloomberg
Domestic Equity Funds	0.355***	0.369+++	ICI/Bloomberg
World Equity Funds	0.543***	0.531+++	ICI/Bloomberg
World Bond Funds	0.280**	0.213+	ICI/Bloomberg
Money Market Funds	-0.302**	-0.210+	ICI/Bloomberg
US Interest Rates and Spread			
Yield 10 year maturity	0.034	0.104	Bloomberg
Yield 3 month maturity	0.006	-0.014	Bloomberg
Term Spread (10-year-3 month yield)	0.025	0.147	
Market Sentiment/Fear/Uncertainty			
VIX Index	-0.464***	-0.296++	Bloomberg
Moody's Baa Corporate Bond Yield	-0.395***	-0.228+	Fred
Moody's BAA-AAA spread	-0.400***	-0.187	
TED spread [a]	-0.470***	-0.388+++	
Uncertainty Baseline Index [b]	-0.351***	-0.367+++	Baker *et al*. (2013)
Uncertainty News Based Index [b]	-0.429***	-0.446+++	Baker *et al*. (2013)
AAII Bullish Sentiment	0.411***	0.333+++	AAII
US. Consumer Confidence U. Mich. Index	0.273**	0.193	Fred
Crude Oil: Brent - Europe quarterly return	0.143	-0.014	Fred
Crude Oil: Brent - Europe annual return	0.241**	0.092	Fred

Notes: This table displays estimates of Pearson (product moment) and Spearman rank order correlation coefficients between the estimated unobservable variable LV and a broad set of economic and financial variables.

*,**,*** denotes significance at the 10%, 5% and 1% level, respectively; *t*-value for H_o: $\rho = 0$ (ρ - the population correlation coefficient) is based on the formula (4), where N=70.

+,++,+++ denotes significance at the 10%, 5% and 1% for the ranked data, c.f. Zar (1972).

[a]TED spread equals to the difference between the three month Euro dollar Libor rate and the three month US Treasury bill rate; both series obtained from FRED.

[b]Uncertainty Baseline Index and the Uncertainty News-Based Index are constructed and discussed by Baker *et al*. (2013).

Fred – Federal Reserve Economic Data, from the Federal Reserve Bank of St. Louis. ICI – Investment Company Institute. AAII – American Association of Individual Investors.

Table 3: Correlation of Probabilities of State $s_t = 0$ with Data on Portfolio Flows

Variable/ Country	Pearson coefficient	Spearman coefficient	Source
Czech Republic			
Portfolio Investment Liabilities	0.283**	0.135	OECD
Portfolio Investment Assets	-0.229*	-0.060	OECD
Hungary			
Portfolio Investment Liabilities [a]	0.319***	0.272++	OECD
Portfolio Investment Assets [a]	0.185	0.009	OECD
Poland			
Portfolio Investment Liabilities [b]	0.400***	0.409+++	OECD
Portfolio Investment Assets [b]	-0.445***	-0.405+++	OECD
United States			
Portfolio Investment Liabilities	0.300**	0.177	IMF
PI Equity Securities Liabilities	0.179	0.099	IMF
PI Debt Securities Liabilities	0.284**	0.163	IMF
Portfolio Investment Assets	-0.497***	-0.400+++	IMF
PI Equity Securities Assets	-0.429***	-0.362+++	IMF
PI Debt Securities Assets	-0.412***	-0.372+++	IMF
United Kingdom			
Portfolio Investment Liabilities	0.001	0.100	IMF
PI Equity Securities Liabilities	-0.043	-0.060	IMF
PI Debt Securities Liabilities	0.027	0.109	IMF
Portfolio Investment Assets	-0.363***	-0.250++	IMF
PI Equity Securities Assets	-0.238**	-0.187	IMF
PI Debt Securities Assets	-0.262**	-0.214+	IMF
Germany			
Portfolio Investment Liabilities	0.244**	0.134	IMF
PI Equity Securities Liabilities	0.104	0.215+	IMF
PI Debt Securities Liabilities	0.237**	0.119	IMF
Portfolio Investment Assets	-0.334***	-0.180	IMF
PI Equity Securities Assets	-0.235*	-0.197	IMF
PI Debt Securities Assets	-0.291**	-0.149	IMF

Notes: This table displays estimates of Pearson (product moment) and Spearman rank order correlation coefficients between the estimated unobservable variable LV and a portfolio flows.

*,**,*** denotes significance at the 10%, 5% and 1% level, respectively; *t*-value for H_o: $\rho = 0$ (ρ - the population correlation coefficient) is based on the formula (4), where N=70, with exceptions [a] and [b].

+,++,+++ denotes significance at the 10%, 5% and 1% for the ranked data, c.f. Zar (1972).

[a] $N = 65$, [b] $N = 57$.

groups of variables are considered: international equity returns, international portfolio flows, the US mutual fund flows, the US term structure and interest rates, other popular market sentiment/risk appetite/economic uncertainty indicators.

In order to establish a benchmark for interpretation of the actual strength of the association of LV with the examined factors, we report the correlation of LV with equity returns of the three CEE markets. The strength of linear correlation is of similar magnitude for all three countries and ranges from 0.698 for Poland to 0.767 for Hungary. Since LV was estimated on the basis of the three return series, we argue that if we find a correlation between LV and other variables of a similar strength, this denotes a high degree of association.

Rank correlation coefficients are somewhat higher than Pearson coefficients and range from 0.762 to 0.858.

International Equity Returns

There is economically and statistically significant positive correlation of LV with regional emerging market equity returns, particularly in Latin American countries. It turns out that the correlation with the equity returns in developed markets as represented by MSCI World Index (excluding the US), S&P500 and the German broad market index DAX is of comparable strength to the association with emerging market returns. This indicates that the market sentiment in the CEE equity markets is closely related to returns in both emerging and developed markets.

The US Mutual Fund Flows

Following Warther (1995), the next examined group of variables includes mutual fund flows as reported by Investment Company Institute (ICI). The net new cash flow (NNCF) variable is constructed by adding net exchanges (exchanges in minus exchanges out) to fund sales and subtracting redemptions. Table **2** demonstrates an economically and statistically significant positive correlation between LV and the net new cash flows to emerging market funds, global funds and international funds (global funds invest both in domestic and international markets). Word equity flows are the sum of the three types enumerated above. We notice a weaker association of LV with net new cash flow to the US domestic equity funds than with the flows to world equity funds. Interestingly, new investment into world bond funds is also significantly *positively* correlated with LV at the 5% level for original data and at the 10% level for ranks. Money inflows into the US money market funds are negatively correlated with LV. This gives some support to the observation that a bear market in the CEE is associated with the flight to safety by international investors.

Portfolio Investment Flows

Table **3** reports product-moment and Spearman coefficients of correlation between LV and portfolio flow series. Portfolio investment carried out by foreigners is recorded as "Portfolio Investment Liabilities" by the recipient country. A positive sign denotes foreign capital flowing into a country; a negative sign means an outflow. We find statistically significant correlation between LV and capital inflows into countries of CEE. "Portfolio Investment Assets", on the other hand, denote debt and equity securities purchased abroad by residents of a given country. It is an established practice in balance of payments accounting that the outflow of capital from a country is recorded with a negative sign. Interestingly we observe that portfolio investment directed abroad by entities from the Czech Republic and Poland shows significant linear correlation with LV at the 10% and 1% level, respectively. Negative coefficients for the Czech Republic and Poland for Portfolio Investment (PI) Assets mean that a high probability of a growth regime is *positively* correlated with domestic capital *outflow* from these countries. This suggests that foreign financial activity by institutions and individuals from CEE is affected by the international market sentiment.

Worldwide purchases of foreign debt and equity securities by the US investors are strongly correlated with LV, foreign capital inflows into the US are also correlated but the strength of the relationship appears weaker than for the capital outflows.

The correlation coefficients for portfolio investment out of Germany and the UK are statistically significant at the 5% level, but the relationship seems to be weaker than for the US. When we evaluate the results reported in Table **3** for rank order correlation coefficients, we may notice that at the 5% level, it is the foreign capital inflows to Hungary and Poland and capital outflows from the US and UK that are statistically significant.

Overall Table **3** and the ICI section of Table **2** demonstrate a significant association of capital flows with the equity market sentiment in CEE.

US Interest Rates and Term Structure

We use the spread between the yield on a long term (10-year) US Treasury bond and the yield on a 3-month US treasury bill. There exists a wide literature on the forecasting power of yield spreads for future movements in nominal interest rates. According to the expectation hypothesis, the expected excess return on the long-term over short-term bonds is zero. One of the consequences of this is that the yield spread constitutes the optimal forecast of changes in short-term interest rates. Hence a positive yield spread could be treated here as an expectation of interest rate rise. This could be associated with a decrease in capital flows to emerging markets, and consequently the correlation coefficient would be negative.

However, results in Table **2** do not support such conclusions for CEE. Contrary to the early reports in the beginning of the 1990s (cf. Calvo *et al*., 1993) we

find no evidence of significant correlation of the investor sentiment in the examined emerging markets with the US interest rates or the term structure spread.

Popular Market Sentiment/Risk Appetite/Economic Uncertainty Indicators

As reported in the bottom panel of Table **3**, LV appears significantly negatively correlated with a number of global "fear", risk and illiquidity indicators. Factors significant at the 1% level include: the VIX index, the spread between the yield on the US medium-grade bonds and the triple A rated bonds, Moody's BAA corporate bond yield, the TED spread and the US macroeconomic uncertainty indicators. The TED spread is calculated as a difference between the three month euro-dollar LIBOR rate and the three-month US Treasury rate. It is considered an excellent indicator of funding constraints (cf. Brunnermeier and Pedersen, 2009). The macroeconomic uncertainty indicators: the aggregate "baseline" index and the uncertainty news-based index are constructed and discussed by Baker *et al*. (2013).

AAII American Association of Individual Investors (AAII) Sentiment Survey measures the percentage of individual investors who are bullish on the US stock market during the next six months. The survey is conducted on a weekly basis and we calculate quarterly averages. The AAII bullish indicator is significantly positively correlated with LV at the 1% level for both original data and ranks.

The University of Michigan US consumer confidence index and the logarithmic year-on-year

Table 4: Correlation of Probabilities of State $s_t = 0$ with Local Factors in Central and Eastern Europe

Variable/ Country	Pearson coefficient	Spearman coefficient	Source
Quarterly Real Consumption Growth			
Czech Republic	0.123	0.089	OECD
Hungary	0.065	-0.060	OECD
Poland	-0.032	0.110	OECD
Term Structure Spread			
Czech Republic	0.191	0.201+	
Hungary	-0.018	-0.144	
Poland	0.300**	0.182	
Quarterly CPI Growth			
Czech Republic	-0.124	-0.012	OECD
Hungary	-0.013	0.086	OECD
Poland	-0.093	0.035	OECD
Growth of REER			
Czech Republic	0.096	0.064	OECD
Hungary	0.252**	0.170	OECD
Poland	0.223*	0.076	OECD
Quarterly IIP growth			
Czech Republic	0.200*	0.122	OECD
Hungary	0.454***	0.173	OECD
Poland	0.392***	0.269++	OECD
Quarterly IIP growth (t+1)			
Czech Republic	0.381***	0.239++	OECD
Hungary	0.519***	0.380+++	OECD
Poland	0.423***	0.367+++	OECD

Notes: This table displays estimates of Pearson (product moment) and Spearman rank order correlation coefficients between the estimated unobservable variable LV and a set of local economic factors.
*,**,*** denotes significance at the 10%, 5% and 1% level, respectively; *t*-value for H_o: $\rho = 0$ (ρ - the population correlation coefficient) is based on the formula (4), where N=70, with exceptions [a] and [b].
+,++,+++ denotes significance at the 10%, 5% and 1% for the ranked data, c.f. Zar (1972).
[a] $N = 65$, [b] $N = 57$.

return on the crude oil contract are positively correlated with LV at the 5% level. Note, however, that the correlation coefficients are noticeably smaller in absolute terms than the coefficients for the global fear indicators, and do not appear statistically significant for the ranked data.

In sum, results reported in Tables **2** and **3** for both original and ranked data demonstrate strong correlation between the estimated probability of the growth regime in equity markets in CEE and a large number of variables measuring international equity returns, mutual fund flows, portfolio flows, market sentiment and global liquidity. Contrary to a number of studies covering earlier and shorter periods, we do not find evidence of a significant relationship between the US interest rates and the market sentiment in CEE.

6.2. Local Factors

The choice of local macroeconomic and financial factors that may potentially influence asset values is largely inspired by Chen *et al*. (1986). In their analysis of the cross section of the US stock returns, the authors used monthly and yearly growth in industrial production, the unanticipated and anticipated inflation, the slope of term structure, consumption, the market index, oil prices and the risk premium.

As demonstrated by Table **4**, the quarterly real consumption growth, the term structure spread and the quarterly CPI growth do not seem to have a significant influence on the market sentiment in CEE. Although the real exchange rate was not a factor considered by Chen *et al*. (1986), we examine its influence following, for example, Calvo *et al*. (1993). Real exchange rate fluctuations are often associated with increased capital inflows. As can be seen in Table **4**, the growth rate in real exchange rate is only weakly correlated with LV, the coefficients being significant for Hungary at the 5% level and for Poland at the 10% level.

The only local factor that exhibits both economically and statistically significant correlation with LV for all the examined countries is the quarterly IIP growth. If we lead LV by one quarter, the correlation with the IIP growth gets stronger for the original data, and becomes statistically significant for the ranked data. This finding remains in agreement with voluminous literature documenting that equity market returns in different countries serve as an excellent leading indicator of economic activity (for a recent contribution, cf. Allen, Bali and Tang, 2012).

What we are able to demonstrate in this paper is that the equity market sentiment in a group of emerging markets is a good leading indicator of the subsequent growth in industrial production in these countries.

7. CONCLUSION

This paper proposes an explanation for cyclical behavior of stock prices in CEE. In the small, open equity market, the main underlying force moving prices seems to be of an exogenous nature. In our model, the international investment climate is an unobservable variable, which drives stock returns. To estimate the model, we apply the Markov switching method developed by Hamilton (1989, 1990) and Engel and Hamilton (1990). We find a number of economic series to be significantly correlated with the filter probabilities obtained from the Markov switching model, which was estimated for the three Central European markets. Data on foreign portfolio flows show a positive correlation with LV, corroborating the claim made at the beginning of this paper that the inflow of foreign capital that is one of the major factors influencing equity markets in CEE. Moreover, significant links between LV and returns on other emerging and developed market indices as well as global liquidity and risk appetite indicators suggest that the markets in Central and Eastern Europe are integrated into the world financial system.

A possible extension of the current paper could involve introducing directly into the model variables that influence the probability of switching between regimes.

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