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IPO Cycles in Central and Eastern Europe: What Factors Drive these Cycles?*

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Abstract
In this paper we provide new evidence on the incentives for initial public offerings (IPOs) in the emerging capital markets of Central and Eastern Europe (CEE) in the 2000s. First, we prove the existence of IPO cycles. Second, we show that the number of IPOs and their underpricing are positively correlated. Third, we provide a unique comparison of the CEE's IPO cycles with the cycles in the EU's developed capital markets as represented by the IPO activity on the Deutsche Boerse. We show that the two cycles have a moderately positive correlation. Fourth, we study the drivers of the cycles. Our results suggest that in addition to macroeconomic conditions, investor sentiment is a very important driver of an IPO's dynamics, which we depict by means of the risk aversion of institutional investors, growth in the assets of pension funds and the volume of trading on the market. Lastly, we provide evidence of drivers of IPO underpricing. We again find that the main driver of underpricing in the CEE region is the current conditions of capital markets, a factor that relates to investor sentiment. In addition, business conditions also contribute considerably to IPO underpricing. We find that a firm's performance has a moderate impact and that other micro factors do not predict underpricing. This finding conveys an interesting economic message, namely that underpricing is predominantly driven by the environment and much less by specific micro characteristics.

1. Introduction

A substantial part of the literature on initial public offerings (IPOs) explains the phenomenon of IPO cycles. Jenkinson and Ljungqvist (2001) report a positive autocorrelation for the United States between 1960 and 1999: periods of high IPO volume are likely to be followed by further high volume. The period of high IPO volume is known as the "hot issue" phenomenon. Many authors have documented the existence of IPO cycles mostly in the United States and developed European capital markets (Ritter, 1984; Lowry and Schwert, 2002; Benveniste *et al.*, 2003; Yung *et al.*, 2008; Ritter *et al.*, 2013).

The 2000s exhibited a very dynamic period for IPOs in the developed capital markets. First, there was the collapse of the dot-com bubble, followed by the bull capital market environment up to 2007, when the financial crisis had a tremendous impact on capital markets. Because IPOs play the important role of capital-raising in capital markets, the crisis period also exhibited a fluctuation in IPOs. Loughran and Ritter (2004) and Günther and Rummer (2006) find this phenomenon during the dot-com bubble. Furthermore, Ritter *et al.* (2013) study the IPO activities in developed

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European Union (EU) markets from 1995 to 2011 and show that IPO volumes in those markets declined because of lower market valuations following the collapse of the dot-com bubble, the "panic" of 2008 and the eurozone crisis.

In the 2000s, the capital markets in Central and Eastern Europe (CEE) region were in the second decade of their existence, as most of the capital markets in CEE were established in parallel with the liberalization of their economic environments approximately two and a half decades ago. The only partial exception in this respect is Austria, which by the 2000s already had a longer capital market tradition and a liberal economic regime. For many reasons, the development of such relatively young capital markets together with their capital-raising function is very important for emerging economies. Bekaert *et al.* (2005) illustrate how the liberalization of equity markets leads to an increase in annual real economic growth. Similarly, Mendelson and Peake (1993) argue that, in emerging economies, the sooner sound equity markets are established, the sooner there are benchmarks for evaluating privatized and private firms. Perotti and Guney (1993) also emphasize the role of large-scale privatization programs, which contribute to the non-debt financing of the public deficit, attract foreign capital and technology, and promote the return of capital from abroad.

IPOs in CEE, especially those undertaken in the 2000s, have been poorly documented in the literature. Because the Warsaw Stock Exchange dominated the decade and was often ranked second or third by IPO value in the EU in the late 2000s (IPO Watch, PWC, 2003–2011), most researchers have focused solely on the Polish market (Darmetko, 2009; Jewartowski and Lizińska, 2012; Lizińska and Czapiewski, 2014; Meluzin *et al.*, 2013; Sieradzki, 2013; Zaremba and Kaminski, 2011; Zaremba and Żmudziński, 2014). Most of the literature related to IPOs in this region also covers (mass) privatization processes and their outcomes in the 1990s, providing assessments of the impact of voucher privatization on capital market development (Perotti and Guney 1993; Aggestam, 2006; Aussenegg and Jelic, 2007; Jelic *et al.*, 2003). These studies show some evidence of underpricing and underperformance; however, the determinants of IPOs in CEE are less well known and are under-investigated. Therefore, our intention is to fill this gap in the academic literature and answer the question of what factors drove IPOs in CEE during the 2000s.

Our paper contributes to the literature in several respects. We provide original evidence of IPO cycles in the stock exchanges of Bucharest, Sofia, Ljubljana, Prague, Vienna and Warsaw. We focus on the period from 2000 to 2009. After 2009, the IPO market in CEE almost vanished. The results show that the number of IPOs and underpricing are positively correlated. In addition, we provide a unique comparison of IPO cycles in CEE with those in the EU's developed capital markets. For this comparison, we use the IPO activity on the Deutsche Boerse, whose bank-based financial environment is similar to that in the CEE countries. The countries in CEE have strong economic links with the developed EU regions, especially with continental Europe. However, the CEE markets have only recently started to provide a channel for acquiring sources of financing for companies and were much less developed throughout the period studied. We show that these two groups of cycles are moderately correlated. The most essential part of our study is the analysis of the main drivers behind IPO cycles and the drivers behind their underpricing in CEE. In line

with some previous findings for Poland, we show that, apart from macroeconomic conditions, investor sentiment is the most important driver of both IPO activity and underpricing. On the other hand, we show that company-specific data are of much less importance, a finding which has strong economic relevance and provides valuable insights for potential investors, issuers and policy-makers in this region and other emerging capital markets.

The paper is organized as follows: In Section 2 we review the literature on IPO cycles and their main macro and micro driving factors. Section 3 provides an overview of the CEE capital markets. In Section 4 we present the data collection and its description, and in Section 5 we describe our hypothesis and methodological approach. In Section 6 we report our main findings. Section 7 concludes the paper.

2. Literature Review

2.1 IPO Cycles

IPOs usually come in waves because of the "hot issue" phenomenon. Jenkinson and Ljungqvist (2001) report a positive autocorrelation between hot issues and cycles for the United States between 1960 and 1999: periods of high IPO volume are likely to be followed by further high volume. The authors argue that the timing of an IPO should depend on factors that determine the trade-off between the costs and benefits of a stock market listing.

Hot and cold IPO periods are classified in terms of the number of IPOs and the average underpricing. Underpricing happens when shares that go public are offered to investors at prices considerably below the prices at which they trade on the stock exchange later. There is a great deal of evidence in the IPO literature that volume and underpricing are positively correlated (Ritter, 1984; Lowry and Schwert, 2002; Benveniste *et al.*, 2003). Ritter (1984) analyzes the hot market of 1980 and reports a first-order autocorrelation of 0.62 for the time series of the monthly average of the initial returns. The first-order autocorrelation of the monthly IPO volume was even stronger at 0.88. He suggests that if high-risk offerings represent an unusually large fraction of the IPOs in some periods, then these periods should also have unusually high average initial returns. Similarly, Lowry and Schwert (2002) indicate that the IPO volume tends to be higher following periods of especially high initial returns. Their findings suggest that both the cycles in the initial returns and the lead-lag relation between them and the IPO volume are predominantly driven by information learned during the registration period. More positive information results in higher initial returns and more companies filing IPOs soon thereafter. Benveniste *et al.* (2003) also provide evidence that hot and cold markets tend to alternate and generate the clustering of IPOs. They argue that issuers go public during a temporary window of opportunity and the price information from past IPOs spills over to the current and future offerings, thus affecting the decision to go public. More recently, Ritter *et al.* (2013), using a sample of developed EU capital markets from 1995 to 2011, confirm a positive correlation between the IPO volume and the average initial returns one quarter before the observed IPOs. Similarly, Zaremba and Kaminski (2011) report a hot market for Poland in the 2000s and show a positive correlation of 0.65 between the average arithmetical rates of return on IPO investments and the number of IPOs.

Using a sample for the United States covering the period between 1960 and 1996, Lowry (2003) shows that the IPO volume fluctuates substantially over time. She reports a first-order autocorrelation of 0.87 for the quarterly IPO volume. However, in contrast to other authors, she does not find any significant relationship between the IPOs' abnormal returns and their volume. She finds that the IPO volume is significantly and negatively related to both the IPOs' post-issue returns and those of the market. Benveniste *et al.* (2003) also show that initial returns and IPO volume are positively correlated in the aggregate. However, similar to Lowry's findings, the correlation is negative among the contemporaneous offerings subject to a common valuation factor.

More recent studies focus on a decline in IPOs after the 2000s. Gao *et al.* (2013) report that from 1980 to 2000 an average of 310 IPOs occurred each year in the United States, but this rate had fell to an average of only 99 IPOs per year from 2001 to 2012. Even more dramatically, an average of 165 small-company (pre-IPO inflation-adjusted annual sales of less than USD 50 million) IPOs occurred each year from 1980 to 2000, and this number dropped by more than 80% to an average of only 28 IPOs per year from 2001 to 2012. Ritter *et al.* (2013) study the IPO activity on the EU's developed markets from 1995 to 2011 and show that the EU volume declined because of lower market valuations following the collapse of the dot-com bubble, the "panic" of 2008 and the eurozone crisis.

2.2 IPO Drivers

According to the exsisting academic research on IPO drivers, there could be a number of factors that influence hot markets, such as pre-issue ownership, information asymmetry, ex-ante uncertainty, investor sentiment, rising share prices, deregulation of listing requirements, attractiveness of business environment and business cycles. Based on Günther and Rummer (2006), there are basically two explanations for the cyclical nature of IPO markets. There are periods when a large number of companies need fresh capital to invest in new projects and there are periods when investors have a lot of money to invest or they might be especially optimistic. Similarly, we can divide the IPO drivers into two main categories: macro and micro factors.

Benninga *et al.* (2005) offer a macro explanation with respect to hot markets. They argue that changes in the macroeconomic conditions simultaneously affect multiple industries and companies. Thus, when one company finds it optimal to issue stocks, so do others. In their model, the entrepreneur trades away the gains of diversification against the benefits of being private. During times in which cash flows are sufficiently high, the potential advantages of diversification outweigh the benefits of private ownership and the company goes public. Similarly, Lowry (2003) argues that not only companies' demand for capital but also investor sentiment are important factors in the IPO volume. She argues that companies seem to successfully go public when a broad class of the market is valued especially highly. She shows that companies are more likely to issue an IPO when adverse selection costs are lower and companies' demand for capital and the investor sentiment are high. This is in line with the information asymmetry theory that argues that when asymmetry is very high, the adverse selection costs of issuing capital are greater and companies rarely

decide to go public in such circumstances or they postpone an IPO until the costs of issuing capital decrease. For the EU's developed capital markets, Ritter *et al.* (2013) report similar findings that confirm the positive impact of the capital market's climate. Using a sample covering the period from 1995 to 2011, the positive correlation between the IPO activity and the equity index stood out in their regression model. Gajewski and Gresse (2006) analyze various features of the European IPO market over the period from 1995 to 2004 and also confirm that initial underpricing is positively linked to information asymmetry in the aftermarket.

Some of the most recent studies focus also on regulatory changes, especially the Sarbanes-Oxley Act of 2002, that could cause the decline in IPO activity (Akyol *et al.*, 2014). However, Ritter (2011) suggests that, although regulations undoubtedly account for some of the decline in IPOs, much of the decline might be due to a structural shift that has lessened the profitability of small independent companies relative to their value as part of a larger, more established organization that can achieve economies of scale. In line with Ritter's findings, Gao *et al.* (2013) analyze IPOs in the United States in the last decade and argue that the regulatory overreach hypothesis is unable to explain many facts and many of its predictions are not supported. They support the economies of scale hypothesis and argue that there has been a fundamental change in many sectors of the economy whereby the importance of bringing products to market has quickly increased.

Loughran and Ritter (2004) analyze the trend in a company's characteristics such as sales, assets, ownership structure, industry and the underwriter's prestige in a US IPO sample covering the period from 1980 to 2003. They conclude that the reasons that IPOs are underpriced vary depending on the environment and that the variation in a company's characteristics are not sufficient to explain the underpricing trends during the observed period. A small part of the increase in underpricing can be attributed to the changing risk composition of the companies going public. The IPO literature also generally assumes that a high degree of pre-IPO leverage serves as a positive signal of a company's quality, as it forces its managers to adhere to tough budget constraints. The impact of leverage on IPO activity is studied by Kim *et al.* (2008), who find that debt only serves as a signal of better quality for the IPOs of low-tech companies, as reflected in lower underpricing. For the IPOs of high-tech companies, the effect of leverage is reversed: for these companies, higher leverage is associated with increased risk and uncertainty, as reflected by greater underpricing.

Studies for the continental EU report similar findings. Lyn and Zychowicz (2003) analyze the underpricing of IPOs in Hungary and Poland in the period from 1991 to 1998. Their cross-sectional regression analysis shows that the market momentum measured by the percentage change in the local market index one month prior to the offering day is a significant and primary determinant of the initial returns in both countries. The evidence suggests that over the period studied, the degree of underpricing was determined by the intensity of demand driven by investors' interest, where the offering prices did not fully adjust to the prevailing market conditions. Similarly, Aussenegg (2006) argue that the initial abnormal returns in Austria can be best explained by ex-ante uncertainty, similar to the model of Rock (1982), and the relationship between underpricing and the performance of the stock market.

Correspondently, Jewartowski and Lizińska (2012) document the strong explanatory power of the early aftermarket's volatility and the issuer's size, growth opportunities and profitability before the offering. Furthermore, Lizińska and Czapiewski (2014) provide evidence on the relationship between both a company's size and profitability and the aftermarket's price performance for Polish IPOs in the 2000s. In contrast, Sieradzki's (2013) observation goes against the information asymmetry theories for the underpricing of Polish IPOs, as he finds no significant relationship between the initial return and the size of the offer. He also reports that the market conditions at the time of an IPO are not significant either. Contrary to his findings, Meluzin *et al.* (2013) identifies conditions in the business sector and the stock market as well as investors' interest as determinants of the timing of IPOs on the Warsaw Stock Exchange in the same period. Guidici and Roosenboom (2006) provide similar results for the new European markets up to the 2000s. They show that the market returns, the IPO-issuing firm's risk, and price revision in the premarket are positively related to the first-day returns. Goergen *at al.* (2009) report first-day underpricing in Germany (Neuer markt) and in France (Nouveau Marche) in the period from 1996 to 2000. They find that the high underpricing in these two markets—contrary to the evidence in the Unites States—is not driven by insiders' selling behavior. The greater underpricing is rather caused by the high degree of riskiness of the issuing companies and by the partial adjustment phenomenon of the offer prices to compensate institutional investors for the truthful revelation of their demand for shares.

3. Overview of the CEE Capital Markets

Our research focuses on the capital markets in CEE. These markets are immature, as most of them were established only a little morethan two decades ago. *Table 1* shows the comparison of the indicators of financial and institutional development for this region (World Bank Doing Business publication, 2013). The comparison illustrates that in some respects the Austrian indicators are more similar to the indicators for the euro area than to those for CEE (e.g. the presence of institutional investors, banks' private credit to GDP and foreign ownership of domestic market capitalization). Yet, some indicators are quite similar to CEE (e.g. investor protection, stock index volatility, turnover velocity and market capitalization to GDP) and are perhaps related to the fact that the Austrian stock market's development actually occurred at the same time as those in the other CEE countries despite its longer existence. We thus include Austria so that we can provide a comprehensive description of IPO performance in CEE, though we acknowledge that Austria is in some aspects more advanced. The EU's enlargements in May 2004 that added the Czech Republic, Hungary, Poland, and Slovenia, and in January 2007 that added Bulgaria and Romania moved the CEE countries even closer to Austria, as their respective national regulatory environments and some institutional structures quickly became very similar to those in Austria and Western Europe.

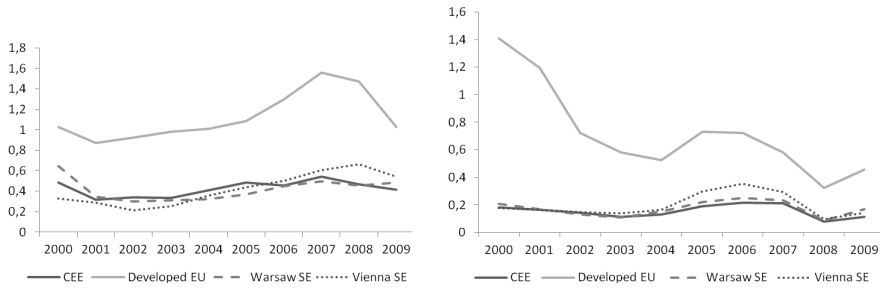
After liberalization took place, the CEE capital markets attracted much attention from international investors. In the 1990s, the region saw relatively large inflows of foreign direct investment (FDI), which by the end of the decade was coupled with favorable macroeconomic effects and relatively low stock valuations. These factors caused institutional investors to become attracted to portfolio investments in CEE (Koeke, 2000). EU accession has only magnified the phenomenon. Market capitali-

Table 1 Financial and Institutional Development Indicators

Indicator name/Country	Austria	Bulgaria	Czech Republic	Hungary	Poland	Romania	Slovenia	Euro area	CEE average	CEE-AUT average
(1) Bank capital to total assets (%)	5	11	6	9	8	11	9	6	8	9
(2) Bank concentration (%)	69	66	70	65	64	71	64	76	67	67
(3) Bank private credit to GDP (%)	107	27	44	39	28	16	48	95	44	33
(4) Mutual fund assets to GDP (%)	33	0	4	7	4	0	6	27	8	3
(5) Pension fund assets to GDP (%)	4	2	4	6	8	0	1	5	4	4
(6) Percentage of foreign banks among total banks (%)	8	54	55	84	65	64	28	27	51	58
(7) Return on equity (%)	6	16	12	19	11	3	10	10	11	12
(8) Volatility of stock price index**	26	28	28	33	32	34	20	22	29	29
(9) Paid-in min. Capital (% of income per capita)	60	68	39	69	213	2	34	46	69	71
(10) Strength of investor protection index (2006)	5.0	6.0	5.0	4.3	5.7	5.7	6.3	6.1	5.3	5.4
(11) Strength of investor protection index (2010)	5.0	6.0	5.0	4.3	6.0	6.0	6.7	6.1	5.5	5.5
(12) 2001 domestic market capitalization in USD mln***	85,270	505	9,331	18,773	26,017	2,124	6,326	5,051,041	-	-
(13) 2007 domestic market capitalization in USD mln***	236,448	21,793	73,420	46,196	207,332	44,925	28,860	9,807,455	-	-
(14) 2010 domestic market capitalization in USD mln***	126,032	7,276	43,056	27,708	190,235	32,385	9,428	6,781,385	-	-
(15) Foreign ownership of domestic market capitalization (2004)	33.8	3.4	19.8	45.6	14.0	4.7	3.9	33.5	16.5	14.1
(16) Foreign ownership of domestic market capitalization (2010)	36.1	9.3	24.9	41.7	17.2	7.1	6.8	50.0	18.8	16.3
(17) Outward-to-inward FDI in 2010 (in %)****	103.5	2.8	11.6	68.4	20.6	6.0	77.0	143.3	37.1	27.6
(18) Total tax rate (% profit)	54	40	49	57	45	50	39	50	48	47

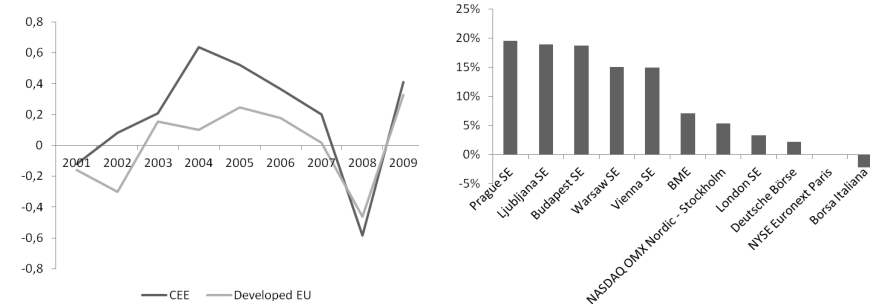
Notes: Averages for 1997–2009 in (1)–(8); euro area and 2004–2009 for (9)–(11); * = UK, Germany and France; ** = authors' own calculation for Austria (2003–2011); *** = euro area data jointly for Germany, the UK, France and Italy.

Figure 1 Average Turnover Velocity within CEE and EU Capital Markets (left) and the Stock Markets' Capitalization-to-GDP Ratio in % (right)



Sources: WB, FESE, WFE, Bucharest SE, Prague SE, London SE; authors' own calculations.

Figure 2 Equity Market Capitalization Growth Rates in CEE and the EU's Developed Capital Markets (left) and Average Annual Index Returns in the Period 2001–2009 (right)



Sources: FESE, WFE, Prague SE, London SE; authors' own calculations.

zations had started to increase and had reached relatively high levels at the beginning of the global financial crisis. Companies were offered unprecedented access to capital markets and there was excessive optimism in the CEE markets that provided windows of opportunity for the issuing companies (Ritter, 1991), which can be seen from the market trends (see *Figure 2*).

Table 1 shows that the CEE markets are institutionally different from the EU's developed markets in terms of banks and market capitalization to GDP, the presence of institutional and foreign investors, and the net investment position (see the outward-to-inward FDI position[1]). Furthermore, according to recent research conducted by Todea and Plesoianu (2013), stock market liquidity (see *Figure 1*) is a very important determinant of a given market's efficiency. CEE's liquidity remained substantially lower throughout the 2000s compared to the EU's developed countries, though it gradually increased. The same holds for investor protection, which in the EU was roughly 14% higher in 2006 than in the CEE countries and was still 11% higher in 2010. These characteristics might specifically impact the IPO phenomena reported for the developed markets.

[1] The very same holds for portfolio investments (not shown).

Table 2 CEE IPO Sample, 2000–2009

IPO value in EUR	IPO delistings		IPO value < < 10 mln EUR		IPO value ≥ ≥ 10 mln EUR		Total	
	No of IPOs	IPO value	No of IPOs	IPO value	No of IPOs	IPO value	No of IPOs	IPO value
2000	6	302.740.000			2	1.277.746.871	8	1.580.486.871
2001	2	23.070.000			1	48.300.000	3	71.370.000
2002	1	4.500.000			1	11.000.000	2	15.500.000
2003	5	1.181.892.698			0	0	5	1.181.892.698
2004	3	173.106.447	2	9.580.977	5	2.083.021.257	10	2.265.708.681
2005	19	459.192.567	12	64.616.148	14	2.468.880.705	45	2.992.689.420
2006	14	874.859.085	17	134.946.200	16	1.946.562.132	47	2.956.367.417
2007	22	1.332.871.004	21	127.751.830	37	2.132.406.087	80	3.593.028.921
2008	15	306.693.311	10	94.430.202	9	2.504.062.177	34	2.905.185.690
2009	2	11.199.997	7	24.355.744	3	216.477.750	12	252.033.492
Sum	89	4.670.125.109	69	455.681.102	88	12.688.456.979	246	17.814.263.190

Sources: CEE stock exchanges and companies, authors' own calculations.

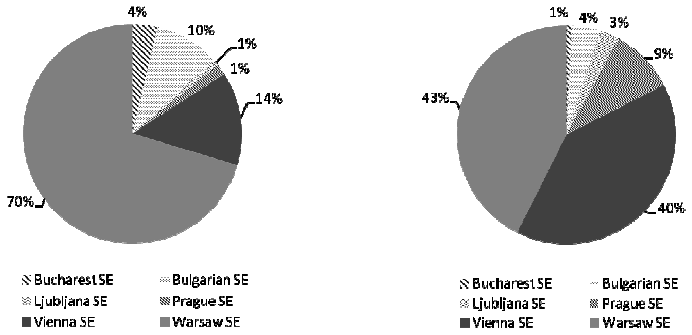
4. Data Collection and General Data Description

4.1 Data Collection

Our sample covers 246 IPOs in the 2000s on the stock exchanges of Bucharest, Sofia, Ljubljana, Prague, Vienna and Warsaw (*Table 2*). The Budapest stock exchange is excluded because no IPOs were conducted in the observed period. We focus on the period from 2000 to 2009 because after 2009 the IPO market in CEE almost vanished. The only exception after 2009 was the Warsaw Stock Exchange, which had listings mostly on the NewConnect market with limited regulatory and reporting requirements. Therefore, in order to keep the comparison between the capital markets consistent, such cases are not included in our analysis (an approach similar to that of Zaremba and Żmudziński, 2014). Separately, we also analyze IPO activities for the most active periods of 1 May 2004 to 31 December 2009 and 1 January 2005 to 31 December 2007.

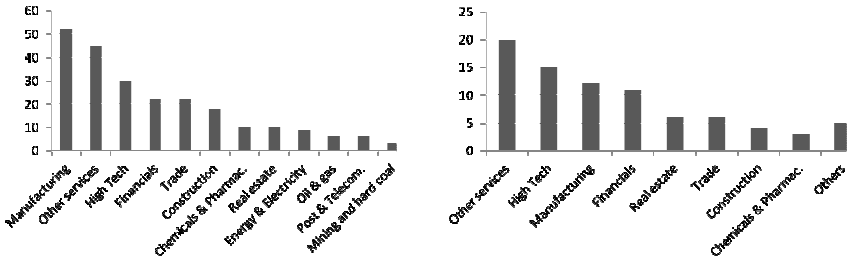
Table 2 gives an overview in which the IPOs are divided into three groups: IPOs that were delisted before the end of 2012, smaller IPOs that raised less than EUR 10 million in new funds, and those IPOs with at least EUR 10 million in new funds raised (with primary and/or secondary shares). In the cases of double listings, we take into account only the IPO in the domestic market. We also include the privatizations of public companies (14 examples of such IPOs), but only if they are public offerings (i.e. privatized initial public offering—PIPO). We divide the IPOs into three groups because of the information that is available for the first two groups and not for the third. This lack of information places limits on the possible respective analyzes. The most relevant IPOs have at least EUR 10 million in value and represent 36% of the IPOs and 71% of the total IPO value. Thirty-six percent of the companies that executed IPOs had been delisted by the end of 2012 (*Table 2*).

Figure 3 Distribution of IPOs by Capital Markets; Number of IPOs (left) and IPO Value (right), 2000–2009



Sources: CEE stock exchanges and companies, authors' own calculations.

Figure 4 Distribution of IPOs by Sector, Total (left) and Delistings (right), 2000–2009



Sources: CEE stock exchanges and companies, authors' own calculations.

We collected the list of companies with IPOs from the stock exchanges' internal documentation and from the websites of the stock exchanges. Furthermore, we double checked the obtained figures against the detailed case-by-case IPO information on the companies' websites and in their prospectuses annual reports. The market share prices, index prices and the fundamental micro and macro valuation factors, such as the companies' yearly sales and leverage figures, GDP growth and private consumption growth per country, were obtained from Datastream. The OECD and World Bank databases provided the macro indicators, such as pension, investment and mutual fund assets per country.

4.2 Descriptive Statistics

The prevailing capital markets in the CEE IPO sample are the Warsaw SE (70% of the IPOs and 43% of the total IPO value in the sample) and the Vienna SE (with 24% and 40% of the respective shares) (*Figure 3*). Of the companies that completed an IPO, 22% are manufacturers (e.g. building materials, plastic materials, sports equipment) and 19% are services (*Figure 4*). Each of the four industries—high-tech companies, financial institutions, trade and construction—represents approximately 10% of the sample. The most delistings are in other services and the high-tech sector. This result shows that the "old economy" comprises the dominant industries in CEE. Although the distribution of the IPO companies among

Table 3 Descriptive Statistics of Numeric IPO Variables

Panel 1 (Total sample)	**Sum**	**Mean**	**Std. Dev.**	**Min**	**Max**
Value of IPO shares in EUR*	17,814,263,190	72,415,704	209,308,263	35,138	1,895,309,124
Index-adjusted initial return**		12%	31%	-79%	194%
Index return**		3%	12%	-43%	38%
Volatility***		3%	3%	0%	25%
Net debt/assets****		11%	26%	-65%	69%
Income/assets****		10%	12%	-11%	98%
Sales/assets****		163%	140%	0%	823%
Panel 2 (IPO value ≥ ≥ 10 mio EUR)	**Sum**	**Mean**	**Std. Dev.**	**Min**	**Max**
Value of IPO shares in EUR	12,688,456,979	144,187,011	301,385,956	10,751,162	1,895,309,124
Market capitalization in EUR	45,097,660,444	512,473,414	1,029,476,965	34,391,179	5,027,345,157
% of primary shares (Share increase)		23%	15%	0%	75%
% of secondary shares		14%	19%	0%	85%
Index-adjusted initial return		13%	30%	-20%	194%
Index return		3%	11%	-41%	37%
Volatility		3%	2%	0%	18%
Net debt/assets		17%	27%	-65%	69%
Income/assets		7%	7%	-5%	28%
Sales/assets		136%	113%	0%	523%

Notes: Total sample of *N* = 88 IPOs. The *value of the IPO shares* represents the total amount of raised capital (with primary and secondary shares), calculated by multiplying the number of shares and the IPO price. *Market capitalization* is the multiple of the post-IPO number of shares and the IPO price. The *% of primary (secondary) shares* is the ratio of new (existing) shares in an IPO to the total number of shares outstanding before the IPO. *Index return* is the performance of the benchmark index of the respective stock market in the three-month period before the beginning of the subscription period. *Volatility* is the standard deviation of the first 30 daily returns. *Financial ratios* (Net debt/assets, Income/assets, Sales/assets) are the company's financial ratios one year before an IPO.

Sources: Panel 1: CEE stock exchanges and companies, authors' own calculations.
Panel 2: Datastream, CEE stock exchanges and companies, authors' own calculations.

the industries is rather dispersed, a decline in the "new economy" is evident. The industry distribution of the IPO companies in CEE and in the EU as a whole is similar in the observed period. According to PricwaterhouseCoopers (PwC) (2009), the top-performing sectors (industrial goods and services, investment companies, technology, financial services, construction and materials, and real estate) in terms of the number of IPOs in 2009 remained the same as in 2008.

Due to the limited company-specific data for delisted and smaller IPOs, the descriptive statistics are divided into two parts: for the total sample of 246 IPOs

and for the sample of 88 tradable IPOs (*Table 3*). The average IPO size for the sample of 246 (88) IPOs is EUR 72.4 (144.2) million. The average index-adjusted initial IPO return is 12% (13%), with the average volatility 30 days after the first trading day at 3% for both samples.[2] The index return as the measure of performance of the benchmark index in the respective stock market during the three months before the beginning of the subscription period is 3% on average for both samples. The performance of the companies one year before their respective IPOs is positive on average (e.g. income-to-assets ratio of 10% and 7%, sales-to-assets ratio of 163% and 136%, and quite low leverage, as measured by the net debt-to-assets ratio of 11% and 17% for the sample of the largest 88 IPOs and the total sample, respectively). The additional data for the sample of the largest 88 IPOs show that, on average, capital increased by 23%, resulting in the average post-IPO company size of EUR 512.5 million.

5. Hypotheses and Method

5.1 Hypotheses

We test five hypotheses regarding IPOs in CEE in the 2000s. The first three are related to the IPO cycles. Our first main research question is focused on the existence of IPO cycles in CEE's capital markets, i.e. the existence of hot and cold IPO markets that are similar to those reported for various developed markets. We test the hypotheses for CEE as a whole during the ten-year bull market and compare the results to the literature. Furthermore, we are interested in the relationships between IPO cycles and underpricing in the CEE markets. Thirdly, since the countries in CEE have strong economic links with the EU's developed regions, we test whether the IPO cycles in the CEE markets are related to the cycles in the EU's markets. The hypotheses are thus: *Hypothesis 1*: There are hot and cold markets in the CEE capital markets. *Hypothesis 2*: The number of IPOs and the underpricing of IPOs in the CEE capital markets are positively correlated. *Hypothesis 3*: There is a positive correlation between the number of IPOs in the CEE capital markets and the EU's markets.

Furthermore, we analyze the factors that influence the occurrence of IPOs and that influence IPOs' initial returns. The next two hypotheses are thus: *Hypothesis 4*: The macro factors that influence the hot IPO markets are investor sentiment, share prices, market liquidity and business cycles. *Hypothesis 5*: The micro and macro factors that influence IPO underpricing are information asymmetry, the market climate, the pre-IPO ownership structure, performance and leverage of companies and ex-ante uncertainty.

5.2 Method

Using a model similar to Ritter (1984) and Lowry (2003), we calculate the first-order autocorrelation for the time series of the number of IPOs and the monthly average of the initial returns to test Hypotheses 1 and 3. We group the IPOs into 119 monthly cohorts and calculate the correlation coefficient by using Pearson's

[2] Berk and Peterle (2015) provide a more detailed analysis of IPO underpricing in CEE in the 2000s. They show evidence of IPO underpricing in CEE in the 2000s by using both index-adjusted and CAPM-adjusted initial returns with alternative weights.

Table 4 Variables Used in the Testing of Hypotheses 4 and 5

Hypothesis	Proxy	Variable
Macro IPO factors—monthly IPO number per capital market as independent variable (Hypothesis 4)		
Business cycles	GDP 2	GDP growth change 2 quarters before an IPO
	GDP 2q	GDP % change 2 quarters before an IPO
	IP 1	Industrial production change 1 quarter before an IPO
	Bond 2	Yields to maturity of government bonds 2 quarters before an IPO
Capital market performance	Index	Average benchmark index return 90 days before the respective month
Activity of market participants	Turnover	Ln (yearly absolute change in the respective market's turnover (USD) 1 year before an IPO)
Investor sentiment/risk aversion	Investment funds	% change of assets, shares, and other equity in total financial assets in investment funds 1 year before an IPO (for OECD countries)
	Pension funds	Ln (yearly absolute change in pension funds in the respective country (USD) 1 year before an IPO)
Macro and micro underpricing factors—index-adjusted initial return as independent variable (Hypothesis 5)		
Pre-IPO company's performance	ROE	ROE 1 year before an IPO
	Income	Net profit (income)/assets 1 year before an IPO
Ex-ante uncertainty	Volatility	Share volatility 30 days after first trading date (standard deviation of returns)
Capital market performance	Index	Benchmark index return 90 days before an IPO subscription period
Business cycles	GDP	Yearly GDP growth 1 year before an IPO
	Bond 3	Yields to maturity of government bonds 3 quarters before an IPO
	IP 2	Industrial production change 2 quarter before an IPO

correlation of the stationary time series (tested with the augmented Dickey-Fuller test). We also employ the one-tailed *t*-test.

In order to find relationships and possible explanations for the IPO drivers, a multiple regression analysis with a range of independent variables is used. Thus, for Hypothesis 4 we test the dependence between the monthly number of IPOs per capital market and the various yearly macro determinants per respective country. We also use quarterly data (e.g. bond yields, industrial production change), if available. To test Hypothesis 5, we use the index-adjusted initial return as the dependent variable and different proxies for the micro and macro determinants of the underpricing. We use an OLS multiple estimation. *Table 4* provides a complete list of the determinants that we use in the multiple regressions for Hypotheses 4 and 5.

In order to analyze the macro drivers for the number of IPOs, we use the percentage of the equities in the total assets of the investment funds and the growth in pension funds one year before an IPO in the respective country to represent investor sentiment. Similarly, we could use mutual funds as a proxy, but due to their high correlation with investment funds we exclude this variable. According to

Benninga *et al.* (2005) and Lowry (2003), there are many possible proxies for business cycles, such as GDP growth, productivity, consumption and sales growth. We focus on those that are available for CEE. Thus, we use GDP growth one year or two quarters before the given IPO and the government bond yields in the respective country as business cycle proxies.

In line with many authors (Lowry, 2003; Lyn and Zychowicz, 2003; Aussenegg, 2006; Guidici and Roosenboom, 2006; Goergen *et al.*, 2009; Ritter, 2013), we use the average performance of the stock market 90 days (the above-mentioned authors use various time periods, for example 30, 45 or 90 days) before the beginning of the subscription period as a proxy for the market's climate. We also add the absolute yearly change in the respective market's turnover for a climate proxy. All of the above-listed authors indicate that market returns are also positively related to the first-day returns. Frequently, this is even a significant and primary determinant of the initial returns. The index returns are also a proxy for the investor sentiment.

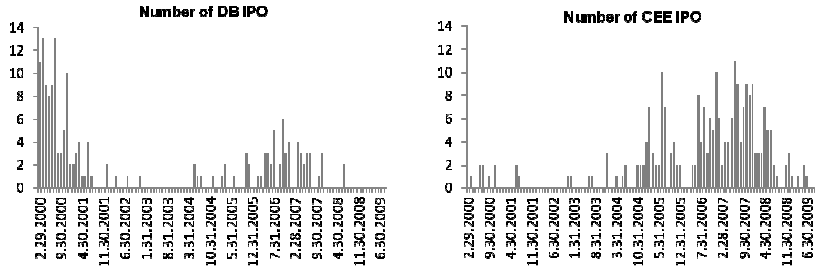
Similar to Loughran and Ritter (2004), we use several proxies for the micro factors in order to analyze the relationship between underpricing and the performance of companies before their IPO decision, i.e. ROE and the income-to-assets ratio one year before the IPO. Furthermore, we add share volatility (standard deviation of the daily returns for the first 30 days after the first trading day) as a proxy for ex-ante uncertainty. Many authors (e.g. Rock, 1982; Ritter, 1984; Ausenagg, 2006, Goergen *et al.*, 2009) use a similar proxy to show that the IPO company's risk is positively related to the first-day returns. We then add the market's climate and some of the macro indicators.

For Hypotheses 4 and 5, we identify the outliers with scatterplots for the dependent variable and the various independent variables and reduce the sample by excluding index-adjusted initial returns over 150% and ROEs below -100%. Then we run the regressions with univariates to identify the relevant variables to be included in the multivariate regressions. To verify that the different groups of proxies capture the distinct factors, we also examine the correlation between the independent values. Taking into account the correlations between the independent variables and in order not to combine the correlated independent variables in the same regression, we develop several model specifications for Hypotheses 4 and 5.

The choice of proxies in many ways depends on the available data and available micro and macro indicators for CEE for the observed period. We could also use other determinants as proxies, such as the same macro indicators but for different time periods and mutual funds, but due to their high correlation with the chosen ones, we ignore them in the regression analysis and use those proxies that report the highest statistical significance.

We do not report the results for the indicators that do not provide statistically significant relations with the number of IPOs or underpricing. Nor do we report any mixed results, such as the micro performance factors (i.e. sales-to-assets ratio, leverage measured by the net debt-to assets-ratio); the indicator for asymmetric information (represented by the IPO's value and measured as a product of the IPO's [offering] price and the number of shares being offered [primary and secondary shares included], as well as by the IPO's market capitalization); the pre-IPO structure (dummy of family/state owned IPOs); or the significance of ownership dilution (measured by the share of secondary and primary shares in the IPO).

Figure 5 Number of IPOs in CEE (left) and on the Deutsche Boerse (right), 2000–2009



Sources: CEE stock exchanges and companies, Deutsche Boerse, authors' own calculations.

Table 5 Autocorrelation of the Monthly Number of IPOs in CEE

Period	No. of IPOs	Autocorr.	*t*-stat.	Stationary test[a]
1.2.2000–31.12.2009	246	0.684***	10.139 (0.000)	true
1.5.2004–31.12.2009	227	0.579***	5.773 (0.000)	true
1.1.2005–31.12.2007	172	0.393***	2.490 (0.003)	true

Notes: The *t*-statistics and *p*-values (in parentheses) indicate the level of significance of autocorrelation for the monthly number of IPOs. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. [a] The stationary test is an augmented Dickey-Fuller (ADF) test at the 5% significance level for constant and trend.

6. Results

6.1 IPO Cycles

To answer our question as to whether IPOs in CEE are cyclical, we calculate the autocorrelations for the number of IPOs and the average underpricing at a monthly frequency. *Figure 5* and *Table 5* report that there are IPO cycles in CEE that have a first-order autocorrelation of 0.68 for the period from 2000 to 2009, which confirms Hypothesis 1. We also calculate the first-order autocorrelation separately for the most active period (*Table 5*) in order to omit the effect of months with no IPOs. The first-order autocorrelations for the time series of the monthly average of the number of IPOs are all statistically significant at 0.58 and 0.39 for 2004 and 2005, respectively. These coefficients are a bit lower compared to the total sample because the months without IPOs positively impact the autocorrelation measure for the entire period between 1 February 2000 and 31 October 2009.

We also calculate the first-order autocorrelation for the time series of the monthly equally weighted average of the index-adjusted initial returns. *Table 6* and *Figure A1* in the *Appendix* show that this autocorrelation is much lower for the number of IPOs and is statistical significant only for the total sample. This result could be partly related to the fact that the samples for all three of the observed periods in *Table 6* are to some extent reduced compared to the sample in *Table 5* due to missing data on the index-adjusted initial returns. *Figure A1* in the *Appendix* shows that the monthly IPO values also indicate that the IPO value is not an indicator of the cycles. We check the autocorrelation of the IPO monthly volume and the results are diverse, which shows that the IPO volume is not relevant in determining the cycles. Small and large IPOs are conducted in hot and cold cycles.

Table 6 Autocorrelation of Adjusted Initial Returns and Correlation of the Monthly Number of IPOs and Adjusted Initial Returns in CEE

Period	No. of IPOs*	Autocorr.	*t*-stat	Stationary test[a]	Corr. coef.	*t*-stat
		Index-adjusted Initial return			No of IPOs/index-adjusted IR	
1.2.2000–31.12.2009	231	0.250***	2.779 (0.003)	true	0.276***	3.089 (0.001)
1.5.2004–31.12.2009	217	0.138	1.130 (0.131)	true	0.268**	2.263 (0.014)
1.1.2005–31.12.2007	166	0.044	0.0257 (0.340)	true	0.269*	1.628 (0.056)

Notes: * Sample reduced due to missing data on index-adjusted initial returns. The *t*-statistics and *p*-values (in parentheses) indicate the level of significance for the autocorrelation of the monthly average index-adjusted initial returns and the correlations between the number of CEE IPOs and the average index-adjusted initial returns. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. [a] The stationary test is an augmented Dickey-Fuller (ADF) test at the 5% significance level for constant and trend.

Table 7 Autocorrelation of the Monthly Number of IPOs on the Deutsche Boerse and CEE Markets

Period	No. of DB IPOs	No. of CEE IPOs	Deutsche Boerse			CEE/Deutsche Boerse	
			Autocorr.	*t*-stat.	Stat. test[a]	Correl.	*t*-stat
1.2.2000––31.12.2009	173	246	0.722***	11.297 (0.000)	true	0.079	0.852 (0.198)
1.5.2004––31.12.2009	66	227	0.405***	3.603 (0.000)	true	0.400***	3.541 (0.000)
1.1.2005––31.12.2007	58	172	0.223*	1.335 (0.095)	false	0.217*	1.296 (0.102)

Notes: The *t*-statistics and *p*-values (in parentheses) indicate the level of significance for the autocorrelation of the monthly number of IPOs and the correlations between monthly number of IPOs in CEE and on the Deutsche Boerse. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. [a] The stationary test is an augmented Dickey-Fuller (ADF) test at the 5% significance level for constant and trend.

In order to test Hypothesis 2, we calculate the correlation coefficient for the same samples as for the autocorrelations of the initial returns (see *Table 6*). Similar to Ritter (1984) and Lowry and Schwert (2002), we find a moderately positive correlation between the number of IPOs and underpricing. This result is robust across all three time periods. We can thus confirm Hypothesis 2, which states that the volume and underpricing of the IPOs in the CEE capital markets are positively correlated.

In order to test Hypothesis 3, we add the IPO data for the Deutsche Boerse in the observed period. In contrast to Anglo-Saxon countries, Germany has a bank-based financial environment where listed companies represent only a small segment of all companies, which is similar to the environment in the CEE countries. This similarity makes Germany the most suitable market with which to compare the CEE capital markets.

There were 173 IPOs on Deutche Boerse with a total value of EUR 37.9 billion between 2000 and 2009 (see *Figure 5*). *Figure 5* and *Table 7* report that there are

IPO cycles on the Deutsche Boerse that have a first-order autocorrelation of 0.72 for the time series of the monthly average number of IPOs (0.41 for the period between 1 May 2004 and 31 October 2009 and 0.22 for the period between 1 January 2005 and 31 December 2007). According to the autocorrelation results, the IPO cycles are stronger on the German capital market than on the CEE capital markets when considering the total sample. The IPO hot market in Germany in 2000 is due to the dot-com bubble. This is not the case in CEE, where a high-tech IPO bubble did not have a chance to develop because of the relatively recent liberalization of the economies in the region.

Table 7 also provides a comparison of CEE's and the Deutsche Boerse's monthly IPO volume for the whole observed period and for the period without the effect of the dot-com bubble and after the accession of the CEE countries to EU. The main finding is that the correlation between these three samples is moderately positive and significant in the most relevant period between 1 May 2004 and 31 October 2009. We get the same result for the most active period between 1 January 2005 and 31 December 2007. In accordance with this result, we argue that the positive IPO trend on the Deutsche Boerse had a positive spillover effect on the IPO activities in CEE at the beginning of the second half of the 2000s, which resulted in the emergence of a hot IPO market. This result supports our Hypothesis 3, which states that there is a positive correlation between the number of IPOs in the CEE capital markets and in the EU's developed markets.

In addition, the autocorrelation coefficients on the German capital market are lower after the dot-com bubble compared to the results for the total period and for the developed IPO markets up to the 2000s (Ritter, 1984; Lowry, 2003). Thus, our results support recent findings (Gao *et al.*, 2013; Ritter *et al.*, 2013) that the lower volume is due to the lower market valuations following the collapse of the dot-com bubble. Moreover, the higher autocorrelation coefficients for the volume in CEE than for the German capital market after the dot-com bubble (*Table 5* and *Table 7*) indicate that, in contrast to the decline in the European IPO volume, the hot market in CEE blossomed in the mid-2000s. However, CEE's IPO volume declined after 2008 due to financial turmoil.

In contrast to the findings for the developed capital markets that show that regulations are to be blamed for the decline in IPOs, we find that since the middle of the 2000s, regulation that was translated from the developed capital markets to the CEE markets might have helped to foster IPO activities in CEE. Namely all of the CEE countries that joined the EU in the mid-2000s went through the process of harmonization of their national regulations with the EU rules and practices (e.g. the Prospectus Directive, the Market Abuse Directive and related regulatory frameworks).

6.2 Drivers of IPO Cycles

In *Table 8* we report the regression results for the monthly number of IPOs per each capital market as the dependent variable by using five different model specifications. In addition, in Model 6 we report the results when taking into account all of the dependent variables.

Models 1 and 2 in *Table 8* show strong support for the importance of the yearly turnover growth before an IPO, which shows the activity of the participants and their

Table 8 Drivers of IPO Cycles in CEE
***N* = 231 (1 February 2000–31 December 2009)**

Dependent variable	Monthly number of IPOs per capital market					
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Constant	-17.28 (-7.4)***	-18.67 (-7.6)***	5.56 (10.5)***	3.91 (6.3)***	-20.62 (-8.04)***	-8.6 (-2.63)*
GDP 2				1.89 (8.6)***		0.67 (2.09)**
GDP 2q					14.84 (3.58)***	9.28 (1.82)*
IP 1		0.22 (2.53)***			0.26 (3.19)***	0.07 (0.63)
Bond 2	-50.14 (-5.23)***		-58.87 (-5.65)***	-42.9 (-4.19)***		-54.8 (-5.5)***
Index				0.99 (0.83)		1.17 (0.17)
Turnover	0.88 (10.46)***	0.82 (8.99)***				-0.32 (-0.95)
Invest. funds			0.18 (9.32)***			0.09 (4.3)***
Pension funds					0.89 (9.16)***	0.98 (2.7)***
Adj. *R*-squared	0.390	0.336	0.346	0.314	0.390	0.517
P-value (*F* stat)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See *Table 4* for the specifications of the variables. The figures in parentheses are *t*-statistics. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

market volume and thus represents investor sentiment. As shown in Model 4, the capital market's performance, which is measured by the average benchmark index return before an IPO, has a positive yet insignificant impact. The business cycle is measured by GDP growth and the change in GDP growth two quarters before an IPO (see Models 4 and 5), the change in industrial production one quarter before an IPO (see Models 2 and 5) and the yields to maturity of government bonds two quarters before an IPO (see Models 1, 3 and 4). We check the different lag-specifications in the regressions with GDP growth, change in industrial production change and bond yields. We find that the results are the most significant for the indicators two quarters before an IPO. All of the models in *Table 8* support the thesis that investor sentiment and the business cycles have a positive impact on IPOs.

Model 3 in *Table 8* estimates the impact of the investment funds' relative portfolio allocations to equity, which is a measure of risk aversion and again represents investor sentiment. The impact is positive and highly significant. Model 5 in *Table 8* also shows the positive impact of the growth in pension funds one year before an IPO, which again represents investor sentiment. The results in Model 6 show that the strongest IPO drivers are business cycles, which are represented by government bonds' price movements and investor sentiment. The results thus strongly support the positive relationships among investor sentiment and business cycles, the different variables and the number of IPOs, which is in line with many

Table 9 Drivers of IPO Underpricing in CEE
***N* = 231 (1 February 2000–31 December 2009)**

Dependent variable	Index-adjusted initial return					
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Constant	0.14 (1.39)	0.13 (1.32)	-0.11 (-1.84)*	-0.11 (-1.90)*	0.22 (2.56)**	0.08 (0.70)
ROE		0.001 (1.81)*		0.001 (1.76)*		0.001 (0.74)
Income	0.26 (1.72)*		0.26 (1.67)*			0.13 (0.55)
Volatility	2.34 (2.62)***	2.45 (2.77)***	2.60 (2.90)***	2.70 (3.04)***	2.63 (3.55)***	2.42 (2.69)***
Index	0.52 (2.90)***	0.54 (3.00)***	0.46 (2.54)**	0.48 (2.65)***	0.67 (4.16)***	0.51 (2.81)***
GDP	0.46 (1.70)*	0.51 (1.89)*	0.63 (2.37)**	0.68 (2.55)**		0.53 (1.90)*
Bond 3	-3.59 (-2.60)***	-3.56 (-2.58)**			-3.92 (-2.46)**	-3.00 (-2.00)**
Industry production 2			0.02 (1.95)*	0.02 (1.92)*		0.01 (1.98)
Adj. *R*-squared	0.129	0.131	0.111	0.113	0.124	0.126
P-value (*F* stat)	0.000	0.000	0.000	0.001	0.000	0.000

Notes: See *Table 4* for the specifications of the variables. The figures in parentheses are t-statistics. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

reported findings (Lowry, 2003; Benninga *et al.*, 2005; Meluzin *et al.* 2013). We have checked the heteroscedasticity-consistent standard errors and run the regressions with the robust standard errors for the original sample, which provided even more robust results with higher *R*-squared results.

To check the robustness of the sample, we run the regression for the sample covering the period from 1 January 2005 to 31 December 2007. This robustness test confirms our results (see *Table A1* in the *Appendix*). Therefore, we can conclude that, apart from the macroeconomic cycle, the most relevant macro driver for IPOs in CEE in the 2000s was investor sentiment as represented by either the activities of the market participants, the aggressiveness of the capital allocations in investment funds, or the size of the pension funds' portfolios.

6.3 Drivers of IPO Underpricing

Table 9 summarizes the results of the multiple regressions for Hypothesis 5. We perform the regressions on the total available sample for the initial index-adjusted returns of 231 IPOs as the dependent variable, and various micro and macro drivers of IPO underpricing.

We find that underpricing is significantly impacted mostly by the performance of the stock market 90 days before an IPO, which relates to the market's climate and

investor sentiment. This result is very robust and is present in all five models. This is in line with the findings of Lyn and Zychowicz (2003) for Hungary and Poland, Aussenegg (2006) for Austria, and Jewartowski and Lizińska (2012) for Poland. Therefore, we can argue that the market's climate is the primary determinant of the initial returns and thus the IPO driver in CEE in the observed period. Thus, the higher the performance of the market before an IPO, the greater the underpricing is, which consequently could result in a higher number of IPOs. The results are consistent with many empirical findings for developed markets as well (Lowry 2003; Guidici and Roosenboom, 2006; Goergen *et al.*, 2009).

Equally to the market's climate, volatility also indicates the degree of riskiness in the issuing companies and has a very strong effect on underpricing. All of the models show that underpricing is significantly greater when the volatility of the share price is higher, which is again in line with many studies (Rock, 1982; Ritter, 1984; Ausenagg, 2006; Goergen *et al.*, 2009; Jewartowski and Lizińska, 2012). This result supports the ex-ante uncertainty theory; hence riskier companies are more underpriced. However, this result should be interpreted with some caution. Specifically, in order to check the robustness of our results, we perform the same regressions with only the dependent variables for the largest 88 IPOs. We add these variables into all of our models. The results are reported in *Table A2* in the *Appendix*. We find that for larger IPOs, the volatility effect is much weaker than for their smaller counterparts. The volatility coefficients are still positive, but significantly lower than those within the group of smaller IPOs. We argue that in the case of larger (probably more transparent) IPOs, the companies' level of riskiness is less of a decisive factor in underpricing.[3] Since smaller and delisted IPOs are most probably less transparent than other IPOs, this result is reasonable and confirms the ex-ante uncertainty when these IPOs are included in the sample. We check the same regressions for only small IPOs and find significantly positive results for volatility, which confirms this assumption.

The first four models in *Table 9* also show some modestly significant effects of company performance on underpricing, measured either by the ROE or income performance one year before an IPO. Due to the relatively high correlations, these indicators are used separately in different regressions. The companies with higher ROE or higher income performance exhibit a greater level of underpricing, which is similar to the findings of Jewartowski and Lizińska (2012) and Lizińska and Czapiewski (2014) for Poland. Based on our results for all six models, we confirm that business cycles have a significantly positive impact on underpricing. Perhaps this is a reflection of the investor structure in the capital market during economic booms, when a higher proportion of uninformed investors participate in the IPO market, which might result in greater underpricing as well as a higher number of IPOs.

Both business cycles and (to some extent) company performance are also confirmed as drivers of underpricing in the case of IPOs with values above EUR 10 million (sample $N = 88$) (see *Table A2* in the *Appendix*), though these results

[3] This is also in line with the observation made by Peterle (2014) that the majority of larger CEE IPOs in the 2000s were carried out with international underwriters, who apparently require higher transparency standards and thus reduce asymmetric information.

are somewhat weaker. Thus, our results for Hypothesis 5 are mostly confirmed for both subsamples. In addition, we have checked the heteroscedasticity-consistent standard errors and run the regressions with the robust standard errors for the original sample, which provided less significant results for company performance (ROE and income) and volatility, but more robust overall results with higher *R*-squared results.

We also check other assumed determinants of IPO activity: pre-IPO ownership structure, ownership dilution, and leverage of companies prior to IPOs. However, these provide mixed or insignificant results. Therefore, we can conclude that in addition to the current conditions of the capital markets, which relate to investor sentiment, business cycles and (to some extent) the given company's performance before the IPO are indicators of underpricing. However, the other company-specific indicators typically tested in the literature are not. The economic message conveyed by our results is that macro and sentiment factors are much more important determinants of underpricing than are micro characteristics. Issuers should thus perhaps focus much more on transparency than on timing the transaction based on the performance of their companies in order to build trust with prospective investors.

7. Conclusions

Based on a sample of 246 IPOs, we show that IPO cycles existed in CEE in the 2000s. Many of the companies in this region decided to go public at about the same time, meaning that their IPOs were clustered. We prove this phenomenon by means of autocorrelation of the IPO volume in the observed period. However, the results with the autocorrelation of the initial returns (a less straight-forward IPO cycle measure) are more diverse. They do not confirm statistical significance in the case of shorter hot periods. Still, in line with many findings for developed capital markets, we prove that there are positive correlations between IPO volume and underpricing. Thus, the periods with higher numbers of IPOs also have higher average adjusted initial returns.

Furthermore, we provide a unique comparison between CEE's IPO cycles with those in the EU's developed capital markets by using the Deutsche Boerse as a proxy. We use this proxy because the German bank-based financial environment is similar to the environment in the CEE countries with a relatively small number of listed companies. First, in line with recent studies (e.g. Ritter *et al.*, 2013) we indicate that the magnitude of the IPO cycle on the EU's developed capital markets (e.g. Deutsche Boerse) declined in the 2000s after the dot-com bubble. Secondly, we show the positive and significant correlation between IPO volume in CEE and on the Deutsche Boerse in the period after May 2004, when the effect of the dot-com bubble on the Deutsche Boerse had long since vanished and some of the CEE countries acceded to the EU. Contrary to some recent findings for developed capital markets that regulations are to be blamed for the decline in IPOs, we argue that the common regulation that was translated from developed capital markets to the CEE markets helped to foster IPO activity in CEE. This happened because most of the capital markets in CEE were established in parallel with the liberalization of the CEE countries' economies approximately two and a half decades ago. However, after 2008 CEE's IPO volume declined following the financial turmoil brought about by the global economic crisis.

Confirmation of the existence of hot and cold markets leads to the next interesting question: what are the drivers of hot markets in CEE? To answer this question, we divide the potential factors into two groups, those that relate to broader economic factors (macro factors) and those that relate directly to the companies' decision to "go public" (micro factors). Our results for the macro determinants show that the most relevant drivers for the IPO volume in the 2000s is investor sentiment and business cycles, which is in line with many reported findings (e.g. Lowry, 2003; Benninga *et al.*, 2005; Meluzin *et al.*, 2013).

Based on our confirmed hypothesis that underpricing and IPO volume are positively correlated, we also use underpricing to study IPO factors. Our results suggest that the market's climate is the primary determinant of underpricing and thus an IPO driver in CEE. We show that the higher performance of the capital market before an IPO, which relates to investor sentiment, leads to greater underpricing, which could again further result in a higher volume of IPOs. Furthermore, our results show that underpricing is significantly greater in the case of higher volatility of the share price, which confirms the ex-ante uncertainty theory that riskier companies are more underpriced. The results are stronger within the group of smaller companies. This result is reasonable and confirms the existence of ex-ante uncertainty when we consider small IPOs, which are less transparent and riskier than other IPOs. Therefore, we argue that riskier and usually smaller companies decide to go public during a hot market when underpricing is greater.

Our results further show some significantly positive effects of company performance, measured by ROE, and business cycles, measured by yearly GDP growth and quarterly interest rates, on underpricing. We interpret these results as more uninformed investors participating in the IPO market during economic booms, which results in greater underpricing and consequently a higher number of IPOs. The other determinants—pre-IPO ownership structure, ownership dilution, and a company's leverage before an IPO—show mixed or insignificant results for the regressions on underpricing.

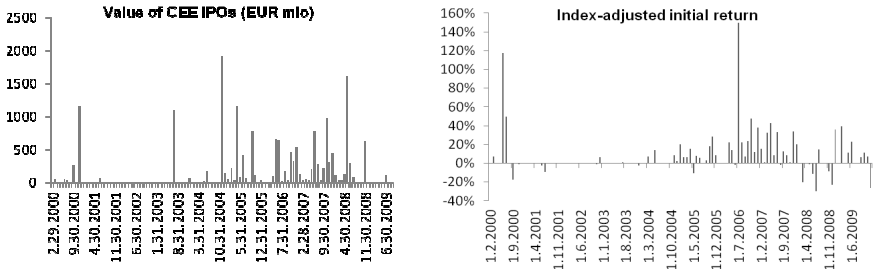
We can conclude that the main IPO drivers in CEE are similar to those for developed capital markets, as our results are generally consistent with the evidence found by many IPO studies. Our outcomes also provide welcome implications for policy-makers, issuers and investors on smaller emerging markets. We highlight investor sentiment as one of the most important IPO drivers. Therefore, the basic functioning of the capital markets is not sufficient to provide efficient capital-raising on the stock exchanges in emerging regions. Policy-makers should provide an attractive investment environment and develop a strong investment culture with an established investment and pension fund industry. Besides favorable business conditions and investor sentiment, the main positive indicator for potential new IPOs is a positive climate on local emerging capital markets. Consequently, issuers who also decide to undertake an IPO in CEE should focus on hot markets and use these periods as a window of opportunity to conduct their IPOs. For issuers, ensuring that there is as much information as possible during the IPO to reduce the riskiness of the company is also valuable. Based on our results, we argue that such transparency is a more relevant factor than the company's performance before the IPO transaction. On the other hand, investors should be aware that in the emerging CEE markets, risker (usually smaller) companies tend to execute IPOs during hot markets;

therefore, investors can expect higher volatility of such companies' share prices after their listing.

Besides macro and micro factors, further research should focus also on institutional factors like the role of the selected underwriter, participation of foreign investors in the offerings and other institutional and cultural differences. Such work will, however, require systematic data-gathering, as such data is currently not readily available.

APPENDIX

Figure A1 IPO Value (left) and Average Index-Adjusted Initial Return (right) in CEE, 2000–2009



Sources: CEE stock exchanges and companies, authors' own calculations.

Table A1 IPO Drivers in the CEE
***N* = 166 (1 January 2005–31 December 2007)**

Dependent variable	**Monthly number of IPOs per capital market**					
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Constant	-25.01 (-8.03)***	-28.64 (-9.32)***	6.29 (10.95)***	4.80 (5.75)***	-25.62 (-8.85)***	-13.87 (-2.61)***
GDP 2				1.52 (4.83)***		0.83 (1.89)*
GDP 2q					12.57 (2.06)**	17.88 (2.35)**
IP 1		-0.07 (-0.58)			0.02 (0.15)	-0.08 (-0.51)
Bond 2	-34.27 (-3.21)***		-80.19 (-6.35)***	-38.31 (-3.03)***		-57.30 (-4.68)***
Index				-3.70 (-1.65)		-1.12 (-0.43)
Turnover	1.15 (10.43)***	1.23 (10.71)***				-0.06 (-0.12)
Invest. funds			0.21 (7.62)***			0.08 (2.32)**
Pension funds					1.11 (9.99)***	0.76 (1.65)*
Adj. *R*-squared	0.448	0.418	0.320	0.241	0.425	0.461
P-value (*F* stat)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See *Table 4* for the specification of the variables. The figures in parentheses are t-statistics. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table A2 Drivers of IPO Underpricing in CEE
***N* = 88 (1 February 2000–31 December 2009)**

Dependent variable	Index-adjusted initial return					
Independent variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Constant	0.17 (1.05)	0.15 (0.88)	-0.20 (-1.68)*	-0.22 (-1.84)*	0.27 (2.42)**	0.08 (0.42)
Constant_88	-0.13 (-0.60)	-0.12 (-0.56)	0.20 (1.44)	0.21 (1.47)	-0.12 (-0.67)	-0.12 (-0.49)
ROE		0.001 (2.47)**		0.001 (2.53)**		0.001 (1.36)
ROE_88		-0.002 (-1.75)*		-0.002 (-1.90)*		-0.001 (-0.58)
Income	0.35 (2.08)**		0.34 (1.99)**			0.006 (0.02)
Income_88	-0.69 (-1.73)*		-0.74 (-1.83)*			-0.64 (-1.06)
Volatility	4.65 (3.01)***	5.00 (3.31)***	5.88 (3.99)***	6.15 (4.25)***	3.00 (3.39)***	5.09 (3.24)***
Volatility_88	-4.00 (-2.09)**	-4.37 (-2.34)**	-5.15 (-2.80)***	-5.48 (-3.02)***	-1.09 (-0.66)	-4.40 (-2.30)**
Index	0.68 (2.75)***	0.67 (2.74)***	0.68 (2.75)***	0.68 (2.75)***	0.61 (3.18)***	0.68 (2.77)***
Index_88	-0.32 (-0.90)	-0.33 (-0.92)	-0.42 (-1.17)	-0.44 (-1.20)	0.16 (0.46)	-0.40 (-1.06)
GDP	0.31 (0.56)	0.39 (0.70)	0.52 (0.94)	0.60 (1.08)		0.46 (0.83)
GDP_88	0.21 (0.32)	0.12 (0.18)	0.02 (0.04)	-0.07 (-0.12)		0.11 (0.18)
Bond 3	-5.34 (-2.76)***	-5.12 (-2.66)***			-5.34 (-2.62)***	-4.46 (-2.13)**
Bond 3_88	4.98 (1.81)*	4.81 (1.75)*			3.52 (1.07)	5.16 (1.71)*
Industry production 2			0.02 (1.75)*	0.02 (1.78)*		0.01 (0.86)
Industry production 2_88			-0.001 (-0.05)	-0.003 (-0.15)		0.01 (0.47)
Adj. *R*-squared	0.173	0.179	0.155	0.163	0.119	0.175
P-value (*F* stat)	0.000	0.000	0.000	0.000	0.000	0.000

Notes: See *Table 4* for the specifications of the variables. Variables X_88 represent the product of variable X and dummy 1 if the IPO is part of Sample *N* = 88 and 0 if the IPO is not part of that sample. The figures in parentheses are *t*-statistics. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

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