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Drivers of Private Equity Investment in CEE and Western European Countries*

Kerstin Bernoth†, Roberta Colavecchio‡, Magdolna Sass§

28 April 2010

Abstract A strong private equity market is a cornerstone for commercialization and innovation in modern economies. However, substantial differences exist in the relative amounts raised and invested in private equity across European countries. We investigate the macro-determinants of private equity investment in Europe, focusing on the comparison between CEE and Western European countries. Our estimations are based on a data set running from 2001 to 2008 and covers 14 Western European and three CEE countries. Applying robust estimation techniques we identify a 'robust' set of determinants of private equity activity in both regions. We find similarities as well as differences in the driving forces of private equity investments in Western European and CEE countries. Our results suggest that commercial bank lending, equity market capitalization, unit labour costs and corporate tax rates are significant determinants of private equity activity.

JEL classification: C23, C52, E22, G24
Keywords: Private Equity, Extreme Bounds Analysis, Central and Eastern European Countries

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1 Introduction

Private equity (PE), which was relatively unknown in the early 1980s, has become an important asset class in global financial markets.[1] A number of studies have documented the key role that PE plays in a country's entrepreneurial performance as PE-backed firms create more innovations, employment and growth than their peers. There now exists a broad consensus that a strong PE market is a cornerstone for commercialization and innovation in modern economies.[2]

Notwithstanding the positive impact of PE activity on economic wealth, there exist substantial differences in the relative amounts raised and invested in PE across industrialized as well as developing countries. In particular, countries like the US or the UK feature a strong market for this asset class, while in Japan the level of PE intensity is rather low. As far as Europe is concerned, despite the considerable growth of PE investments over the last decade, the diversities in PE activity across countries are still significant. Different developments can be identified amongst Western European countries (Schertler (2003)) but they are even more pronounced when the comparison is between Western and Central and Eastern European (CEE) countries.[3] In particular, the PE industry has a much shorter history in the CEE region than in Western Europe and the volume of the investments as a fraction of GDP in CEE is - although increasing rapidly recently - significantly lower than in the rest of Europe.

Given the widely-documented positive impact of PE activity on economic development and entrepreneurship, understanding the determinants of PE industry has been a primary goal for both academics and regulators. Nonetheless, there is still no broad consensus on the macro-determinants of PE investments and the literature focussing on the CEE countries in the attempt

[1] In broad terms, PE indicates the provision of equity capital to unlisted companies and includes several investment stages: venture capital (VC), buyouts and restructuring. In particular, VC provides equity funding to younger, small and relatively high-risk companies featuring strong growth potential; while leveraged buyouts and restructuring deals usually target more mature firms where substantial gains in operational efficiency are expected to materialise.

[2] Empirical evidence on the economic impact of PE is provided, for example, in the work of Levine (1997), Hellmann and Puri (2000), Kortum and Lerner (2000), Belke et al. (2003), and Fehn and Fuchs (2003).

[3] CEE comprises the countries of Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

to explain the region's major obstacles to catching up with the developed markets is relatively scarce (compare e.g. Farag et al. (2004) and Groh and von Liechtenstein (2009)).

In this paper, we aim to identify the macroeconomic determinants of PE investment focussing on a comparison between CEE and Western European countries. In particular, this paper tests whether financial market conditions, business confidence, liquidity of the stock markets, human capital endowment and regulation in the labour market are driving forces of PE activity and to what extent such forces differ in Eastern and Western European countries. Our estimations are based on a data set that covers annual data running from 2001 to 2008 for 14 Western European and three CEE countries.

In the related literature many different variables have been suggested to be potential determinants of PE activity, but only few studies control for the variables analysed by others. We tackle the problem of model selection under uncertainty by applying first a so called 'Extreme-Bounds Analysis' (EBA) proposed by Sala-i-Martin (1997). The idea of this approach is to estimate a large set of model specifications and to check how sensitive the estimated coefficient of each variable is to the inclusion of additional explanatory variables. Thus, a major contribution of our paper is the identification of a set of determinants that are 'robustly' correlated with PE activity in the two regions. In a second step, we apply a fixed-effects panel estimation approach to estimate the determinants of PE investments. The choice of regressors is motivated by the results of EBA in the sense that the panel estimations are based only on 'robust' variables. This has the advantage that we can reduce substantially the set of regressors, which becomes especially important for small data samples like ours.

We find similarities as well as differences in the driving forces of PE investments in Western European countries and CEE countries. In both regions, PE investment is positively affected by the size of commercial bank lending relative to GDP and by the size of equity market capitalization, however, both effects are much stronger for CEE countries than for Western European countries. Western European countries attract more PE capital when their real GDP level is low but their growth pace is fast and when the growth rate. Contrarily, PE flows to CEE countries are unaffected by economic growth aspects. The growth rate of unit labour costs has a significant negative impact on PE investments in Western Europe, while investment decisions in Eastern European countries stay unaffected by the pace of wage growth. Further, corporate tax incentives play a significant role in attracting PE investments

in CEE countries but not in Western European countries.

The reminder paper is structured as follows. Section 2 gives a short overview of PE and venture capital (VC) industry in Europe over the last decade. Section 3 reviews the literature on the macro-determinants of PE and VC. In Section 4, the estimation method and the data are described together with the main estimation results. Section 5 concludes.

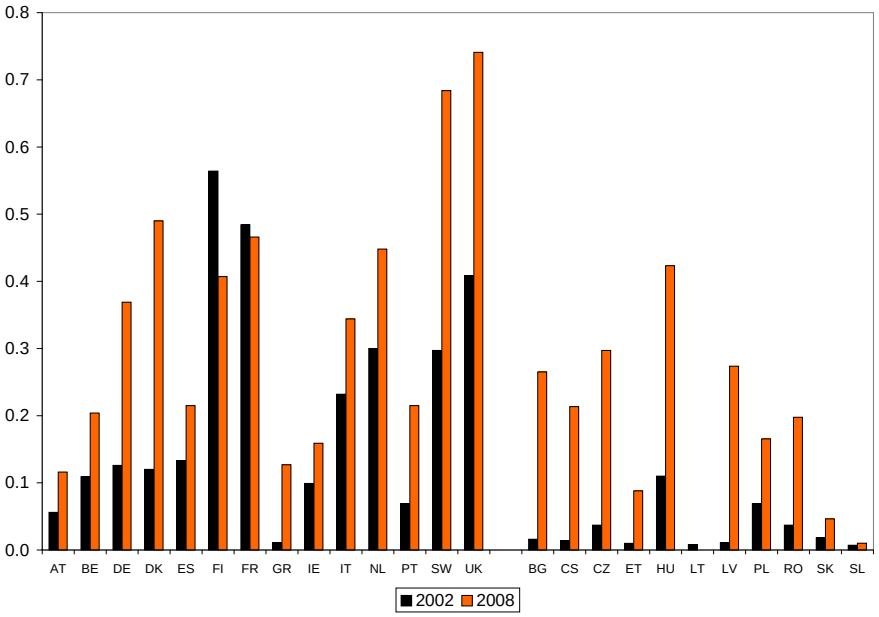
2 Private Equity Investment in Europe

Until the late 1990s in Europe, the market for leveraged loans remained small and was largely dominated by banks. Because loans were privately placed, the barriers to entry, such as information gathering and screening technology, were high for non-bank and retail investors. Since the early part of the current decade, favourable global market conditions have led to a significant growth in the PE markets. Nonetheless, European comparisons reveal that there are large differences in PE activity across countries.

On national levels, the PE activity is often measured as the volume of PE investments related to the size of the economies, i.e. their GDP. PE investments represented 0.27% of the EU GDP in 2002 and in 2008 this proportion rose to 0.40%. A comparison with the CEE figures reveals that the CEE region is still far below the average of Europe as a whole. In 2002 the ratio of PE investment to GDP in CEE was 0.05% and rose to 0.21% in 2008. Despite such a remarkable improvement, the CEE share is still only half of the Europe-wide average.

Figure 1 presents the volume of PE investments as a fraction of GDP in the years 2002 and 2008 for several Western European and CEE countries. The histogram shows a significant increase of PE investments in all the considered countries, with the exception of Finland and France, which both experienced a decline in PE activity. Moreover, between 2002 and 2008 Finland and France lost their leading positions in the ranking of countries by investment as percentage of GDP to UK and Sweden, whose PE investment to GDP ratio between 2002 and 2008 increased from 0.40% to 0.74% and from to 0.30% to 0.68%, respectively. However, Figure 1 also reveals the presence of a few other PE "hot spots" in Europe besides the four abovementioned countries: Denmarks share rose from 0.12% in 2002 to 0.49% in 2008 while in the Netherlands PE investments grew from 0.30% of GDP in 2002 to 0.45% in 2008. Gemany and Portugal were the countries which experienced

Figure 1: PE investment as % of GDP



the most remarkable increase in PE activity over the considered time span. Their PE investments to GDP ratio increased from 0.13% to 0.37% and from 0.07% to 0.22%, respectively.

PE activity in CEE more than doubled between 2002 and 2008 and PE financing has rapidly gained acceptance as a permanent part of the CEE region's capital markets. The conditions for PE in CEE continue to develop in a positive way and the difference between Western and CEE markets has been shrinking rapidly. Nonetheless, the development of PE in CEE is still at a relatively early stage, as the bulk of fund raisings and investments did not start until the mid and late 1990s and hence many of the private equity projects so far have not yet completed a full cycle of investments and exits. According to 2008 figures, PE investment in CEE proved resilient in the face of global downturn, with investment activity remaining highly concentrated in the region. Five countries - Poland, Hungary, the Czech Republic, Ukraine and Romania - accounted for 86% of the total investment amount.

3 Macro-determinants of PE and VC activity: a brief literature review

Over the last decade a growing body of literature has focussed on the macro-economic environment spurring active PE markets and an increasing number of studies have attempted to quantitatively evaluate the determinant of PE investing in particular economies. An important step towards the assessment of the competitive position of countries regarding the reception of risk capital funding is made by Groh and Liechtenstein (2009a and 2009b), who perform a survey among institutional investors to shed some light on the relevance of the abovementioned issues when allocating PE in emerging markets. The authors find that protection of property rights and corporate governance are perceived as most important for international PE allocation decisions, followed by the assessment of the management quality of local GPs and entrepreneurs according to Western management standards. Other relevant criteria turn out to be the expected deal flow, and the degree of bribery and corruption. Surprisingly, according to Groh and Liechtenstein (2009a and 2009b), institutional investors in PE are not impressed by government programs to spur local risk capital markets: the availability of public funding plays no role in allocation decisions.

Black and Gilson (1998) find a relationship between the degree of development of a country's stock market and the overall volume of VC investments. They claim that that the comparative advantage of the U.S. VC industry is indeed the existence of a strong initial public offering (IPO) market, which in turn represents a potential exit strategy for VC investors. Building on the work of Black and Gilson (1998), Jeng and Wells (2000) develop a framework aiming at assessing the macro determinants of VC investments and test it on a panel data set spanning over 10 years and 15 countries. In particular, as explanatory factors for VC investing the authors consider: IPOs, GDP growth, labor market rigidities, accounting standards, private pension funds, government programs and market capitalization growth. The inclusion of the latter variable rests on the idea that increases in market capitalization create a more favorable environment for investors in general. Therefore, increases in market capitalization should be met by greater supply of funds to venture capital investments. They conclude that IPOs are the strongest driving force of PE investing, while market capitalization turns out to be insignificant, which is not surprising given the fact that it is closely related to IPOs. The

importance of IPO markets is underlined as well by Bonini and Alkan (2009), who employ a panel data set of 16 countries, and 15 explanatory variables from 1995 to 2002. They find that active IPO markets are significant factors in explaining the cross-country variation of the levels of investment. Gompers and Lerner (1998), however, find the contrary. Focussing on the forces that affected independent VC fundraising in the U.S. over the period 1969-1994 they use IPOs as a proxy for fund performance and find no significant effect of the IPO variable on real VC investment.

Several papers show that also GDP growth plays a significant role in attracting PE investment. Gompers and Lerner (1998) find that higher GDP growth implies higher attractive opportunities for entrepreneurs, which in turn lead to a higher need for venture funds. While Jeng and Wells (2000) do not find a significant effect of GDP growth on VC investments, Romain and van Pottelsberghe de la Potterie (2004a) and Bonini and Alkan (2009) also confirm the positive relationship between risk capital and GDP growth.

Gompers and Lerner (1998) and Bonini and Alkan (2009) argue that the level of interst rates in a country might be relevant in attracting VC. One theory is that level of interest rates should affect negatively the supply of venture capital since a high level of real interest rates reduces the attractiveness of risky investments. In line with this theory, Bonini and Alkan (2009) find a significant negative effect of the level of interest rates on early-stage VC investments. On the contrary, Gompers and Lerner (1998) show that the US Treasury bill return in the previous year affects positively the demand for VC funds in the US. A possible explanation of Gompers and Lerner's result is that they use a short-term interest rate. If short-term interest rates increase, the attractiveness of venture financing versus credit through usual financial institutions increases from the entrepreneur's viewpoint. The authors' explanation is that interest rates affect also bank financing costs and when bank financing becomes more costly VC may be a better and more flexible alternative to raise funds for a new venture.

Concerning the impact of capital gains tax rates on VC activity, Gompers and Lerner (1998) conclude that a decrease in the corporate tax rate has a positive and significant impact on commitment to new VC funds. Similarly, Bruce (2000 and 2002), Cullen and Gordon (2002) and Bonini and Alkan (2009) find that taxes affect significantly the entry of businesses. Focussing on CEE countries, Groh and Lichtenstein (2009) find in their survey among institutional investors that low corporate taxes (on average) are the strongest incentive for investors to invest in these emerging markets. This result is

confirmed by the United Nations (2004), who report that CEE governments try to attract investors with low corporate tax rates and tax incentives within the European Union accession process.

La Porta et al. (1997 and 1998) highlight that a country's legal environment strongly affects the size and extent of its capital market and plays a major role in local firms abilities to receive outside funding. Different degrees of investors protection, shareholders rights and enforceability determine the amount of capital raised and invested and the way it is split between debt, equity and other securities. More recently, Desai et al. (2006) investigate the influence of institutional settings in 33 European countries, addressing the issues of fairness and the protection of property rights, on the entry of enterprises into the markets. The authors used the number of new enterprises as proxy for the demand for PE. Cumming et al. (2006) show that the quality of a country's legal system matters more than the size of a country's stock market when it comes to facilitating PE-backed exits. Building on this result, Cumming et al. (2010) conclude that cross-country differences in legality have a significant impact on the governance of investments in the PE industry. The underlying idea is that better laws facilitate investors' board representations and simplify the origination and the screening of the deals. Moreover, Bonini and Alkan (2009) show that VC investments are positively correlated with the quality of the entrepreneurial environment and that a favourable socioeconomic and investment environment has a strong and positive impact on the inception and development of VC investment activity.

Schertler (2003) uses dynamic panel estimations to identify the drivers of VC activity in 14 Western European countries between 1988 and 2000. The study emphasizes that the liquidity of stock markets (proxied by either stock market capitalization or the number of listed firms), human capital endowment (proxied by the number of employees in the R&D field and the number of patents) and labour market rigidities significantly affect (early-stage) VC investments.[4] In particular, rigid labour market policies might negatively affect the attractiveness of a PE market. Institutional investors could hesitate investing in countries with exaggerated labour market protection and immobility. Jeng and Wells (2000) also find that labour market

[4]In contrast to Jeng and Wells (2000), Schertler (2003) finds that liquidity of stock markets significantly affects early stage investments rather than expansion stage VC investments. These opposing results could be originated by differences in the specification of the proxy variables.

rigidities[5], government programs for entrepreneurship and bankruptcy procedures contribute to explain a significant part of cross-country variations in VC investments. Further, Bonini and Alkan (2009) and Gompers and Lerner (1998) give evidence that a significant positive correlation between R&D expenditure and VC activity exists and Romain and van Pottelsberghe de la Potterie (2004b) find that the level of entrepreneurship interacts with the R&D capital stock, technological opportunities, and the number of patents.

So far the literature analysing the determinants of PE activity in the CEE region in the attempt to explain the region's major obstacles to catching up with the developed markets is scarce. Farag et al. (2004) focus on the VC and PE markets in Hungary, the Czech Republic and Poland, and compare them with the German market. Using the results of a survey conducted among 68 General Partners (GPs) in diverse transition countries, they identify several factors that inhibit emerging markets' catching up. In particular, they claim that major obstacles are the lack of skilled managers for the PE-backed enterprises[6], together with the limited availability of debt financing. In the authors' view, legal and institutional improvements aimed at protecting potential lenders would stimulate growth in the supply of risk capital. In contrast, access to bank financing does not represent an issue in emerging regions according to the analysis of Johnson et al. (1999), who rather emphasize the relevance of the protection of property rights. These results are consistent with those of Klonowski (2005). In his work, the author lists 26 decision criteria for individual transactions in emerging economies, and identifies the most important ones on the base of a survey among 200 GPs. The recent work of Karsai (2009) provides a comprehensive overview of the developments of the PE and VC industry in CEE between 2002 and 2008 and speculates on the future effects of the global financial crisis and recession on the region's PE market. In the author's assessment the region's decline in VC and PE investments will take place in a delayed and relatively moderate fashion. In particular, the major part of the extremely large amount of capital raised over the last five years is expected to remain invested and the decrease foreseen for the coming one or two years will be milder than the one experienced by other developed markets. However, fundraising for new funds is expected to become more difficult due to the shortage of money of

[5]Jeng and Wells (2000) find that labour market rigidities do not significantly influence total VC but affects negatively the early stage of VC investment.

[6]This finding is in line with Bliss (1999), Karsai et al. (1998), and Chu and Hisrich (2001).

the most significant investors of funds.

4 Estimations

4.1 Estimation Methodology

Since there exists no consensus theoretical framework to guide empirical work on the choice of the appropriate model, a huge number of different variables have been suggested in the existing literature to be potential determinants of PE investment. Only few studies control for the variables analysed by others, and therefore the robustness of the estimation results to the inclusion of additional explanatory variables is questionable. This problem becomes especially relevant for small data sets, when the number of regressors has to be hold small. Ideally, one only wants to include regressors that turn out to be robust to the inclusion or omission of other regressors.

We solve the problem of model selection under uncertainty and small data samples by applying first a so called 'Extreme-Bounds Analysis' (EBA) proposed by Sala-i-Martin (1997), which builts on earlier work by Leamer (1983, 1985) and Levine and Renelt (1992).[7] The idea of Sala-i-Martin's approach is to estimate a large set of model specifications and to check how sensitive the estimated coefficient of each variable is to the inclusion of additional explanatory variables. Let's assume that we consider N variables to be potentially relevant determinants of PE. To run the extreme-bounds test, we estimate the following fixed effect panel model:

$$y_{it} = \alpha_i + \boldsymbol{\gamma}'\boldsymbol{x}_{it} + \beta z_{it} + \boldsymbol{\delta}'\boldsymbol{v}_{it} + \epsilon_{it}, \tag{1}$$

where y_{it} measures PE investment as share of GDP in country i in year t and α_i denotes country-fixed effects. $\boldsymbol{x}_{it}$ is a $l \times 1$ vector of regressors which are regarded as highly explanatory from both economic theory and empirical evidence.[8] As such, this set of so called 'standard' regressors is included in all the estimated specifications. z_{it} is the variable of interest that we want

[7] One might argue that in this context factor analysis is an alternative to EBA. However, principle components analysis makes the interpretation of the impact of individual coefficients less clear. Moreover, since we want to allow for differences in the determinants between Western and CEE countries, we would have to calculate separate factors for both regions, for this our data set is too small.

[8] Their exclusion would result in an omitted variable bias.

to test for its robustness. $\boldsymbol{v}_{it}$ is a vector of k variables randomly drawn from the pool of the remaining $N-l-1$ potentially relevant regressors with $k < N-l-1$.[9] Regression (1) is repeated for all possible $\delta = \binom{N-l-1}{k}$ combinations of the set of leftover regressors.

Thus, we end up with δ estimates of the slope coefficient β and its standard deviation σ. From these we calculate the lower extreme bound defined as the lowest value of $\beta - 2\sigma$ and the upper extreme bound defined as the largest value of $\beta + 2\sigma$. Following Sala-i-Martin (1997), we complement this information by investigating in addition the entire distribution of the estimated slope coefficient by calculating the unweighted average of the individual cumulative distribution functions (CDF(0)) of β.[10] Sala-i-Martin regards a variable as a 'robust' determinant, if 90% of the distribution of the slope coefficient β is positive or negative, respectively. This procedure is repeated for all variables of interest of the remaining pool of explanatory variables, z consisting of (N - l - 1) variables.

These robust variables identified by EBA are then used in a second step as a motivation for the choice of regressors in a fixed effects panel estimation approach. Thus, we estimate the following equation to identify the determinants of PE investment:

$$y_{it} = \alpha_i + \boldsymbol{\gamma}'\boldsymbol{x}_{it} + \boldsymbol{\beta}'\boldsymbol{z}_{it}^{R} + \nu_{it}, \tag{2}$$

where y_{it} measures PE investment in country i in year t, $\boldsymbol{x}_{it}$ is a $l \times 1$ vector of 'standard' explanatory regressors and $\boldsymbol{z}_{it}^{R}$ denotes the vector containing the set of robust variables identified by EBA.

[9] Sala-i-Martin (1997) and Levine and Renelt (1992) suggest to limit k to a maximum of three.

[10] Sala-i-Martin (1997) proposes to aggregate the individual CDF(0)'s by applying a weighting scheme that is proportional to the (integrated) likelihoods of each regressions, such that models that are more likely to be the true model get more weight. However, this goodness of fit measure is not optimal for two reasons. First, in case of unbalanced panels due to missing observations in some explanatory variables, which is the case in our data set, regressions based on a larger set of observations will get more weight, since they have a (spuriously) better fit. Second, as argued by Sturm and de Haan (2005), weights constructed in this way are not equivariant for linear transformations in the dependent variable, such that changing scales will result in different outcomes. We will therefore calculated the unweighted averages of the individual CDF(0)'s.

4.2 Data

Our data set consists of annual data running from 2001 to 2008 and covers 14 Western European countries, i.e. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and UK and three CEE countries, i.e. the Czech Republic, Hungary and Poland. Our dependent variable is PE investment[11] measured relative to nominal GDP that is invested in both publicly quoted and privately held companies in each of the 17 countries each year. The data on PE is provided by the European Venture Capital Association (EVCA).[12] A complete list of the data sources is provided in the appendix.

Since we aim to answer the question, what policy makers can do to attract PE investment, we focus entirely on macroeconomic determinants. The choice of our set of explanatory variables is motivated by the earlier literature and by data availability:[13]

- Δ GDP: Annual real growth rate of GDP in %.
- GDP p/c: Real GDP per capita in Euros.
- Interst Rate: Short-term (3-months) interest rate in %.
- Equ.capit.: Equity market capitalization in % of GDP.
- Δ Equ.capit: Annual growth rate of equity market capitalization in %.
- MSCI Return: Annual return of the Morgan Stanley Capital International index.

[11] Total PE investment includes all investment stages: venture capital, buyouts and restructuring. Unfortunately, the data available is not detailed enough to differentiate between investment stages as it is done, e.g., by Jeng and Wells (2000) and Da Rin et al. (2006)

[12] EVCA has recently started to collect data on other CEE countries but these data series are either too short or data of several countries are pooled together, e.g. the Baltic states. The limited data availability hampers an extention of our data set. Moreover, Czech Republic, Hungary and Poland are the major recepients of PE investments, e.g. in 2006 PE to these three countries accounted for more than 80% of total investments to all CEE countries.

[13] We have tested the variables for stationarity using the panel unit root test of Im, Pesaran and Shin (2003). It suggest that the assumption of stationarity is a reasonable one. The results can be obtained by the authors on request.

- Lending/GDP: Commercial bank lending to private sector in % of GDP.
- Inflation: Annual change of (harmonized) CPI in %.
- Bus.Confidence: Standardized business confidence indicator.
- Corp.Tax: Corporate tax rate in %.
- Patents: Total number of newly registered patents in % of population.
- Unemployment: Total unemployment relative to total labour force in %.
- Empl.Protection: Synthetic indicator of the strictness of regulation on dismissals and the use of temporary work contracts measuring the strictness of employment protection.
- Union strength: Number of union members relative to total employment in %.
- Labour cost: Normalized ratio of total labour costs to real output.
- Labour cost growth: Annual growth rate of unit labour costs in % of GDP.

The focus of this paper is to analyse, whether PE in CCE countries is determined by different variables than in Western European countries. Thus, ideally we want to run our estimations for two seperate data sets, one for Western European and CEE countries. However, since our data set covers only three CEE countries, this is not possible. Instead, we allow for differences in the determinants of PE investment in both regions by multiplying our explanatory variables with two dummy variable, (W) and (E), which take the value one, if a country belongs to the Western European countries or CEE countries, respectively, and zero otherwise. Thus, we end up with 32 different explanatory variables.

4.3 Estimation Results

Extreme Bounds Analysis Before we run EBA to identify the robust determinants of PE investment, we have to choose the 'standard' explanatory variables ($\boldsymbol{x}_{it}$) that always appear in the regressions. From an economic

perspective, it makes sense to choose real GDP growth and real GDP per capita, which are also common regressors in the related literature.[14] Further, we set the parameter k equal to three, which means that we complement the standard set of explanatory variables with three additional explanatory variables drawn from the set of leftover regressors. Since this procedure is repeated for all possible $\delta = \binom{32-4-1}{3}$ combinations of the leftover regressors, the robustness test of every single variable is based on in total 2925 regression models.[15]

The estimation results of EBA are shown in Table 1. The results for the individual variables are sorted by their score on the CDF(0) that measures the percentage of the distribution of the coefficients that lies either above or below zero. The first column shows for each variable of interst the average number of observations on which the different regression models are based. The lower and upper bound of the estimated coefficients are shown in column (2) and (3). Column (4) shows the percentage share of significantly estimated slope coefficients and column (5) lists the unweighted CDF(0). The unweighted mean of the 2925 estimated coefficients (β) and their standard errors are shown in column (6) and (7).

While Sala-i-Martin regards a variable as a 'robust' determinant, if 90% of the distribution of the slope coefficient β is positive or negative, respectively, we choose a less restrictive threshold of 85%. Our choice is motivated by the fact that our data set is relatively small, which in turn will result on a higher uncertainty around the estimated coefficients. We find that nine variables are considered to be robustly related to PE investment, according to the criterion CDF(0)$>$ 0.85. This is equity market capitalization/GDP and commercial bank lending/GDP for both, the Western European and the CCE countries, and the annual growth rate of unit labour costs, labour union strength, the business confidence indicator, the short-term interest rate and the corporate tax rate for the Western European countries. As shown in column (4), seven

[14] Compare e.g. Gompers and Lerner (1998), Romain and Pottelsberghe de la Potterie (2004a), Groh and Liechtenstein (2009). As a robustness test, we have also estimated EBA without sorting GDP growth and per capita GDP in the set of 'standard regressors'. Our results confirmed that these two variables are highly robust and significant regressors.

[15] We have also repeated the estimates choosing $k = 2$ and $k = 4$. The results did not differ from the results when setting $k = 3$, only the calculations became much more time consuming when setting $k = 4$ (17550 regressions for each variable). The estimation results are available from the authors on request.

Table 1: Extreme Bounds Analysis

Variable	Av.No Obs.	Ex.bounds lower	Ex.bounds upper	%sign at 5%	Unw. CDF(0)	Unw. β	Unw. St.errors
Equ.Capit.(W)	127	0.02	0.09	100.00	1.00	0.053	0.007
Lending/GDP(W)	127	0.01	0.08	99.52	1.00	0.039	0.007
Lending/GDP(E)	127	-0.06	0.24	79.97	0.98	0.133	0.032
ΔLabour cost(W)	124	-0.31	0.07	74.94	0.97	-0.168	0.041
Union strength(W)	118	-1226.13	-19.47	29.30	0.96	-525.782	143.187
Equ.Capit.(E)	127	-0.09	0.33	48.48	0.95	0.125	0.035
Bus.Confidence(W)	127	-0.19	0.61	47.35	0.92	0.216	0.061
Interest Rate(W)	127	-0.69	1.28	27.49	0.88	0.385	0.136
Corporate Tax(W)	127	-0.35	0.13	9.13	0.86	-0.112	0.047
Patents(W)	118	0.00	0.00	0.00	0.84	0.000	0.000
MSCI Return(E)	127	-0.16	0.09	9.50	0.84	-0.033	0.015
Patents(E)	118	0.00	0.02	2.02	0.83	0.004	0.002
Union strength(E)	118	-1841.75	2897.45	9.88	0.82	603.864	289.766
Empl.Protection(E)	127	-7.29	10.19	0.24	0.80	2.796	1.607
ΔEqu.Capit.(E)	127	-0.09	0.06	5.88	0.79	-0.018	0.011
Empl.Protection(W)	127	-4.08	5.49	0.00	0.76	1.360	0.931
Bus.Confidence(E)	127	-0.68	1.82	21.78	0.76	0.315	0.139
Unit labour cost(E)	124	-80.85	45.77	0.00	0.74	-17.773	13.441
Interest Rate(E)	127	-0.85	0.77	0.00	0.72	-0.144	0.123
Corporate Tax(E)	127	-0.90	0.78	0.00	0.71	-0.137	0.127
ΔEqu.Capit.(W)	127	-0.03	0.05	8.24	0.69	0.006	0.005
Inflation(W)	127	-0.71	1.12	0.00	0.64	0.133	0.163
Unemployment(W)	127	-0.42	0.82	0.03	0.60	0.069	0.120
ΔLabour cost(E)	124	-0.17	0.21	0.00	0.59	0.024	0.049
Inflation(E)	127	-0.70	1.06	0.00	0.59	0.074	0.151
Unemployment(E)	127	-0.84	0.94	0.00	0.57	-0.036	0.124
Unit labour cost(W)	124	-23.00	20.37	0.00	0.54	0.874	4.292
MSCI Return(W)	127	-0.04	0.03	4.41	0.51	-0.001	0.005

(W) denotes the coefficients for Western European countries and (E) for CEE countries.

of the nine 'robust' variables are in addition significant in at least half of the regressions. The only exceptions are the interest rate and the corporate tax rate variables, which are only significant in around 30% or 10%, respectively.

The average coefficients all robust estimated variables (column (6)) turn out to have the expected sign. PE investment increases with the size equity market capitalization, the ratio of commercial bank lending relative to GDP and the level of the business confidence indicator. Labour union strength, the annual growth rate of unit labour costs and the corporate tax rate level have a decreasing impact on PE investments.[16]

Fixed-Effects Panel Estimations The results of the EBA serve as a motivation for the choice of variables that we finally use as determinants in a fixed effects regression. Using only 'robust' variables has the advantage that we can be confident that the sign of their estimated coefficients is independent of the omission or inclusion of other explanatory variables. Therefore, to save degrees of freedom, we restrain from adding several 'robust' estimated determinants into the regression. Thus, in each regression we include the 'standard' explanatory variables, real GDP growth and real GDP per capita, and one of the five as robust identified regressors, i.e. equity market capitalization/GDP, commercial bank lending/GDP, the annual growth rate of unit labour costs, labour union strength, the business confidence indicator, short-term interest rates and finally the corporate tax rate.[17] All variables are added separately for Western European countries and CEE countries to focus on the differences in the driving forces of PE investment in the two areas.

A necessary condition for our panel estimation approach is that the Western European countries and the CEE countries are 'poolable'. Therefore, we have tested whether the estimated slope coefficients, excluding the constant terms to allow for country fixed effects, are the same for the 14 Western European countries and the three CEE countries, respectively. We find that the null-hypothesis of equality of the slope coefficients has never to be rejected for both country groups.

[16] A more detailed explanation of the individual coefficients follows in the next section.

[17] In addition, we have also included as a robustness test each of the remaining explanatory variables to the regression, but they all turned out to be highly insignificant. Thus, this confirms the findings from EBA and we can be sure that we are not missing any important information from the set of available regressors.

The unbiasedness and efficiency of fixed-effects panel models is based on the condition of no serial and cross sectional correlation in the error terms. Applying the Wooldridge test for serial correlation, we find that the null-hypothesis of no serial can never be rejected, which suggests that the choice of a static fixed-effects panel model is appropriate. In order to test for cross-section dependence the Friedman and Frees tests are applied. The test results are inconclusive. The Friedman test does never reject the assumption of cross-section independence, while the Frees' test rejects this assumption in four out of six regressions.[18] Consequently, we use an OLS estimator with country-fixed effects and with panel-corrected standard errors proposed by Beck and Katz (1995), which corrects for heteroskedasticity and contemporaneous correlation across countries.[19] The estimation results and the results of the various specification tests are shown in Tables 2 and 3.

As indicated by the R^2 values in the last row of Table 2, our fixed-effect panel models are able to explain roughly two thirds of the variation in PE investment. The estimation results of these regressions broadly confirm the results of EBA concerning significance and the coefficient signs. We find more significance in our explanatory variables when focussing on Western European countries than on CEE countries.

The decision to invest in firms located in CEE countries is unaffected by the level of per capital GDP or real GDP growth, which confirms the finding of Jeng and Wells (2000). Contrarily, investments to firms in Western Eurpean countries are motivated significantly by real GDP growth and real GDP per capita. The faster a country is growing in terms of GDP, the more PE investment is attracted, which is in line with the finding of Gompers and Lerner (1998) and Romain and Pottelsberghe de la Potterie (2004a). However, the more developed a country becomes in terms of real GDP per capita, the less PE funds are flowing into its economy.

As shown in column (1), equity market capitalization turns out to be a strong driver of PE investment in both regions, which underlines the finding

[18]De Hoyos and Sarafidis (2006) point out that the Friedman tests are biased in cases where cross-sectional dependence is characterized by alternating correlations in the residuals. The Frees' test is not subject to this drawback and is therefore more reliable.

[19]Estimating our equation as a system of seemingly unrelated regression equations (SURE) and then estimate the system by generalized least squares (GLS) techniques is not a feasable option with our data set, since our time horizon T is shorter than the panel dimension N. Beck and Katz (1995) show that they estimtion approach has good small sample properties.

Table 2: OLS estimations with panel corrected standard errors and country fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GDP p/c(W)	-0.23	-0.13	-0.20	-0.22	-0.18	-0.21	-0.18
	(0.00)	(0.05)	(0.00)	(0.01)	(0.03)	(0.00)	(0.02)
GDP p/c(E)	-0.11	-0.08	-0.36	-0.34	-0.35	-0.04	-0.37
	(0.86)	(0.86)	(0.64)	(0.55)	(0.65)	(0.96)	(0.56)
ΔGDP(W)	0.10	0.65	0.82	0.57	0.45	0.59	0.55
	(0.65)	(0.00)	(0.00)	(0.04)	(0.12)	(0.01)	(0.02)
ΔGDP(E)	-0.31	0.06	0.06	-0.10	0.08	-0.07	-0.31
	(0.07)	(0.58)	(0.73)	(0.50)	(0.64)	(0.66)	(0.25)
Equ.Capit.(W)	0.04						
	(0.01)						
Equ.Capit.(E)	0.10						
	(0.03)						
Lending/GDP(W)		0.03					
		(0.01)					
Lending/GDP(E)		0.11					
		(0.00)					
ΔLabour cost(W)			-0.16				
			(0.08)				
ΔLabour cost(E)			-0.01				
			(0.83)				
Union strength(W)				-453.87			
				(0.02)			
Union strength(E)				747.07			
				(0.00)			
Bus.Confidence(W)					0.09		
					(0.30)		
Bus.Confidence(E)					-0.02		
					(0.93)		
Interest Rate(W)						0.25	
						(0.30)	
Interest Rate(E)						-0.22	
						(0.14)	
Corporate Tax(W)							-0.08
							(0.19)
Corporate Tax(E)							-0.24
							(0.09)
Constant	5.25	1.44	6.66	27.39	-0.69	0.35	9.55
	(0.83)	(0.54)	(0.52)	(0.00)	(0.75)	(1.63)	(0.09)
N	136	136	18 129	119	135	136	136
R^2	0.68	0.67	0.64	0.65	0.63	0.63	0.63

p-values shown in paranthesis. (W) denotes the coefficients for Western European countries and (E) for CEE countries.

Table 3: Test results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wooldridge Test[a)]	0.68	0.97	1.00	0.74	0.53	0.94	0.93
Friedman Test[a)]	0.05	0.67	0.82	0.12	0.42	0.45	0.12
Frees Test[b)]	0.35	0.67*	0.21	1.01***	0.86***	0.77***	0.88***
Poolability Test[a)]							
Western Countries	0.51	0.61	0.53	0.02	0.89	0.95	0.92
CEE Countries	0.22	0.86	0.24	0.32	0.13	0.18	0.12

[a)] Figures represent p-values; [b)] Figures represent Q-statistics. Critical values of the Frees test are: : 10% = 0.358, 5% = 0.492 and 1% = 0.768.

of Black and Gilson (1998), Gompers and Lerner (2000) and Schertler (2003) that PE capital flourishes in countries with deep and liquid stock markets. The explanation is that a strong and active equity market represents a potential exist strategy for PE investors and create a more favorable environment for investors. For CEE countries, this positive effect is much stronger than for Western European countries. A one percentage point increase in equity market capitalization relative to GDP increases PE activity in Western European countries by 0.04 and to firms in CCE countries by 0.10 percentage points relative to GDP. However, a Wald test cannot reject the Null that the impact of equity capitalization on PE investment is the same for both regions (p-value = 0.20).

In both regions, PE investment is significantly attracted by the availability of debt financing (column (2)). However in CEE countries this effect is almost four times stronger than for Western European countries. A one percentage point increase of commercial bank lending relative to GDP increases PE flows to CEE countries by 0.11 and to Western European countries by 0.03 percentage points. A Wald test for equality of the coefficient estimated for both regions has to be clearly rejected. Thus, we can confirm Farag et al. (2004) result that limited availability of debt financing is one of the major obstacles for PE activity.

We find that primarily in Western European countries labour market condition play a significant role in attracting PE activity, which is in line with Schertler (2003). Column (3) shows that the annual growth rate of unit labour costs negatively affects the attractiveness of PE investments to Western European companies, which reflects the diminishing effect of labour costs on expected corporate profits. When focussing on PE activity in CCE

countries, we find that the growth rate of unit labour costs plays no significant role in explaining investment decisions. Moreover, in both regions the power of labour unions has a significant impact on private equity flows. In Western European countries private equity investment decreases the stronger labour unions are, which is in line with our expectations. Surprisingly, we find the opposite result for the CEE countries. The stronger labour unions are, the more private equity is attracted.

Column (5) shows the estmation results for the business confidence indicator. Despite the result of EBA, which suggests that at least for Western European countries this variable is a robust and very often a significant driver of PE flows, we find in none of the two regions a significant effect of the business cycle indicator on PE investments. Thus, expectations about the future economic activity of the private sector seems to play no significant role PE investment decisions.

As shown in column (6), we find no significant effect of the short-term interest rate on PE investment. This result supports the findings of EBA, which shows that this variable is only significant in around 30 percent of the 2925 regressions, and it also fits to economic theory saying that the level of interst rates has an ambiguous effect on private equity. On the one hand the level of interest rates should have a decreasing effect on the supply of private capital since a high level of real interest rates reduces the attractiveness of risky investments. On the other hand, the level of interest rates also affect bank financing costs and when bank financing becomes more costly PE may be a better and more flexible alternative to raise funds.

In the last column of Table 2, we show the estimation results, when adding the corporate tax level to the regression. For both country groups the coefficient shows the expected negative sign, but it is only significant for CEE countries. This suggests that tax competition is an important tool for Eastern European countries to attract PE flows. The lower the corporate tax rate is the more PE will flow into the country. This result confirms the findings of Gompers and Lerner (1998), Bruce (2000 and 2002) and Cullen and Gordon (2002), and Groh and Lichtenstein (2009), who find that tax incentives play an important role in attracting PE investments.

5 Conclusion

The Europe-wide level of investments in PE has grown remarkably in the last decade but the observed rates of growth have been extremely different across countries, especially in the comparison across Western and CEE countries. Given the widely-documented positive impact of PE activity on economic development and entrepreneurship, understanding the determinants of PE industry has been a primary goal for both academics and regulators. Nonetheless, there is still no broad consensus on the macro-determinants of PE investments and the literature focussing on the CEE countries in the attempt to explain the region's major obstacles to catching up with the developed markets is relatively scarce.

Our study adds to this strand of literature and investigates the macro-determinants of PE investment in Europe, focussing on a comparison between CEE and Western European countries. In particular, using panel data from 14 Western countries and three CEE countries spanning from 2001 to 2008, the paper tests whether financial market conditions, business confidence, liquidity of the stock markets, human capital endowment and regulation in the labour market are driving forces of PE activity and to what extent such forces differ in Eastern and Western countries. In the first step of our analysis, we employ 'Extreme-Bounds Analysis' (EBA) to narrow down the large number of macro-determinants cited in the literature to a 'robust' set of explanatory variables. In the second step, we use fixed-effect panel estimations to shed new light on the debate on the driving forces of PE investments.

The main findings are as follows. First, we find that only nine out of 32 variables turn out to be 'robustly' correlated to private equity investments. For many determinants that have been cited in the related literature to be important determinants, we could not confirm a stable relationship with PE investments. Second, in line with previous studies, we find that in both Western and CEE countries PE investment is positively affected by the size of commercial bank lending relative to GDP and by the size of equity market capitalization. Thus, well developed financial markets are essential, if countries want to attract more PE capital. The impact of both factors appear to be much stronger in CEE countries than in Western European countries. Third, Western European countries seem to attract more PE capital, when they are on a fast-growing GDP path, but have still a lot of growth potential in terms of real GDP per capita. On the other hand, PE flows to CEE coun-

tries are unaffected by economic growth aspects. Fourth, we find that the short-term interest rate does not significantly affect PE investment. A possible explanation for this results, which is in line with the outcome of the EBA, is that the level of interst rates has an ambiguous effect on PE, depending on the preponderance of supply-side or demand-side (entrepreneurs) effects on PE invesment. Finally, tax competition is an important tool for Eastern European but not for Western European countries to attract PE investment. In this sense, the lower the corporate tax rate is, the more PE will flow into these emerging markets.

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A Data Sources

- PE investment/GDP: European Venture Capital Association (EVCA).
- Δ GDP: World Economic Outlook, IMF.
- GDP p/c: World Market Monitor, IHS Global Insight.
- Interst Rate: ECB and OECD.
- Equ.capit.: World Market Monitor, IHS Global Insight.
- Δ Equ.capit: World Market Monitor, IHS Global Insight and own calculations.
- MSCI Return: World Market Monitor, IHS Global Insight and own calculations.
- Lending/GDP: World Market Monitor, IHS Global Insight.
- Inflation: World Market Monitor, IHS Global Insight.
- Bus.Confidence: OECD.
- Corp.Tax: OECD.
- Patents: OECD and own calculations.
- Unemployment: OECD and own calculations.
- Empl.Protection: OECD.
- Union strength: OECD and own calculations.
- Labour cost: OECD.
- Labour cost growth: OECD and own calculations.