

The Future of Private Equity in Europe – The Determinants Across Countries

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Abstract: *This paper examines two aspects related to private equity investments in Europe. First, we will present the evolution of private equity investments across European countries during the last crisis. Second, the paper will analyse and identify the main determinants of the European private equity market, using an empirical panel analysis. The empirical model includes many of the determinants already tested in previous studies (GDP growth, Market Capitalization, Research and Development Expenditures, Interest rates, etc.) and also new variables such as productivity and corruption index which we consider important factors in explaining the evolution of private equity investments in Europe. The present research paper follows the equilibrium model of private equity investments (Gompers and Lerner 1998, Jeng and Wells 2000, Romain and de La Potteria 2004, Félix 2007). We will use aggregated data from European private equity market during 2000–2013, as well as macroeconomic data, in order to estimate a panel data model with fixed and random effects. This paper will also run the Hausman specification test in order to compare the consistency of fixed effects models and random effects models. Our results confirm existent hypotheses regarding the importance of some determinants on the evolution of private equity investments in Europe. However, in the context of the last crisis new factors emerged as important for the private equity market in Europe such as productivity or corruption.*

Keywords: *private equity, economic growth, market capitalization, unemployment rate, corruption, private equity determinants, Europe.*

JEL Codes: C23, G24, G32, G34.

1. Introduction

This article tries to answer to the following questions: How the recent crisis impacted the evolution of Private Equity in Europe? and What are the factors affecting the evolution of private equity investments in Europe?

Europe is the second largest private equity market worldwide after United States. In 2013, total private equity investments amounted to 35.7 billion euros which represents a drop of 49% compared to pre-crisis levels. This drop was mainly in relation to the austerity measures taken by European governments in order to respond to the sovereign

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debt crisis. However, in the last years we have seen that private equity investments began to slightly revive in Europe but modest and well below pre-crisis levels.

The objective of this research is to identify and analyse the main factors affecting the evolution of private equity in Europe. It should be noted that the literature is not exhaustive in terms of identifying the determinants of private equity market. However, some studies managed to identify and validate macroeconomic variables such as the GDP growth, the market capitalization, the R&D expenditure, the interest rates, etc. as drivers for the private equity market. In general, the literature studies the phenomenon of venture capital which targets the investments in start-ups and is a subcomponent of the private equity investments.

The papers which are more relevant for this study, both in terms of model and methodology, are the following: Gompers and Lerner 1998, Jeng and Wells 2000, Romain and de La Potteria 2004, Félix 2007.

Gompers and Lerner (1998) study the development of venture capital activity in U.S. taking into account the period 1969 - 1994. The main variables studied were: the number of IPOs, the economic growth (expressed as GDP growth in real terms) and the short-term interest rate (expressed as the yield of U.S. Treasury securities). Gompers and Lerner (1998) confirm the positive effect of the economic growth on the evolution of venture capital in U.S. Both authors also confirm statistically the negative relationship between the venture capital and the short-term interest rate. However, Gompers and Lerner (1998) failed to statistically validate a relationship between the number of IPOs and the funds raised for the venture capital investments.

In another similar study, Gompers and Lerner (1998) tested and validated a correlation between the US Government expenditure in R&D and the evolution of venture capital investments. This variable was validated by the econometric model as significant with a positive impact on the venture capital investments.

Jeng and Wells (2000) studied the evolution of venture capital investments in 21 countries during 1986 and 1995. Both authors analysed the determinants of venture capital such as market capitalization, number of IPOs, economic growth (expressed as GDP growth in real terms), labour market rigidity, value of pension funds and the level of taxation on capital gains.

The possibility of having access to IPO divestments is considered by both authors as the most important factor for an private equity investment fund when deciding to raise money for the venture capital investments. However, Jeng and Wells (2000) failed in their analysis to validate a significant correlation between the evolution of venture capital investments and the following variables: economic growth, market capitalization and tax on capital gains.

Romain and de La Potteria (2004) continues to study the determinants of venture capital for a sample of 16 OECD countries during the period 1990 - 2000. The main variables used in their econometric model are: economic growth rate (expressed as GDP growth in real terms), long-term interest rate, short-term interest rate, economic

growth rate, level of R&D spending, number of patents filed, labour market rigidity and entrepreneurial activity.

Unlike Jeng and Wells (2000), the authors Romain and de La Potteria (2004) showed that the economic growth affect positively and significantly the level of venture capital investments. Moreover, both authors confirmed that long-term interest rate, short-term interest rate, technological developments, level of entrepreneurial activity, R&D expenditure and labour market rigidities are key factors in the evolution of venture capital.

Latest research work led by Félix et al. (2007) was focused on the European continent and analysed a group of 23 European countries for the period 1992 - 2003. These authors are among the few authors who exclusively focus on the European private equity market. Félix et al. (2007) developed an econometric model based on the following variables: economic growth (expressed as GDP growth in real terms), long-term interest rate, market capitalization in absolute terms, R&D expenditure in absolute terms, unemployment rate, number of IPOs, number of mergers and acquisitions (M&A) and write-offs.

Félix et al. (2007) confirmed the findings of the authors mentioned above, namely the economic growth and the market capitalization were validated as drivers of venture capital market in Europe. The number of IPOs and the number of mergers and acquisitions (M&A) were also validated as determinant factors affecting significantly the level of venture capital. Additionally, long-term interest rate was statistically validated as having a positive impact on the evolution of venture capital. However, the R&D expenditure and the write-offs were not statistically validated by the econometric model of both authors.

The reminder of this paper will be organized as follows: Section 2 will present the factors which we consider important in explaining the evolution of private equity investments in Europe. Section 3 will describe the data and it will reflect the dynamics of private equity during the last crisis. Section 4 will present the methodology and will describe the equilibrium model of private equity investments and the Hausman specification test which will allow us to compare the consistency of fixed effects models and random effects models. Section 5 explains the results of our econometrical models and Section 6 concludes the research paper and points out several strategic directions that are meant to support the future development of private equity in Europe.

2. Existent Theories on the Determinants of Private Equity

In the last two decades, numerous studies have identified various factors that significantly impact the evolution of private equity investments. Therefore, this research paper reviewed the determinants of private equity which were validated by the literature such as: the real GDP growth (Gompers and Lerner (1998); Romain De La Potterie (2004) and Félix et al. (2007)), the market capitalization (Black and Gilson (1998) and Félix et al. (2007)), the interest rate (Gompers and Lerner (1998); Romain De La Potterie (2004) and Félix et al. (2007)), the unemployment rate (Félix et al. (2007)), the R&D expenditure (Gompers and Lerner (1998) and Romain and de La Potteria (2004)).

This research paper also introduced new variables such as productivity and corruption index which were not tested previously in the literature but we consider important factors in explaining the evolution of private equity investments in Europe.

Table 1. Factors analysed for the reference authors in the area in analysis

| Determinants | Gompers and Lerner (1998) | Jeng and Wells (2000) | Romain and de La Potterie (2004) | Félix et al. (2007) |
|--------------------------|---------------------------|-----------------------|----------------------------------|---------------------|
| Economic growth | + | Ø | + | + |
| Market capitalization | | Ø | | + |
| Number of IPOs | Ø | + | | + |
| Number of M&A | | | | + |
| Number of write-offs | | | | Ø |
| Short term interest rate | - | | + | |
| Long term interest rate | | | + | + |
| Unemployment rate | | | | - |
| Tax rate | - | Ø | | |
| R&D expenditure | + | | + | Ø |
| Number of patents filed | | | + | |
| Entrepreneurial activity | | | + | Ø |
| Labour market rigidity | | - | - | |
| Value of pension funds | | + | | |

*Source: the author based on the findings from the literature.
(+) a variable which has an effect significantly and positively validated.
(-) a variable which has an effect significantly and negatively validated.
(Ø) a variable which was not validated.*

Our research paper distinguishes from the studies presented in Table 1 by the fact that it analysis the determinants of the private equity market as a whole. The research led by Black and Gilson (1998), Gompers and Lerner (1998), Jeng and Wells (2000), Romain and de La Potterie (2004), respectively Félix et al. (2007) is focusing on the venture capital investments which are a subcomponent of private equity.

Let us now study each determinant of the private equity and explain for each determinant the expected theoretical impact on the evolution of private equity market in Europe. This will be useful in interpreting our empirical results and comparing them with previous studies.

2.1. Economic growth

According to the literature, the economic growth is expressed as Gross Domestic Product growth in real terms.

Hypothesis 1: In this study we would like to test the hypothesis that economic growth significantly and positively affects the private equity investments in Europe. This hypothesis could be seen as a logical consequence of the fact that during a period of economic growth the investment opportunities for the private equity funds increase.

In the literature several studies have shown a positive correlation between private equity investments and economic growth. Gompers and Lerner (1998), Romain and de La Potterie (2004), respectively Félix et al. (2007) showed a positive correlation between GDP growth in real terms and the level of venture capital.

Based on literature findings, we expect that private equity activity in Europe to be pro-cyclical in the sense that its evolution might follow periods of economic expansion.

2.2. Market capitalization

Hypothesis 2: We assume a positive relationship between the evolution of private equity and the size of the stock market which is represented by the indicator of market capitalization in absolute terms.

Based on the research work led by Félix et al. (2007), in our paper we consider for all European countries as a variable the market capitalization in absolute terms. For the period 1992-2003, Félix et al. (2007) had statistically validated a positive relationship between the venture capital in 23 European countries and the market capitalization of these countries.

Jeng and Wells (2000) considered the number of IPO as a driver for the private equity market and argued that an increase of this variable will reflect a dynamic stock market which can provide interesting opportunities to disinvest for the private equity funds.

The authors mentioned above are claiming that the number of IPOs is the most important driver for the venture capital funds to allocate additional resources for this sector, in conclusion Jeng and Wells (2000) consider the number of IPOs the main factor in explaining the evolution of venture capital.

2.3. Interest rate

Hypothesis 3: In this research paper we expect that an interest rate increase will generate an increase of private equity investments across European countries.

Romain and de La Potterie (2004) claim that the interest rate is a key factor in the evolution of private equity. The authors argue that a long term interest rate increase for the 16 OECD countries could lead to an increase in private equity investments.

However, Gompers and Lerner (1998) used as variable for the empirical model the short term interest rate which was expressed as the return on U.S. treasury bills and then both authors showed a negative relationship between the interest rate and the venture capital. As U.S. treasury bills investments are considered alternative investments to venture capital, Gompers and Lerner (1998) concluded that an increase in the short-term interest rate will determine a decrease in venture capital investments.

2.4. Unemployment rate

Hypothesis 4: This article assumes a negative relationship between the dynamics of private equity and the unemployment rate.

The research paper published by Felix et al. (2007) shows that unemployment is a macroeconomic indicator which negatively affects the private equity investments in Europe.

In our econometric model we will test if there is a negative relationship between the unemployment rate and the offer of private equity investments and in the same time we will test a positive relationship between the unemployment rate and the demand of private equity investments in Europe. However, the sign of the relationship between these variables in the equilibrium (demand/supply) model of private equity investments depend on which of the two effects is stronger.

2.5. R&D expenditure

Hypothesis 5: This article assumes a positive relationship between the R&D expenditure and the development of private equity in Europe.

This hypothesis was confirmed in literature by Gompers and Lerner (1998). Both authors showed that an increase in R&D expenditure was followed by an increase in technological opportunities and in the '90s, these technological opportunities had a positive impact on the demand and supply of venture capital funds in U.S.

Later, Roman and De La Potterie (2004) confirmed the positive role of the new technological opportunities and the increased number of patents filed on the venture capital transactions.

2.6. Corruption

Hypothesis 6: This article assumes a negative relationship between the corruption index and the evolution of private equity in Europe.

It should be noted that compared to the variables presented above, the corruption was studied previously only by Cherif and Gasdar (2009) in the context of understanding venture capital dynamics in U.S.

The corruption index presents the level of institutional transparency and business conditions in a country. The values of this variable were collected from the cpi.transparency.org database. In our empirical model the corruption is ranking from 1 to 100. Hence one could notice that corruption index for the emerging countries in Eastern Europe is below the European average.

2.7. Productivity

Hypothesis 7: A positive change in productivity per employee will determine an increase in private equity activity.

This research wants to introduce a new variable such as productivity in our empirical model. As far as we know, there is no other research that has tried to show a correlation between the productivity and the private equity investments.

The need to study the relationship between productivity and the evolution of private equity appears important in the context of a profound crisis of competitiveness for the European continent. During the period 2000 - 2007, the growth of economic competitiveness was +1.8% in Europe, +1.7% in Japan and +2.3% in the US, then during the period 2008-2012 the competitiveness has increased only by +0.25% for the European continent compared to +0.9% in Japan and +2.0% in the US. These figures clearly show that Europe is lagging behind its main competitors in terms of competitiveness: the United States and Japan.

3. Data

For the empirical analysis we use data on 27 countries which were grouped as follows: Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Romania, Spain, Sweden, the Baltic States, ex-Yugoslav states, United Kingdom.² We grouped the central-eastern European countries for reasons of data availability during the period studied. It should be also noted that for the same reasons of data availability the reports published by EVCA ("European Venture Capital Association") use the same type of grouping for the Eastern European countries.

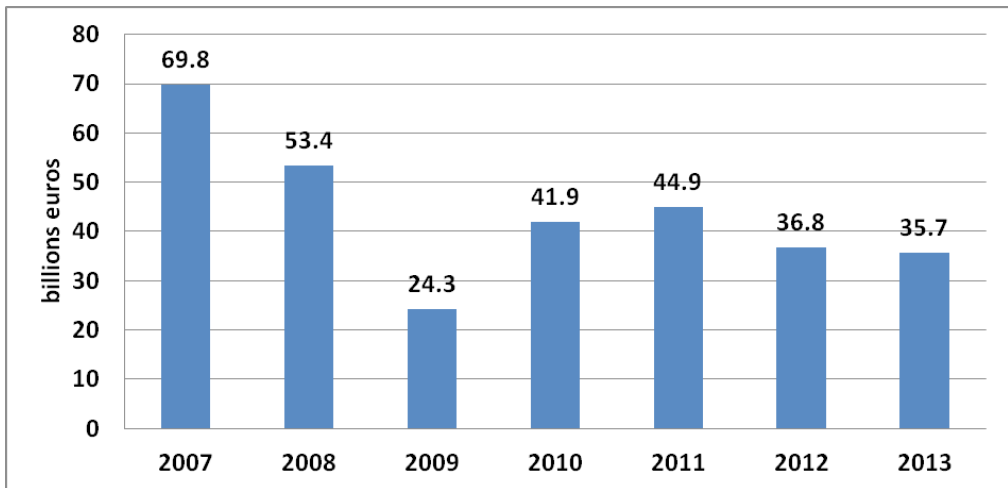
Taking into account the geographical area that we want to cover it was necessary to use various sources of data for establishing our own complete database. In order to have a complete picture on private equity investments across European countries we have used Thomson Reuters' database and EVCA's Yearbooks. It should be noted that by combining the information provided from both databases we managed to put together our own database with the most complete information on private equity activity, particularly for Eastern European countries.

² Baltic States include Estonia, Lithuania and Latvia. Ex-Yugoslav States include: Serbia, Bosnia-Herzegovina, Slovenia, Croatia, Macedonia and Montenegro. For reasons of data availability we followed the methodology used by EVCA and we added to this group of countries Slovakia.

We work with a panel data for these 27 countries, from 2000 – 2013, which leads to a database of 378 observations for each variable.

An overall view on the private equity market at European level shows an important drop compared to pre-crisis levels. However, as shown in Table 2, during the last years the European private equity market started to recover slowly and below pre-crisis levels.

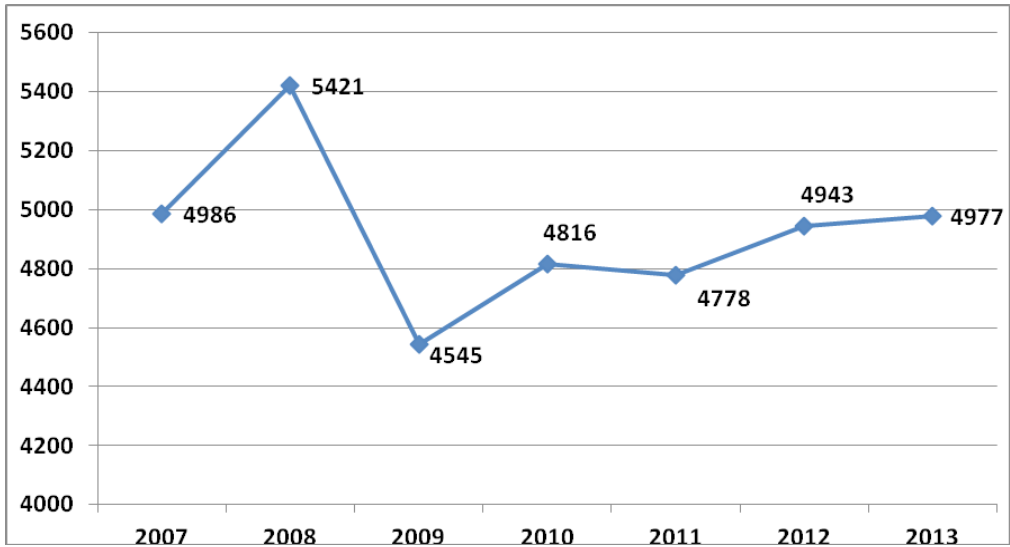
Table 2. The dynamics of private equity in Europe



Source: the author based on the information provided by the report „European Private Equity Activity 2013“. Available: www.evca.eu. Consulted in September 2014.

In 2013, United Kingdom was the leader in the private equity market in Europe with 27% of market share. This was possible despite the fact that according to the European Commission (2014) the small and medium size companies (SME) located in UK generated only 14.5% from the total value added generated in 2013 at European level. In terms of private equity market shares United Kingdom was followed by France (18%) and Germany (14%), countries which generated 21.6% respectively 14.6% from the total value added generated by all the European SMEs.

Britain’s dominant position was made possible because of a favourable legal and fiscal framework for private equity activities. It should be noted that in UK exists a more flexible legislation regarding the regulation of pension funds activities and less heavy procedures for a company to go public than the European average. It could also be added the mentality of the managers and the owners of British companies which are more opened to the private equity investors than the European average.

Table 3. The number of companies financed by private equity in Europe

Source: the author based on the information provided by the report „European Private Equity Activity 2013“. Available: www.evca.eu. Consulted in September 2014.

Table 3 shows a sharp decline in the number of companies that were financed by private equity investments in Europe in 2013 (4977) compared to pre-crisis levels (5421). This reflects the lack of investor confidence in the macroeconomic conditions of the European continent, and the difference between the price at which the buyer values a transaction and the seller prices the same transaction.

The following variables: annual real GDP growth rate, market capitalization, interest rate, unemployment rate, R&D expenditure, corruption and productivity per employee were collected from the annual reports provided by Eurostat. Additionally, the information regarding the corruption index was collected from the database “cpi.transparency.org”.

4. Methodology

In this research paper we want to analyse the evolution of private equity investments from a temporal perspective over a period of 14 years and from a sectoral perspective by studying the private equity in 27 European countries. Hence, we use a panel data analysis that includes both a horizontal dimension (i) and a temporal dimension (t).

The basic structure for analysis of a panel data regression is the following:

$$Y_{it} = \beta_0 + \beta X_{it} + u_{it} \quad (1)$$

Where $i = 1 \dots N$ relates to the number of countries and $t = 1 \dots T$ relates to the number of years for which we conduct the empirical simulations.

The objective of this research paper is to build a panel data regression using the following variables: private equity investments, economic growth, market capitalization, interest rate, unemployment rate, R&D expenditure, corruption and productivity.

Then, we introduce a cross-section fixed effects and a cross-section random-effects models. The fixed effects model assumes that all members of the panel have the same variance and that there is no correlation over time neither across, nor within the members of the panel. The random effects model assumes that the unobserved effect is uncorrelated with each explanatory variable and both could randomly vary over time and from one country to another. Jeng and Wells (2000) argue that the fixed effect estimation provides the best understanding of the evolution of private equity from one country to another, respectively random effects estimation gives a better understanding of the evolution of private equity over time.

As a quality check we will run the Hausman specification test in order to compare the consistency of fixed effects models and random effects models in explaining the evolution of the European private equity activity.

This research paper follows the equilibrium model of private equity investments used by the following authors: Gompers and Lerner 1998, Jeng and Wells 2000, Romain and de La Potteria 2004, Félix 2007. In order to identify the key determinants of private equity in Europe, we study the degree of statistical significance of the coefficients in the equilibrium model of supply and demand of private equity investments.

The offer of private equity in Europe represents the total amount of funds raised for private equity investments. The offer of private equity is described by the following equation:

$$\text{Private equity supply}_{it} = \beta_0 + \beta_1 \text{VarGDP}_{it} + \beta_2 \text{InterestR}_{it} + \beta_3 \text{Unemployment}_{it} + \beta_4 \text{R\&D}_{it} + \beta_5 \text{MarketCap}_{it} + \beta_6 \text{Corruption}_{it} + \beta_7 \text{Productivity}_{it} \quad (2)$$

$$t = 1, \dots, 13 \text{ and } t = 1, \dots, 14$$

The demand of private equity is the total amount of shares which were put for sale by the managers of the European private companies. The demand of private equity is described by the following equation:

$$\text{Private equity demand}_{it} = \beta_0 + \beta_1 \text{VarGDP}_{it} + \beta_2 \text{InterestR}_{it} + \beta_3 \text{Unemployment}_{it} + \beta_4 \text{R\&D}_{it} + \beta_5 \text{MarketCap}_{it} + \beta_6 \text{Corruption}_{it} + \beta_7 \text{Productivity}_{it} \quad (3)$$

$$i = 1, \dots, 8 \text{ and } t = 1, \dots, 14$$

In order to formulate the equilibrium model we consider the equality between the amount of funds supplied by the private equity investors and the demand for such funds. Hence, following the methodology used by the above mentioned authors we have obtained the following equilibrium model of private equity investments:

$$Private\ equity_{it} = \theta_0 + \theta_1 VarGDP_{it} + \theta_2 InterestR_{it} + \theta_3 Unemployment_{it} + \theta_4 R\&D_{it} + \theta_5 MarketCap_{it} + \theta_6 Corruption_{it} + \theta_7 Productivity_{it} \quad (4)$$

$$i = 1, \dots, 8 \text{ and } t = 1, \dots, 14$$

VarGDP – gross domestic product growth in real terms.

InterestR – long term interest rate.

Unemployment – unemployment rate for each country.

R&D – public expenditure with R&D.

MarketCap – market capitalization for each country.

Corruption – corruption index as provided by cpi.transparency.org.

Productivity – total value added generated per employee in one year.

5. Final Results

5.1. Descriptive Statistics³

The mean annual value of the dependent private equity investments varies from 0.6 million euros in Ex-Yugoslavian States to 40.9 billion euros in the U.K., as shown in the second row in Table 4. On average, over all periods, the private equity investments across European countries are about 194 million euros. Hence, in the U.K., annual private equity investments are about 6.5 times as high as annual private equity investments on average in Europe. U.K., France and Germany represent on average, over all periods, 57% from the European private equity market.

The countries also differ substantially with respect to the total value of market capitalization. This variable fluctuates from low levels for the Eastern European emerging countries such as Bulgaria and Romania, to significant values for developed countries such as the U.K. or France.

In terms of R&D expenditure, the annual record for our sample is own by Sweden with 3.9% of its GDP invested in one year. The Nordic countries like Finland or Denmark tend to invest more on research and development than the European mean. Over all periods, the R&D expenditure for our sample of countries is on average about 1.2% from the European GDP.

5.2. Correlations

The correlations presented in Table 5 offer a first clue at the relationship between private equity investments in Europe and macro determinants. Most of the correlation coefficients between private equity investments and the independent variables of the

³ Descriptive statistics for all macro and political variables are presented in Table 4.

empirical model are below 0.5. However, a strong correlation between the evolution of private equity and the market capitalisation (about 0.8) can be easily noticed.

By contrast, correlation coefficients between unemployment and interest rate, respectively productivity and R&D expenditure are relatively high, above 0.8. This correlation can induce serious problems of multicollinearity and might limit the extent to which the relevance of each dependent variable can be identified.

Many economic variables have the property of being correlated. This is not surprising, given the natural links between some variables such as R&D expenditure and productivity. The standard solution is to group those variables that capture similar dimensions (Daude and Stein, 2007). This paper will group unemployment and interest rate on one hand, and productivity and R&D expenditure on the other hand. Furthermore, we will try to avoid analysing all these variables by using the same model.

5.3. Panel Regression Results

This section provides the empirical results from our panel estimations. Tables 6 and 7 show the most significant drivers for the private equity evolution in Europe under the fixed-effects models, respectively under the cross-section random models. Then, this section compares the results highlighted in tables 6 and 7 with the existing results in literature, in terms of the signals of the coefficients.

Following our results presented in tables 6 and 7 it can be easily noticed that two variables have a higher significance and influence on the private equity evolution than others. One can conclude that during the 2000 - 2013 period, the main drivers for private equity in Europe were the unemployment rate and the market capitalisation of each country. The unemployment rate and the market capitalisation were statistically validated as significant with the highest probabilities for the fixed-effects models as well as for the cross-section random models.

In the first column of Table 6 and 7 (see the Appendix), we present the results of the same model which is including all seven variables together. Given the high correlation among the variables and the important multicollinearity problems, it is still interesting to point out that the variables unemployment rate and market capitalisation seem to be the most relevant factors in the European private equity evolution.

In this analysis, GDP growth rate presents a statistically significant and negative impact which comes in contrast to what authors such as Gompers and Lerner (1998), Romain and de La Potterie (2004), respectively Félix et al. (2007) had concluded in their research. However, one should notice that the GDP growth rate is validated significant with a probability of 90% according to the Student-t test. Moreover, authors such as Jeng and Wells (2000) concluded that for a sample of 21 countries, the GDP growth was not a determinant for venture capital investments evolution.

The market capitalisation shows a positive effect on the European private equity market. This relation was statically validated with a probability of 99% which makes the variable market capitalisation one of the main drivers for the evolution of private equity

investments in Europe during the last years. One could add that the existence of an active stock market in European countries lead to the accomplishment of more private equity investments in those countries.

Table 6 and 7 illustrate that in all the estimated models, the relationship between the private equity investments in Europe and the market capitalization is statistically significant and positive. This relationship confirms the work lead by Félix et al. (2007) which showed that in 23 European countries that were analysed, an increase in the market capitalisation of one county lead to an increase in investors' positive expectations about that economy.

With respect to the interest rate, the results of the estimations show that this variable is not statistically significant which, again, is in contrast to what authors such as Gompers and Lerner (1998), Romain and de La Potterie (2004) and Félix et al. (2007) had determined. This means that according to our research in the past years, the interest rate levels had a limited influence on the private equity funds' decision to invest in the European economies. However, one should notice that the interest rate coefficient is positive and from this perspective our work is in line with the existing literature: Romain and de La Potterie (2004) and Félix et al. (2007).

The unemployment rate had a strong negative impact on the evolution of private equity investments in Europe, in both fixed and random effects models. The relationship between both variables was validated with a probability of 99% for all estimated models. This confirmed the conclusions of Félix et al. (2007) who had shown a negative relationship between the labour market of 23 European countries and the development of their venture capital markets.

Additionally, our empirical estimation showed that the private equity funds were very vulnerable and wary about the high level of unemployment in some European countries. The negative relationship between both variables could reflect the fact that an increase in the number of unemployed persons will not translate into an increase in self-employment which, in turn, would have led to an increase in the demand of private equity investments.

With respect to the R&D expenditure, the results of the fixed and random models show that this variable is not a driving factor for private equity evolution in Europe. The coefficient was not statistically validated as significant and the signal of the coefficient varies across models. This is not in line with the existing results of the literature.

In tables 6 and 7, only one model which was tested with both fixed and random effects illustrated a statistically significant and negative relationship between the R&D expenditure and the European private equity market. However, one should underline that t-statistics values were statistically validated at the significance level of 10%. The negative relationship between both variables is contrary to the results obtained by Gompers and Lerner (1998) or Romain and de La Potterie (2004). A possible explanation would be that our variable does not measure the innovation correctly. An argument to the previous statement would be that authors such as Romain and de La Potterie (2004) used two additional variables to present the role of R&D expenditure and those two variables were actually statistically validated in their regressions.

In this paper, we have introduced one institutional variable which is the corruption. In tables 6 and 7, the corruption was statistically validated as significant with a probability of 99% and this variable generally had a negative impact on the evolution of private equity investments in Europe. Following our analysis, a certain increase in corruption in some European countries will lead to an outflow of private equity investments from that country. This relationship between corruption and private equity investments is in line with the hypothesis of our model.

Finally, with respect to the effect of the productivity on the private equity activity in Europe, the results of our estimations showed that the signal of the coefficient is positive. This paper is the first to establish a relationship between the productivity and the evolution of private equity in Europe and in our models with fixed and random effects, the coefficients of the productivity were statistically validated as significant with a probability of 99%.

5.4. Robustness – Hausman test

In this paper we had run the Hausman specification test in order to compare the consistency of fixed effects models and random effects models. The null hypothesis of the Hausman test suggests that the coefficients of both estimations with fixed, and respectively with random effects are consistent but only the coefficients of the estimation with random effects are more efficient for our model. Hence, the acceptance of the Hausman null hypothesis will lead us to conclude that the estimation with random effects is more suggestive to explain the impact of the independent variables on the evolution of private equity in Europe.

Table 8 (see the Appendix) reports the results of the Hausman test. One could observe that for all estimated columns and models the null hypothesis of the Hausman test is accepted, so we can choose the random effects estimation as optimal for our regression. Hausman test shows that the estimated value for χ^2 is less than its critical table value which makes us accept the null hypothesis of random effects estimation as being optimal.

6. Conclusions

This paper studies the determinants of the European private equity activity during the last crisis using fixed and random effects models. The panel regressions are based on 378 observations collected over 14 years from 27 European countries. The empirical model includes many of the determinants already tested in previous studies (GDP growth, market capitalization, research and development expenditures, interest rates, etc.) and also new variables such as productivity and corruption index which we consider important factors in explaining the evolution of private equity investments in Europe.

This paper estimated both fixed effects models and random effects models in order to understand the impact of macroeconomic variables on the private equity activity in Europe. In most cases, Hausman's test showed that the random effects models seemed

to be more efficient than the fixed effects models to explain the evolution of the private equity investments in Europe.

Of the seven key factors that have been analysed, we obtained the results which confirmed the assumptions and the conclusions of the existing literature for the following variables: market capitalization and unemployment. These two variables were also the main drivers of the private equity activity in Europe because were statistically validated as significant with the highest probabilities.

Furthermore, our study showed that the new determinants we introduced in our model - corruption index and the productivity - were clearly relevant in explaining the development of the private equity activity in Europe.

The variable of economic growth rate presents quite significant negative coefficients across countries where this variable was validated as significant and this contradicts the results of the existing literature.

Finally, the independent variables represented by the interest rate and by the research and development expenditure did not have a significant effect on the private equity investments in Europe during the last years.

This paper identified the main drivers of private equity investments evolution in the European countries during 2000 – 2013. Furthermore, the dynamics of these determinants could provide us information about the possible future evolution of private equity in Europe.

Based on our empirical results, one important recommendation is that the European unemployment crisis should become a priority on every policymaker`s agenda. This research shows that the private equity investors are very susceptible to the level of unemployment in the European countries, and increases in unemployment and long-term unemployment could harm the private equity investments in Europe over a large period of time.

The last recommendation for the policy makers in Europe is that the further development of immature capital markets in Europe would increase the opportunities for private equity funds to find better deals to divest. Better developed capital markets in European countries would show stronger real economies and would be an incentive for the private equity investors to raise additional funds for those economies.

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Annexes

Table 4. Descriptive statistics

| | Mean | Maximum | Minimum | Std. Dev. | Observations |
|----------------------------|-------------|----------------|----------------|------------------|---------------------|
| Private equity investments | 1941637 | 40897427 | 0.000000 | 4683575 | 294 |
| Economic growth | 0.888002 | 9.500000 | -8.900000 | 2.370771 | 294 |
| Interest rate | 3.046742 | 22.500000 | 0.021100 | 2.639068 | 294 |
| Unemployment | 5.482813 | 27.500000 | 0.044000 | 4.979249 | 294 |
| R&D expenditure | 1.298189 | 3.910000 | 0.003500 | 1.148342 | 294 |
| Market capitalisation | 4.55 | 3.86 | 5.05 | 7.25 | 294 |
| Corruption | 0.326531 | 1.000000 | 0.000000 | 0.469743 | 294 |
| Productivity | 48.42786 | 93.96500 | 3.773930 | 25.92686 | 294 |

Source: the author

Table 5. Correlations Matrix

| | Private equity | Economic growth | Interest rate | Unemployment | R&D expenditure | Market capitalisation | Corruption | Productivity |
|-----------------------|----------------|-----------------|---------------|--------------|-----------------|-----------------------|------------|--------------|
| Private equity | 1 | | | | | | | |
| Economic growth | 0.147 | 1 | | | | | | |
| Interest rate | 0.155 | 0.027 | 1 | | | | | |
| Unemployment | 0.140 | -0.010 | 0.802 | 1 | | | | |
| R&D expenditure | 0.206 | 0.205 | 0.481 | 0.523 | 1 | | | |
| Market capitalisation | 0.880 | 0.170 | 0.221 | 0.318 | 0.309 | 1 | | |
| Corruption | -0.242 | -0.255 | -0.373 | -0.407 | -0.653 | -0.342 | 1 | |
| Productivity | 0.249 | 0.367 | 0.601 | 0.526 | 0.811 | 0.338 | -0.661 | 1 |

Source: the author

Table 6. Empirical results with fixed effects models for the Private Equity variable

| Potential Determinants | Private equity (Fixed Effects) | | | | | |
|----------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|---------------------------------|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Economic growth | -2074,65 (-0,033) ^c | -18203,83 (-0,314) | 8409,94 (0,147) ^c | | -469,61 (-0,007) | -2942122 (-0,380) |
| Interest rate | 184634,0 (1,982) ^e | | | | | |
| Unemployment | -105382,4 (-1,348) ^a | -26157,72 (-0,408) ^a | -60347,18 (-0,962) ^a | -64547,89 (-1,158) ^a | -54953,73 (-0,853) ^a | -25864 (-0,403) ^a |
| R&D expenditure | 5890382,4 (0,653) ^e | | | | -359659,5 (-0,434) | |

| | | | | | | |
|------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Market capitalisation | 6,40E-06 (11,642) ^a | 6,27E-06 (11,77) ^a | 6,07E-06 (11,477) ^a | 6,08E-06 (11,601) ^a | 6,10E-06 (11,358) ^a | 6,21E-06 (11,790) ^a |
| Corruption | -17816.24 (-0,55) ^e | -24539.06 (-0,809) | -3312.00 (-0,114) | -2642.05 (-0,092) | -5175.32 (0,174) ^a | |
| Productivity | 46320.28 (1,663) ^e | 51724.49 (2,209) | | | | 45724.32 (2,061) ^a |
| Adjusted R-squared | 0,853 | 0,854 | 0,851 | 0,852 | 0,851 | 0,854 |

Source: the author. The table presents the results of fixed effects panel data models. The values of the t-statistics for each variable are presented in parentheses. The t-statistics values are significant at the following levels: ^a significance at 1%; ^b significance at 10%; ^c significance at 15%; and, ^e significance at 20%.

Table 7. Empirical results with random effects models for the Private Equity variable

| Potential Determinants | Private equity (Random Effects) | | | | | |
|------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|-----------------------------------|------------------------------------|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| Economic growth | -26075,80 (-0,446) ^c | -27260.86 (-0,490) | -12858.31 (-0,237) ^c | -460083.5 (-0,426) | -531232.1 (-0,888) | |
| Interest rate | 248059,3 (2,670) ^e | | | | | |
| Unemployment | -215713,5 (-3,434) ^a | -114617.1 (-2,312) ^a | -108431.3 (-2,229) ^a | -105245.6 (-2,363) ^a | -97040,4 (-1,838) ^a | -118309.9 (-2,413) ^a |

| | | | | | | |
|------------------------------|------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| R&D expenditure | -183230,3 (-0,457) ^e | | | | | -233233,2 (-0,567) |
| Market capitalisation | 6,17E-06 (18,756) ^a | 6,05E-06 (16,822) ^a | 6,04E-06 (17,031) ^a | 6,03E-06 (17,381) ^a | 6,06E-06 (16,723) ^a | 6,01E-06 (17,241) ^a |
| Corruption | 2883,24 (0,126) ^e | -15799,28 (-0,784) | -506,411 (-0,035) | -1247,59 (-0,090) | 7640,482 (0,361) ^a | |
| Productivity | 907,12 (0,056) ^e | 17010,84 (1,095) | | | | 8397,82 (0,753) ^a |
| Adjusted R-squared | 0,589 | 0,524 | 0,534 | 0,541 | 0,529 | 0,605 |

Source: the author. The table presents the results of random effects panel data models. The values of the t-statistics for each variable are presented in parentheses. The t-statistics values are significant at the following levels: ^a significance at 1%; ^b significance at 10%; ^c significance at 15%; and, ^e significance at 20%.

Table 8. Hausman test estimations

| Model | Variables | X ² estimated value | X ² critical value | Probability | Ho or Ha* validated | Estimation Efficient |
|----------|-----------------------|--------------------------------|-------------------------------|-------------|---------------------|-----------------------|
| 1 | Economic growth | 12.02 | 14.7 | 0.11 | Ho | Random effects |
| | Interest rate | | | | | |
| | Unemployment rate | | | | | |
| | R&D expenditure | | | | | |
| 2 | Market capitalisation | 5.61 | 11.07 | 0.34 | Ho | Random effects |
| | Corruption | | | | | |
| | Productivity | | | | | |
| | Unemployment rate | | | | | |
| 3 | Market capitalisation | 2.01 | 9.49 | 0.73 | Ho | Random effects |
| | Corruption | | | | | |
| | Productivity | | | | | |
| | Unemployment rate | | | | | |
| 4 | Market capitalisation | 2.01 | 7.81 | 0.58 | Ho | Random effects |
| | Corruption | | | | | |
| | Productivity | | | | | |
| | Unemployment rate | | | | | |
| 5 | Market capitalisation | 1.85 | 11.07 | 0.87 | Ho | Random effects |
| | Corruption | | | | | |
| | Productivity | | | | | |
| | Unemployment rate | | | | | |
| 6 | Market capitalisation | 5.68 | 9.49 | 0.23 | Ho | Random effects |
| | Corruption | | | | | |
| | Productivity | | | | | |
| | Unemployment rate | | | | | |

Source: the author based on the information provided by Hausman test. *) Ho is null hypothesis, Ha is alternative hypothesis