

# Meta-analysis of determinants of venture capital activity

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## ABSTRACT

**Objective:** The objective of the article is to quantitatively systematise the existing literature on country-level venture capital (VC) activity and find the sources of discrepancy in previous studies.

**Research Design & Methods:** This article collects studies that focus on venture investments across countries. I retrieved 840 estimates reported in 30 studies and analysed them using meta-analysis methods. The average effect sizes were estimated and corrected for publication bias. Then, I controlled for 24 aspects of study design and data in order to find the cause of differences in the primary results.

**Findings:** The findings suggest that the average effect of the studied determinants of VC activity is positive and significant. Technological opportunities, macroeconomic conditions and financial market development show the highest effect which confirms the previous research. The choice of data source influences the results in a systematic way, while model specification does not affect the reported coefficients. The results showed that drivers of VC in developed and developing countries do not differ significantly, the same finding is obtained for various stages of VC.

**Implications & Recommendations:** The analysis of existing literature delineates the research agenda for further enhancing the institutional, technological, and macroeconomic descendants of VC. It revealed that informal institutions have been studied scarcely and deserve more attention in future research. The findings show that VC is not heterogeneous across the stages of investment which is important for venture fund management. By scrutinizing different aspects of model design and data samples I provide methodological recommendations for further research.

**Contribution & Value Added:** To my knowledge, this is the first meta-analysis of VC determinants. The research method allowed to quantitatively summarise previous studies and detect the between-study differences. This article collects all the coefficients of VC drivers that have been reported up to date while previous literature reviews focused on some limited sets of variables. The article contributes to existing theory by answering the questions regarding VC heterogeneity.

**Article type:** research article

**Keywords:** venture capital; literature review; meta-analysis; publication bias

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## INTRODUCTION

The year of 2018 impressed with record figures of venture capital (VC) invested worldwide at over 250 billion USD (KPMG, 2018). In 2020, the market remained strong, defying concerns of a potential slowdown due to the pandemic. While the USA continue driving global VC, Asia ranks second in investment levels, raising nearly twice the amount European VC-backed companies did (21.1 bln USD versus 12.1 bln USD) in the third quarter of 2020 (KPMG, 2020). The academic literature stresses the importance of a vibrant VC market. Lerner and Tag (2013) emphasize that the ability of VC investors to overcome information asymmetries and provide capital to innovative business boosts economic growth. Allen (2012) summarizes the positive effect of VC on welfare. Popov and Roosenboom (2013) and Popov (2014) find that VC increases the rate of new business creation.

A growing number of studies answer questions regarding the VC industry's evolution and mounting investments. However, the evidence across studies is inconclusive, which creates obstacles in their interpretation and theory-building. Considering extant VC literature reviews, we observe an evolution from mostly descriptive works to structured articles with more thorough sample building. Apart from some prominent surveys published recently (Wallmeroth *et al.*, 2018; Devigne *et al.*, 2018; Tykvová, 2018; Hahn *et al.*, 2019; Grilli *et al.*, 2019), most reviews fail to detect inconsistencies in primary studies. Although reviews have evolved from descriptive to structured articles, the majority utilize qualitative methods, while quantitative research of VC literature remains scarce.

The novelty of this article is that it provides a quantitative analysis of previous studies on VC determinants across countries. Given the sufficient volume of cross-country research meta-analysis was used as a method, which, to my knowledge, is the first meta-analysis in this discipline. By combining data from individual studies, I calculate effect sizes on a greater sample and correct it for publication bias, which allows for more precise estimates of underlying relationships (Glass, 1976). Meta-regression analysis provides statistical evidence on the causes of the variation in results in primary studies, which could not be done in a qualitative literature review. This study also covers all determinants of the VC market activity that were analysed before, while former reviews focus on specific drivers. Moreover, I have included the most recent studies, many of which have not been used in earlier reviews.

Previous surveys detect methodological issues in VC research. Tykvová (2018) argues that different results may be obtained from different proxies and econometric methodologies. Data source may also introduce a statistical bias due to differences in definitions of VC across countries (Devigne *et al.*, 2018). Other issues include heterogeneity of investors and cyclicity of the VC industry, which may introduce biases in panel data analysis (Manigart & Wright, 2013; Drover *et al.*, 2017; Grilli *et al.*, 2019). In general, authors argue that more comparative and replicative studies with independent datasets are needed to enhance accumulated knowledge (Cumming & Vismara, 2017; Drover *et al.*, 2017).

This meta-analysis addresses the aforementioned methodological issues. In the meta-regression, I will control for data sources and econometric models used in each primary study to see if they influence the effect values. Similarly, the stage of VC investments is used as a moderator variable to provide evidence on the heterogeneity of investors since many authors defined it as an open question in VC research. To shed light on the possible influence of institutional context, I differentiate between samples of developed and emerging countries utilised in primary studies.

This article has several research objectives. Firstly, it systematizes the empirical evidence on the determinants of VC activity. I conduct a keyword search in the main databases and complement it with a manual search in references, which yielded a comprehensive set of studies produced to date. Secondly, I analyse VC determinants using combined datasets, which significantly decreases sampling error and provides an overall reliability which is unavailable from any single study alone. It also helps to cover all variables that were studied in the existing literature. The result of the analysis are mean effect sizes of each variable corrected for heteroskedasticity and publication bias. The third objective is to observe factors influencing the variation of coefficients across studies. In order to do so, I run a meta-regression on the characteristics of articles in the sample. These moderators include data characteristics and methodology. While previous literature reviews critically appraise the current state of the literature, this study reports the statistical evidence on existing gaps.

The remainder of this article will be organized as follows. Firstly, I will review the previous literature on country determinants of VC and formulate hypotheses. Then, I will present how the sample was collected and discuss the meta-analysis methodology. The next part will cover effect sizes that have been obtained and the results of meta-regression analysis. In conclusion, I will discuss the limitations of the study and propose avenues for future research.

## LITERATURE REVIEW

There is an ongoing academic endeavour in determining the effects of country characteristics on VC activity. The modern stream of literature on VC investments applies a supply and demand model initially

developed by Black and Gilson (1998) and Gompers and Lerner (1999). Studies propose a wide range of supply-side and demand-side variables that may influence the volume of VC investment in a country.

This review considers all variables found in the existing literature. I also added variables that have been overlooked by the previous literature reviews, which include the country's FDI, along with the annual volume of trade and exports. As most variables considered in primary studies are proxies for a handful of underlying factors, I grouped them into meta-categories. These meta-categories follow the classification of Grilli *et al.* (2019) and consist of three main clusters: 1) institutions (formal and informal); 2) technological opportunities; 3) macroeconomic conditions. In the next subsections, I consider each category and build relevant hypotheses.

### Formal Institutions

Institutions in the form of two groups, formal and informal, were introduced by North (1990). Formal institutions are particularly important in managing the risks of venture investing. High levels of uncertainty in the VC environment, coupled with potential information asymmetry between investors and entrepreneurs, force venture capitalists to regularly utilise risk mitigation mechanisms. The efficiency of such mechanisms is dependent upon well-functioning formal institutions. Formal institutions were abundantly studied in VC literature. They may be categorized in regulatory conditions (including fiscal policy and labour markets), government quality, and financial markets.

The role of the legal environment in mitigating risks was established in the extant research (Lerner & Schoar, 2005; Armour & Cumming, 2006; Hazarika *et al.*, 2009; Cumming *et al.*, 2010; Aggarwal & Goodell, 2014). States with relatively low or unreliable investor protection (i.e. civil law countries) develop smaller VC markets in comparison to common law countries. Protection of investor rights and disclosure requirements aim to reduce information asymmetries and opportunistic behaviour among involved parties (Grilli *et al.*, 2018; Jeng & Wells, 2000; Cumming *et al.*, 2016). An availability of contract instruments, such as convertible bonds and limited partnership contracts, improves the governance of entrepreneurial firms (Cumming, 2011). With regard to fiscal policy, previous studies show that low corporate tax results in higher returns for venture capitalists, while reduced capital gains tax produces profits for equity type of investing, benefiting both VC managers and entrepreneurs (Armour & Cumming, 2006; Popov & Roosenboom, 2013). An empirical analysis concludes that high tax rates seem to be one of the major obstacles for venture industry growth in Europe (Grilli *et al.*, 2018). The labour market rigidity shows influence on the demand side of the VC industry. The strict labour regulation is seen to increase costs for young firms and lower the entrepreneurial base, as was concluded by the majority of existing studies (e.g., Jeng & Wells, 2000; Cumming, 2011; Bonini & Alkan, 2012) with some exceptions (Grilli *et al.*, 2018).

In order to enforce the aforementioned regulatory tools, a high level of governance is needed. The existing studies provide evidence on the role of government in cross-country variation of VC. The impact of government quality holds for both global (Li & Zahra, 2012) and European context (Grilli *et al.*, 2018).

Financial market development is one of the most studied formal institutions. It comprises of domestic stock market capitalization, exit markets size, and performance of stock indexes. The category is considered as a determinant of the supply side of VC market. The ability to realize gains through exits is critical to VC funds as it generates a return for limited partners and increases the chance of future funds. However, the existing literature does not provide clear evidence on the impact for different stages of VC. Among the first to distinguish between different VC stages were Jeng and Wells (2000). Their model shows the positive impact of IPO market volume on the activity of late-stage VC. Later, Bonini and Alkan (2012) highlight the positive role of IPOs on early-stage deals. Schertler (2003) and Cumming (2014) show the positive effect of stock market capitalization on early-stage investments, while Félix *et al.* (2013) observe the significance of this variable only for later stages. Regarding geographical context, the mergers and acquisitions (M&A) volume has a bigger influence in Europe, in which the initial public offering (IPO) market is less vibrant (Félix *et al.*, 2013; Grilli *et al.*, 2018).

- H1:** Developed formal institutions – proxied by high investors legal protection, low taxation, flexible labour market, high government quality, and developed financial market – have a positive effect on a country's volume of VC investments.

### Informal institutions

Compared to formal institutions, informal institutions were overlooked in academic literature. They describe characteristics of individuals and refer to the demand side of the VC market. Modern research highlights the role of entrepreneurship, which represents country-level entrepreneurialism, social capital or trust, uncertainty avoidance, individualism, and power distance (Hain *et al.*, 2016). Drover *et al.* (2017) focus on informal institutions confirming they can shape VC investment patterns. The informal attributes, such as social networking, play an important role (Masiak *et al.*, 2020), especially elevated in weak legal environments (Ahlstrom & Bruton, 2006; Lingelbach, 2015). The cross-country variation in the levels of entrepreneurship is an important factor in VC investments (Romain & van Pottelsberghe, 2004), yet the effect of entrepreneurship may be mediated by other institutional variables. Wessendorf *et al.* (2020) demonstrate the importance of entrepreneurial spirit on the firm level.

With the increasing internationalization of VC, more studies focus on cultural distance and trust, but the findings are inconclusive. Nahata *et al.* (2014) showed that cultural distance positively affects VC success, Li *et al.* (2014) found the opposite effect. There is a negative relationship between trust and exit pay-out, but more sophisticated venture capitalists tend to invest more in low trust countries (Bottazzi *et al.*, 2016).

**H2:** Developed informal institutions, including entrepreneurship, individualism, trust, and low uncertainty avoidance, have a positive effect on a country's volume of VC investments.

### Technological opportunities and macroeconomic conditions

A large body of literature considers the link between innovation and VC. There are various proxies for technological opportunities across academic works such as patents, public and private R&D expenditures, and R&D capital stock. Recent studies proxy technological opportunities with innovation index (e.g., Sargon & Katircioğlu, 2019). The use of proxy seems to affect the results. It was shown that innovation boosts venture investment activity in European high-income countries. Ning *et al.* (2019) show the positive impact of patent creation on VC industry growth. At the same time, Grilli *et al.* (2018) find a negative correlation between private R&D investments and VC activity. Authors explain the negative relationship with the choice of the measure used. Namely, the more funds private companies invest in R&D, the less they might be interested in start-ups as a source of technological innovation, which reduces the volume of acquisitions, one of the key VC exit mechanisms. In general, technology is a booster for the business creation and demand for VC.

**H3:** A high level of technological opportunities, measured by the volume of R&D, patents creation, and innovations, has a positive effect on a country's amount of VC investments.

The GDP growth rate is the most studied driver of VC, but the empirical evidence on its significance is mixed (e.g. Jeng & Wells, 2000; Black & Gilson, 1998; Hain *et al.*, 2016). Many studies show a procyclical nature of VC market with an increasing volume of investments in times of economic expansion (e.g., Jeng & Wells, 2000; Ning *et al.*, 2019). At the same time, Sargon and Katircioğlu (2019) do not find any significant effect of this variable in European countries. Mustafa and Mazhar (2020) show that GDP growth along with inflation rate are influential in the Indian VC market.

**H4:** Favourable macroeconomic conditions, including a growth of GDP and volume of trade, have a positive effect on a country's volume of VC investments.

## RESEARCH METHODOLOGY

### Data selection

The collection of data and research methodology was implemented with the compliance of reporting guidelines for meta-analysis in economics (Havranek *et al.*, 2020).

As the first step, a key word search was completed in Web of Science and Scopus databases and Google Scholar search engine. I used the combination of keywords that were selected in order to

exhaustively cover my research hypotheses. The process of building the search inquiry and all key words are presented in Table 1.

**Table 1. Keyword search strategy**

Main keyword	venture	capital	determinants	institution
Synonyms	private equity	investments	growth	market
		funding	country	exit
		activity	structure	IPO
		finance	analysis	regulation
			empirical	entrepreneurship
				disclosure
				corruption
				macro
				GDP

Source: own study.

The date of the last search was 12.10.2020. No limits were set for the year of publication, database indexes, and publication status; anonymous records were excluded. Along with a keyword search, I scanned reference lists of included studies or relevant reviews. This procedure helped to ensure a more complete coverage of the topic by accounting for the variability of scholarly works.

In the second step, articles were evaluated according to eligibility criteria in line with the research hypotheses. After the screening of abstracts and checking for the availability of the full texts, 167 unique contributions were assessed following the inclusion rules from Table 2.

**Table 2. Eligibility criteria for selected studies**

No.	Criteria	Description
1.	Dependent variable	Dependent variable is country-level venture investments across all stages of VC.
2.	Empirical study	Empirical study provides concrete evidence on the relationship between variables.
3.	Data	Statistical coefficients, number of observations, standard errors (SE) or t-statistics are reported.

Source: own study.

The first criterion specified the country-wide scope of the study and a definition of dependent variable. In order to comply with my research objectives, I excluded works that do not distinguish between VC and private equity funds. In order to draw valid conclusions on the phenomenon under investigation, I limited the sample to empirical studies. The last criterion specified that the empirical articles report statistics that can be converted into effects sizes that include beta coefficients, SE or t-statistics and number of observations. As a result, 30 primary articles were selected, which yielded 840 observations for the meta-analysis.

### Research methods

Coefficient estimates and SE were collected from the primary studies. Given the broad set of proxies in the selected articles, it is worthwhile to recalculate them to a common metric. I transformed the adjusted estimates into partial correlation coefficients (PCC) following the Equation 1. The choice of PCC was driven by the wide use of the coefficient in recent meta-analysis studies (Irsova & Havranek, 2013) and the nature of variables under study. According to Stanley and Doucouliagos (2012), PCC is a unitless estimation of the size and direction of the association between two factors holding other variables constant.

$$PCC = \frac{t}{\sqrt{t^2 + df}} \tag{1}$$

where:

- $PCC_i$  - is an effect size measured by partial correlation coefficient;
- $t$  - is the t-statistic of the coefficient from primary study;

$df$  - is the degrees of freedom collected from primary study.

Next, effect sizes were corrected for the presence of publication bias. Publication bias is identified as a tendency of authors to report statistically significant results that support widely accepted theory (Stanley & Doucouliagos, 2012). In order to quantify the degree of observed reporting bias, I employed the FAT-PET analysis shown in Equation 2. Funnel-asymmetry test (FAT) is based on hypothesis that effect sizes are independent of their SE in the absence of publication bias. The precision effect test (PET) indicates the effect beyond the publication bias.

$$PCC_i = \beta_0 + \beta_1 SE(PCC_i) + \varepsilon_i \quad (2)$$

where:

$PCC_i$  - is the effect size;

$SE(PCC_i)$  - is the SE of the effect size.

Equation 3 was estimated using OLS with clustered SE and weighted least squares (WLS). Stanley and Doucouliagos (2015) demonstrated that WLS provides superior estimates compared to fixed effect and random effects models when there is publication bias or small sample, which is the case in this study. In WLS, studies are weighted by the inverse SE of PCCs, assuming lower SE indicates more precise findings. Following the trend in meta-analysis, I collected estimates from all specifications in each study. As argued by Havranek *et al.* (2020) the omission of some specifications in the studies leads to arbitrary selection bias, while averaging of reported estimates discards a lot of information. Therefore, some articles presented a high number of coefficients, which may result in overweighting particular studies. To address this problem, I ran another WLS weighted by an inverse number of estimates in primary study (Astakhov *et al.*, 2019; Zigraviova & Havranek, 2016).

The final research objective was to observe factors influencing the variation of findings across primary studies. Although articles included in the sample had similar research questions, they varied in study designs that may have affected reported results. The presence of heterogeneity in economic research and its impact on estimated effects was confirmed by Stanley and Doucouliagos (2012). In the case of VC studies, the observed heterogeneity may stem from sample characteristics, model used, a measure of VC activity (dependent variable) and VC drivers (independent variables). To account for possible disparity, I ran a meta-regression based on FAT-PET Equation 3.

$$PCC_i = \beta_0 + \beta_1 SE(PCC_i) + \beta_k \sum_{i=1}^n X_{ki} + \varepsilon_i \quad (3)$$

where:

$SE(PCC_i)$  - is the SE of the effect size;

$X_{ki}$  - is the vector of mediator variables.

Table 3 provides an overview of mediator variables with their definitions and statistics. The obtained characteristics were transformed to dummy variables and divided in four groups: sample, model, dependent variable (DV), and VC driver.

The sample characteristics include dummies for the samples of developed countries (OECD members). The structure of VC market and the degree of institutional quality differ greatly between developed and developing states which can affect the results. Model characteristics capture regression model design. Most frequently used are GLS, OLS, fixed effects (FE), random effects (RE) and instrumental variables (IV). Other methods are used as a dummy reference. Moreover, I coded the measures of VC activity and whether it was scaled to GDP or population of the country. To control for the measure of VC driver in the study, I introduced ten dummy variables. Among them there were three macroeconomic determinants, (*gdp*, *trade*, and *unemployment*) and technological opportunities (*tech*). Fiscal policy, labour markets, other regulatory institutions, government quality, and financial markets represented formal institutions, while informal institutions were summarized in the variable *informal*. Publication characteristics were not included since the final sample consisted of studies taken from peer-reviewed journals.

**Table 3. Definition and summary statistics of variables**

Moderator variable	Definition	Obs	Mean	Std
Effect size	Effect size	840	0.111	0.213
Standard error	SE of the effect size	840	0.085	0.039
<i>Sample characteristics</i>				
Panel	=1 if panel data used	809	0.105	0.206
Time-series	=1 if time-series data used (reference)	31	0.262	0.314
Time dummy	=1 if time dummy was used	208	0.086	0.128
EVCA	=1 if European VC Association is used as a data source	430	0.085	0.159
TR	=1 if Thomson Reuters is used as a data source	359	0.118	0.222
Other	=1 if other data source is used (reference)	51	0.280	0.394
Developed	=1 if only developed countries are included in sample	537	0.108	0.200
Global	=1 if developed and developing countries are included in sample (reference)	303	0.115	0.235
<i>Model characteristics</i>				
GLS	=1 if estimation method is GLS	40	0.142	0.157
OLS	=1 if estimation method is OLS	137	0.188	0.280
FE	=1 if estimation method is fixed effects	329	0.101	0.220
RE	=1 if estimation method is random effects	254	0.084	0.159
IV	=1 if estimation method is instrumental variables	35	0.076	0.140
Other	=1 if other estimation method is used (reference)	45	0.094	0.234
<i>DV characteristics</i>				
Scaled	=1 if DV is scaled to GDP or population	626	0.103	0.213
VC investments	=1 if DV is VC investments	576	0.112	0.241
VC funds raised	=1 if DV is new VC funds raised	79	0.067	0.110
Early VC investments	=1 if DV is early-stage VC investments	172	0.131	0.125
Late VC investments	=1 if DV is late-stage VC investments	8	0.076	0.175
Other	=1 if DV is another measure (reference)	5	-0.031	0.334
<i>VC driver</i>				
Fiscal	=1 if fiscal incentives are used as a VC driver	82	0.018	0.240
Labour	=1 if fluidity of labour markets is used as a VC driver	23	0.053	0.103
Other regulatory	=1 if other regulatory institutions are used as a VC driver	67	0.016	0.145
Government	=1 if governmental quality is used as a VC driver	64	0.100	0.131
Fin. Market	=1 if financial market conditions are used as a VC driver	194	0.133	0.218
Informal	=1 if informal institutions are used as a VC driver	34	0.146	0.191
Tech	=1 if technological opportunities are used as a VC driver	142	0.197	0.217
GDP	=1 if GDP is used as a VC driver	177	0.126	0.225
Trade	=1 if trade is used as a VC driver	22	0.148	0.163
Unemployment	=1 if unemployment rate is used as a VC driver (reference)	35	-0.044	0.149

Source: own elaboration in Stata.

## RESULTS AND DISCUSSION

The obtained mean effect sizes of VC drivers taken from 30 studies are summarised in Table 4. Hadi's (1992) multivariate outlier method was applied to filter effect sizes and SE. The procedure identified nine outliers, resulting in 831 observations in the general sample. Column 1 presents unweighted means measured by OLS with SE clustered at the study level. Columns 2 and 3 depict means weighted by the study's precision (inverse SE) and inverse number of estimates collected per study, respectively.

All means are above zero indicating a direct association between country characteristics and the volume of VC investments. Technological opportunities, which present patents creation and R&D sector of the country, show the highest effect on VC activity, which is consistent with previous research (Sargon & Katircioğlu, 2019; Ning *et al.*, 2019). Doucouliagos (2011) provides guidelines for the magnitude of effects in meta-analysis. The partial correlation coefficient (PCC) below 0.07 is considered negligible, between 0.07 and 0.17 shows a small effect, the range from 0.17 to 0.33 displays a moderate effect, and coefficients above 0.33 have a strong effect on dependent variable. In the meta-analysis technological opportunities exhibit the moderate effect, while other variables have the small effect on VC volume. There are no variables whose PCCs fall below 0.07.

**Table 4. Estimates of the country characteristics effect sizes**

Variable	OLS (unweighted)	WLS (precision)	WLS (estimates)	Obs
All variables	0.106***	0.102***	0.105***	831
All institutions	0.077***	0.085***	0.078***	458
Formal institutions	0.072***	0.078***	0.076***	424
Financial market conditions	0.104***	0.096***	0.102***	187
Macroeconomic variables	0.134***	0.110***	0.155***	198
Technological opportunities	0.190***	0.177***	0.163***	138

Notes: \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively.

Source: own elaboration in Stata.

Following the methodology, the next step was to correct estimates for publication bias (see Table 5). The significant coefficient for SE shows the presence of selective reporting, while the intercept was the corrected underlying mean size. Column 1 presents the baseline OLS result of regressing coefficients of country characteristics on their SE. Column 2 shows the findings of WLS specification when the precision is used as the weight. Similarly, column 3 summarizes the results of WLS model weighted by inverse number of estimates per study.

The FAT-PET analysis supports the positive effect of country characteristics after adjusting for reporting bias. All models present the significant values for intercept for general sample and groups of institutions. The results show the negative publication bias for these variables, and at the same time, the corrected effect is higher than in Table 4. Similar results are obtained for financial markets, technological, and macroeconomic characteristics. Interestingly, WLS provides no evidence of selective reporting for these variables. Overall, there is a positive underlying relation between all country specific factors considered in the literature and VC activity. To evaluate the extent of selectivity, Doucouliagos and Stanley (2013) developed guidelines, in which substantial bias lies in the range between 1 and 2. Thus, the presented evidence points to moderate publication bias shown by OLS and WLS estimators. Moreover, studies tend to underestimate the positive effect size of a country's institutional development, which was shown to be more pronounced than is commonly argued.

Previously, I scrutinized the literature and discussed the discrepancy in the existing studies' results. The final objective is to explore what drives this heterogeneity by testing the characteristics of the articles with meta-regression. Table 6 reports the results of meta-regression with all variables described in Table 3. The random effects multi-level (REML) model was tested to be the most appropriate.



**Table 5. FAT-PET estimates for country characteristics effect sizes**

FAT-PET	OLS	WLS (Precision)	WLS (Estimates)	Obs
<i>All variables</i>				
SE (reporting bias)	-0.204 (0.429)	0.201 (0.479)	-0.757 (0.002)	831
Constant (corrected effect)	0.123 (0.000)	0.089 (0.001)	0.171 (0.000)	
<i>Institutions</i>				
SE (reporting bias)	-0.650 (0.022)	-0.366 (0.326)	-0.866 (0.001)	458
Constant (corrected effect)	0.135 (0.000)	0.110 (0.002)	0.155 (0.000)	
<i>Formal institutions</i>				
SE (reporting bias)	-0.581 (0.016)	-0.271 (0.395)	-0.827 (0.000)	424
Constant (corrected effect)	0.125 (0.000)	0.097 (0.010)	0.150 (0.000)	
<i>Financial market conditions</i>				
SE (reporting bias)	0.121 (0.778)	0.429 (0.341)	-0.238 (0.569)	187
Constant (corrected effect)	0.094 (0.012)	0.067 (0.004)	0.123 (0.001)	
<i>Macroeconomic variables</i>				
SE (reporting bias)	0.479 (0.328)	1.141 (0.023)	0.316 (0.740)	198
Constant (corrected effect)	0.096 (0.035)	0.045 (0.041)	0.130 (0.068)	
<i>Technological opportunities</i>				
SE (reporting bias)	0.550 (0.126)	0.822 (0.057)	0.881 (0.188)	138
Constant (corrected effect)	0.140 (0.001)	0.116 (0.005)	0.089 (0.120)	

Notes: *p*-values are indicated in the brackets

Source: own elaboration in Stata.

As for study characteristics, it shows that the data source affects the results. It can be explained by the difference in the definitions of VC across data sources. Thomson Reuters (TR) and EVCA have negative coefficients, which means that the use of other sources such as local VC associations may inflate the obtained estimates. This concern was raised in previous studies. Cumming (2014) showed that the use of different datasets may lead to contradictory findings. The literature review by Devigne *et al.* (2018) highlights the inconsistency in definitions of VC across countries. Venture capital is cyclical, which is supported by the significant time dummy. The studies that control for the observed period show lower effect sizes.

There is no difference in the effect of VC drivers between developed and developing countries. In developed countries investors pay the same attention to country specific factors as in emerging countries. This is a surprising result, since recent studies focus on the differences across countries. Tykvová (2018) and Grilli *et al.* (2019) call heterogeneity within VC one of the hot topics in current scientific discussion. The lack of heterogeneity of determinants among countries may be explained by the growing internationalization of VC. Funds have developed versatile policies that they apply to different countries. This trend is reflected in a mounting number of articles on cross-border VC (Devigne *et al.*, 2018; Tykvová, 2018).

**Table 6. Meta-regression analysis of moderator variables**

	REML	p-value	CI	
<i>Sample characteristics</i>				
Panel	-0.015	0.751	-0.110	0.079
Time dummy	-0.086	0.000	-0.128	-0.045
EVCA	-0.173	0.000	-0.237	-0.108
TR	-0.115	0.001	-0.185	-0.044
Developed	-0.001	0.980	-0.060	0.059
<i>Model characteristics</i>				
GLS	0.113	0.020	0.018	0.207
OLS	0.054	0.148	-0.019	0.126
FE	-0.020	0.559	-0.086	0.047
RE	0.015	0.652	-0.051	0.081
IV	0.007	0.886	-0.085	0.098
<i>DV characteristics</i>				
Scaled	-0.026	0.231	-0.069	0.017
VC investments	0.088	0.338	-0.092	0.268
VC funds raised	0.055	0.561	-0.130	0.240
early-stage VC	0.104	0.262	-0.078	0.286
late-stage VC	0.170	0.138	-0.055	0.395
<i>VC driver characteristics</i>				
Fiscal	0.043	0.288	-0.036	0.123
Labour	0.057	0.278	-0.046	0.160
Other regulatory	0.054	0.189	-0.027	0.135
Government	0.142	0.000	0.063	0.221
Fin. Market	0.139	0.000	0.069	0.208
Informal	0.172	0.000	0.082	0.262
Tech	0.205	0.000	0.133	0.278
GDP	0.144	0.000	0.074	0.214
Trade	0.143	0.006	0.041	0.246
constant	0.079	0.469	-0.135	0.294

Source: own elaboration in Stata.

The use of a particular econometric estimator does not affect the results of the study. However, the methodological advances are required to allow for causal interpretations of VC drivers and control for mediation effects in studied variables. The obtained result may be altered, as the number of studies increases that uses IV and other, more sophisticated methods.

There is no significant difference between the VC drivers' effect on early-stage versus late-stage VC investments. The finding argues that VC is not heterogeneous across stages. The result may be affected by the issue of defining the stage of VC. Early-stage deals are not always disclosed and may be underrepresented in VC databases (Devigne *et al.*, 2018). Firstly, the level of disclosure in developing countries is generally lower. Secondly, the use of angel investing as an alternative to VC for early-stage deals is increased in weak legal environments (Cumming & Zhang, 2019).

As discussed in the theory section, the choice of the VC determinant impacts the findings. This result is consistent with the initial FAT-PET estimation, in which technological opportunities show the largest significant effect. Surprisingly, informal institutions show the second highest effect. The positive effect is also observed for the variable trade, which represents the openness of the economy. This variable was quantitatively analysed in the literature review for the first time. The positive significant effect of GDP, financial market conditions and government quality supports the findings of previous studies.

## CONCLUSIONS

This article provides a thorough overview of produced results on the dynamics of VC development, and it statistically explains the causes of disparity in findings. The article collects 30 studies that shed light on how country characteristics can shape the VC market. The main research hypotheses were verified. Macroeconomic variables and technological opportunities positively affect the VC volume. Institutional variables are also important in venture market.

A methodological limitation is that meta-analysis can only correct the estimates provided by researchers. If all estimates are biased, then the meta-result will be biased as well. Furthermore, the effect of macroeconomic conditions is not one-sided. While GDP is one of the drivers of VC, venture market fosters business creation and welfare (Allen, 2012; Popov & Roosenboom, 2013; Popov, 2014). The methodology used by the articles in this study may not capture the underlying causal relationships. Another concern is the limited number of studies, especially those considering informal institutions and developing countries.

Based on the reviewed literature, I wish to highlight several venues for future research. The number of studies on different VC drivers remains uneven for informal institutions, which are overlooked. Currently, there is a lack of proxies for cultural attitudes, which are particularly important for international investments (Devigne *et al.*, 2018) and may be important for shaping VC policy (Grilli *et al.*, 2019). Future research should focus on this matter, as informal institutions presented significant effects in meta-regression. The articles that used data from developing countries appeared quite recently in VC discussion, much more research is needed to study processes in developing context (Drover *et al.*, 2017). Among the reasons are the low quality of data and immature VC markets in those regions. Replicating studies on different databases was suggested in previous literature reviews (e.g. Tykiová, 2018) as a mean to verify obtained results. The meta-analysis may be replicated with an enriched database in the future. The newest approaches that combine quantitative and qualitative analysis of previous literature (e.g. qualitative meta-analysis) may be especially helpful. There is a number of studies conducted on the firm level. An interaction between country-level and firm-level VC drivers is one of the prominent venues for future research. As mentioned above, methodological advances are required for capturing the complex relationships among institutional variables. The call for altering methodological tools already appeared in reviews by Drover *et al.* (2017) and Devigne *et al.* (2018).

The findings of this article should interest academics. It is important to control for the time period as VC is cyclical and may vary across different sample periods. Given the inconsistency of VC definitions, the international data sources are preferable. Researchers should be very careful in defining dependent variables, especially when it comes to scaling it to GDP or population, since it may invert country VC rankings (Cumming, 2011).

The results may be also useful for practitioners and innovation policy. The increasing internationalization of VC calls for investors' attention towards institutional characteristics across countries. Legal framework and cultural distance may increase the severity of the agency problem and costs for venture capitalists. Decision-making can be altered according to macroeconomic conditions and institutional variables of a region, in which the portfolio company is domiciled. Policymakers should draw more attention to the factors that were found to be significant in VC investments. Policy should focus not only on direct antecedents of VC like technology but also enhance government quality, reduce trade restrictions, and grow financial markets. Moreover, the shaping of informal institutions may become a new way for policymakers to foster national VC markets and encourage foreign capital inflow.

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#### Appendix: List of the primary studies used in meta-analysis

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### Conflict of Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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