ECO AUSTRIA
INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

July 2022

RESEARCH PAPER NO. 21

Government-backed venture capital investments and performance of companies: the role of networks

Monika Köppl-Turyna
Stefan Köppl
Dimitris Christopulos

www.ecoaustria.ac.at

ECO
AUSTRIA

RESEARCH PAPER NO. 21

Government-backed venture capital investments and performance of companies: the role of networks

Monika Köppl-Turyna – EcoAustria – Institut für Wirtschaftsforschung
Stefan Köppl – Herriot-Watt University
Dimitris Christopoulos – MODUL University Vienna

July 2022

Imprint:
EcoAustria – Institute for Economic Research,
Am Heumarkt 10, 1030 Wien, Austria, Tel: +43-(0)1-388 55 11

www.ecoaustria.ac.at

ECO AUSTRIA

Government-backed venture capital investments and performance of companies: the role of networks

Monika Köppl-Turyna, Stefan Köppl, Dimitris Christopulos

July 2022

Abstract

In this paper we analyze how different types of venture capital investments – private, public and indirect public – affect performance of portfolio companies. We use data on more than 20,000 VC deals in Europe between 2000 and 2018 and we hand collected a unique dataset on the institutional setting (public/indirect/private) of almost 5000 investors. We find that public VC investors perform consistently worse than purely private ones, while indirect public investments (such as the "Juncker Plan" or InvestEU investments) perform consistently better. We link these findings to the fact that public funds do not enter the best performing cliques of investments. On the other hand, indirect funds invest in the VC funds with the best network characteristics, which raises a question of whether indirect VC investments are associated with a high level of windfall gain, and not necessarily improve the value added by the VC funds. We confirm the main conclusions using instrumental variables' specifications.

Schlüsselwörter: venture capital, network analysis, governmental venture capital, European Investment Fund, syndication, public policy

JEL-Klassifikation: G24, G28, H81, L26, D73

Government-backed venture capital investments and performance of companies: the role of networks

Dimitris Christopoulos[a], Stefan Köppl[b] & Monika Köppl-Turyna[c*]

*[a]MODUL University Vienna, Department of Sustainability, Governance, and Methods, Am Kahlenberg 1, 1190 Vienna; [b]Heriot-Watt University, Edinburgh Campus The Avenue, Edinburgh EH14 4AS, United Kingdom; [c]EcoAustria – Institute for Economic Research, Am Heumarkt 10, 1030 Vienna, *monika.koeppl-turyna@ecoaustria.ac.at*

Abstract

In this paper we analyze how different types of venture capital investments – private, public and indirect public – affect performance of portfolio companies. We use data on more than 20,000 VC deals in Europe between 2000 and 2018 and we hand collected a unique dataset on the institutional setting (public/indirect/private) of almost 5000 investors. We find that public VC investors perform consistently worse than purely private ones, while indirect public investments (such as the "Juncker Plan" or InvestEU investments) perform consistently better. We link these findings to the fact that public funds do not enter the best performing cliques of investments. On the other hand, indirect funds invest in the VC funds with the best network characteristics, which raises a question of whether indirect VC investments are associated with a high level of windfall gain, and not necessarily improve the value added by the VC funds. We confirm the main conclusions using instrumental variables' specifications.

JEL Codes: G24, G28, H81, L26, D73
Keywords: venture capital, network analysis, governmental venture capital, European Investment Fund, syndication, public policy

---

1. Introduction

Long-term growth in modern, technology-driven economies is best achieved through innovation. And since innovation is often linked to entrepreneurship, recent policies aimed at promoting entrepreneurship through large scale public programs. For instance, European governments plan to spend 1,000 billion euros in years 2020 to 2030 to support businesses to innovate and grow. The EU plans to raise 372 billion euros in investment in sustainable technologies and digitization within the InvestEU programme, among others with equity instruments. While evidence of effectiveness of such policies has been at best mixed, the topic is of high policy importance. The interesting question is through which instruments this money is spent. In this work we focus on the role of public venture capital for fostering entrepreneurship and innovation.

There are several theoretical reasons for why government-backed VC firms (GVC) would have a different impact on the economy from the private ones. Moreover, even the very rationale for existence of GVCs has been subject to academic and policy-oriented debates. Foremost, compared to the US, there is less VC capital available in Europe. Moreover, the capital that is present is rather invested in later stages and for buyouts, rather than in early-stage financing. This rationale has led European policymakers to focus on early-stage funds. In fact, more than 30% of early-stage investments in Europe have been conducted by the governments (Kraemer-Eis et al, 2016). While it is beyond doubt, that informational asymmetries possibly lead to underprovision of private capital to early-stage ventures - and the problem seems to be more severe than for other forms of financing - it is far less clear whether public capital can help circumvent the problem. There is no obvious reason for which public-backed VCs should have any informational advantage over the private ones. In many a case, it leads to stringer disclosure standards in due diligence whenever public capital is involved, which likely generates additional costs.

On the other hand, public-backed capital is also used to circumvent another typical market failure: the public-good nature of innovation, which leads to its underprovision. By directly subsidizing innovative firms, policy makers hope to correct the externality and provide a socially optimal level of innovation. However, in this case, it is also empirically unclear, whether such policies bring expected returns. Hünermund and Czarnitzki (2019) provide an overview of evidence of causal effects of innovation policies and find that typically the positive effect is small, if any at all.

One of the possibilities, that governments can use to correct for the financial gap in funding new ventures, is to directly provide them with necessary capital. It can be done via non-repayable subsidies, debt, e.g., long-term loans with low interest, or equity, e.g., government-backed venture capital. The latter has been present in diverse forms: directly investing in entrepreneurial companies, as private-public funds, and as fund-of-funds – the latter conducted e.g. by the European Investment Fund.

GVCs, however, face a similar problem to the private ones – informational asymmetry - when it comes to assessment of investment opportunities. Moreover, investment of public means is not necessarily driven by highest expected profit, but by political considerations, such as investing in local markets or promoting local employment. While not necessarily being a bad thing, if aiming at e.g., fostering local growth, it comes with a risk of political abuse and thus inability to pick actual winners. On top of that, it has been argued that public VCs crowd out private money. Finally, GVCs might not be effective in monitoring, nurturing, and mentoring investee companies.

As described in more detail in the next section, there is a fair amount of empirical evidence, that government-backed VCs are less effective than private ones in positively stimulating performance of companies. What remains less well-understood is the question of why this is the case. In this paper, we look at this question from the perspective of network analysis and argue that one of the reasons for a poorer performance of public VCs in stimulating growth of companies are their different interconnectedness in the VC network of investors, which are, as shown e.g. by Hochberg et al (2007) for the US and Christopoulos et al (2022) for Europe, crucial elements of the success of portfolio companies. Due to different incentives to private funds, public VC firms are less often involved in the outstanding deals as they are not a welcomed partner for private firms. On the other hand, indirect governmental investments – such as funds of funds – perform better than the average but we hypothesize, that this is mainly due to selection of the best connected VCs rather than value added.

Using a new hand-collected dataset of about 5,000 investors combined with data on almost 20,000 deals in Europe, we find that public VCs are associated with lower number of financing rounds, a lower growth of sales after the deal, and a lower probability of an exit by an IPO or M&A, compared to deals involving only private VCs. On the other hand, involvement of indirect public VC is associated with better outcomes in all three cases, compared to the purely private VC. We show the latter result also using instrumental variables' approach, i.e. when considering for the fact, that unobservable characteristics of funds affect the probability of receiving an EIF investment. We link these effects to different network properties of the three types of VC funds, in particular to the fact, that public VCs are not members of the best-connected cliques of investors, who tend to enter syndicated deals. On the contrary, we also find evidence that indirect VC investments flow into the best-connected VCs, which at the same time perform the best and that there is little gain from the EIF investment in these cases. This raises the question of whether there are windfall gains associated with this type of governmental support.

2. Literature Review

2.1. Rationale for GVCs

Existence of government venture capital (GVC) is in the first place based on the premise, that an equity gap exists for early-stage investments. There are several reasons, for why seed-stage companies face a financing gap. Firstly, it is the public good nature of innovation, which leads to less financing for young, innovative firms, than the socially optimal level would be. Secondly, information asymmetries lead to insufficient investment, as potential investors cannot circumvent agency problems, such as moral hazard. The second market failure can be to a certain extent alleviated by venture capitalists, who monitor the portfolio companies directly, and actively participate in their management, as well as through careful contracting.

Government venture capital exists also for not strictly economic reasons, but rather because certain political goals are followed. For instance, even if no equity gap exists in the aggregate level, regional discrepancies might exist. Typically, start-ups and their investors are found in geographical clusters, while other parts of the country remain underdeveloped. Secondly, public policy might be interested in improving employment possibilities, independently of the purely economic reasoning. Finally, strategic reasons might encourage governments to develop local supply in some branches, such as e.g., health products.

While there are, at least, good theoretical reasons, for the benefits of GVCs, a careful scrutiny needs to take into account the potential pitfalls and costs. Firstly, government VCs might not be equally successful in picking the most innovative or performing companies, because they lack the assessment skills or because political reasons distort the decision-making. There is some evidence, that GVCs are less successful than private VCs (PVCs) in selecting the most promising portfolio companies, e.g., because of lack of rigour in the selection process (Christofidis and Debande, 2001; Leleux and Surlemont, 2003), or because of undue political pressure (whereas the latter argument can be considered a "feature" and not a "bug" of the government venture capital, in which political goals, such as regional development can be considered equally valid as a pursuit of the highest return on investment).

Secondly, governmental VCs might not be as successful in active management and monitoring development of portfolio companies, for instance, because of lack of necessary incentive schemes typical for private VCs. As Cumming et al (2017) observe, institutional VCs would typically use contracts with fund managers involving performance pay and hurdle rates and clawbacks in the event of poor performance (as reported for instance by Cumming and Johan, 2013). GVCs, by contrast, are reputed (whereas no systematic evidence exists on this matter) to have compensation terms that are comparatively invariant across managers and funds, and invariant over time and as such, agency problems in effort are exacerbated among public funds (Cumming et al., 2017).

2.2. GVCs and performance of companies

Regarding developing firms, Colombo, Cumming and Vismara (2016) provide an extensive literature overview of GVCs' impact on firms' performance. Of particular interest is one measure of performance: a probability of a successful exit. Some studies show positive impacts of GVCs on exits, e.g., Cumming and Johan (2016), find that GVC backing results in a higher percentage of investments that are publicly listed, as well as a greater market capitalization of such investments relative to both VC- and Private Equity-backed firms. Most other, however, are less optimistic. Brander, Du and Hellmann (2015) compare the performance of companies backed by government-backed VCs (GVCs) versus other types of VCs from 25 countries and they find that companies with mixed GVC and PVC backing have higher exit rates than companies backed only by not government-sponsored VCs, and this effect can be largely explained with the higher investment amounts. Companies backed purely by a GVC have significantly lower exits rates, even after accounting for their lower investment amounts (Da Rin, Hellmann and Puri, 2013). Cumming, Grilli and Murtinu (2017) also look at the impact of government versus private independent venture capital backing on the exit performance of entrepreneurial firms and shows that that private independent VC-backed companies have better exit performance than government-backed companies. Mixed-syndicates of private-independent and governmental VC investors give rise to a higher (but not statistically different) likelihood of positive exits than that of IVC-backing. Also, Cumming and Johan (2008) find that government VCs are more likely to have unsuccessful exits (secondary sales, buybacks and write-offs) insofar as they have inefficient organization structures.

2.3. Economic effects of GVCs

Innovation

When it comes to the effect of government-backed VCs on innovation, several studies looked at the effect of VCs on diverse measures of innovation such as total factor productivity (TFP), the number of patents, R&D inputs or growth. Pierrakis and Saridakis (2017) compare innovation rates, as measured by patenting rates, between privately and publicly backed companies in the UK. They conclude, that while private VC capital increases a probability of a patent application, backing by public capital *decreases* it. In contrast, the probability of a company to have a patent or have applied for one does not vary significantly between companies that receive investments from both the public and the private sector and those companies that receive investments solely from private VC funds. These results suggest that solely public VC investments are associated with lower innovation rates, and syndicates between public and private capital are not necessarily better than backing by a purely private capital.

Bertoni and Tykvova (2015) look at innovation rates of young biotech companies in Europe. They measure invention using patent stock at the company level, while innovation is proxied by the citation-weighted patent stock. Their main result shows that investment by non-syndicated government VCs do not have any impact on the invention or innovation rates. They do, however, boost the impact of independent venture capital investors on both invention and innovation if they syndicate, and so conclude that GVCs are a poor substitute for private capital but a good complementary resource.

Sales and Employment

Grilli and Murtinu (2014), using data provided by the European Commission, show that while a backing by a private VC is associated with higher employment growth compared to no backing, this does not hold for GVC. In fact, in some specifications, the authors find a negative relationship. The authors find a positive and statistically significant impact of syndicated investments by both types of investors on firm sales growth, but only when led by IVC investors. They conclude that the ability of governments to support high-tech entrepreneurial firms through a direct and active involvement in VC markets is doubtful.

A somehow more optimistic view is presented in Standaert and Manigart (2018). They look at employment growth in companies backed by the Belgian government fund-of-funds acting as a limited partner of private VCs and compares it to the case of direct investment by the GVC. They are able to show that also GVCs are associated with some employment growth, but it is much higher if the government acts indirectly but as a partner of an IVC. Finally, Croce, Martí and Reverte (2019), for Spain, find that that IVCs exert a higher impact on employment growth in invested companies than GVCs in investments carried out during a period of crisis whereas the opposite is found in the case of investments completed before the crisis.

Crowding out

Surlemont and Leleux (2003), for instance, look at the development of the industry in 15 European countries between 1990 and 1996 and find that public involvement causes greater amounts of money to be invested in the industry as a whole. This means, that no crowding out of private investment is present. They do show, however, that large public involvement correlates with smaller VC industries. Cumming and Johan (2019) survey the literature and find mixed effects, highly dependent on the region and context: for Canada there is evidence of crowding out by Cumming and MacIntosh (2006) and Cumming, Johan and MacIntosh (2017), while no such evidence is present for Europe. However, Cumming and Johan (2019) warn against drawing bad policy conclusions, resulting from studies of (lack of) crowding out, as these are often driven by methodological pitfalls.

2.4. Syndication and networks and performance of companies

There is a fair amount of evidence that syndication of investments affects the performance of companies, as reviewed by Jääskeläinen (2012), among others. Several channels are believed to be responsible for the positive effect of syndication: "four-eyes principle" improving the selection process, overcoming informational asymmetries, diversification for financial risk, improved deal flow, and finally, window dressing in later rounds. Building upon this literature Hochberg et al (2007) argue, that strong network characteristics of VC firms allow them to profit more from the benefits of syndication, and thus be related to more successful portfolios: for example, the number of VCs with which it has a relationship as proxies for the information, deal flow, expertise, contacts, and pools of capital it has access to. They conclude that strong network properties result in more financing rounds and a higher probability of an exit. Christopoulos et al (2022) found similar results for Europe.

3. Research questions and theoretical predictions

While there is tentative evidence, that public venture capital firms are associated with worse performance than the private ones, the topic is still fairly underdeveloped. Firstly, there is little evidence on different forms of public VC in Europe. To the best of our knowledge, the only study which looks at this topic in a systematic manner is Alperovych et al (2018). They do not, however, analyze how these two different forms correspond to performance, but only provide a descriptive analysis of different forms of governmental VC available in Europe. Systematically speaking, public equity support instruments include (Szkuta et al, 2020):

- Public venture capital funds directly investing in companies (henceforth *direct VC*): investment decisions are made by public officials, usually alongside a private co-investor. The private co-investors might be granted preferential tax treatment on capital gains or protected from losses through downside guarantees.

- Public funds investing in private VC funds (henceforth *indirect or hybrid VC*): Public funding is used only to leverage private investment. Investment decisions are taken by the private actors but the government sector may influence private funds' actions through guidelines or conditions governing investment criteria or individual deals. Public officials sit on the management boards of the private funds. One of the most common vehicles for indirect support is the fund-of-funds instrument whereby public funds-of-funds invest in private VC funds. This form of investment became highly important in the last years, since the European Investment Fund (EIF) started its fund-of-fund investments
- Equity guarantees or government-backed loans to finance VC: Governments loan money to private leverage Partners (LPs) fund-investors (family offices, banks, pension funds, etc.) to finance their VC investments or guarantee such investments by covering potential losses up to a defined limit.

While we exclude the third instrument in this research, we expect the first two - direct vs. indirect GVC - to have different characteristics and different effects. We are interested in the following research questions: Are there differences in the network properties between private and government VCs in Europe? What characteristics of government VC firms explain their access to networks of investors? Are government venture capital firms associated with worse performance of portfolio companies in the cross-European context, as found in the previous literature for specific cases and countries? Are there differences in performance of portfolio companies between the direct and indirect government VC, as found in some previous literature for specific countries? And finally, can the differences between direct and indirect government VC e.g. in terms of performance be explained by different network characteristics of investors?

In the first step, we combine two strands of literature on VC performance: the conjecture that government VCs are associated with worse performance of portfolio companies, and that strong syndication networks are associated with better performance of portfolio companies (see, e.g., Hochberg et al, 2007; Christopoulos et al, 2022). We ask in the first step, whether these two facts can be related: are there systematic differences between the network characteristics of government and private VC firms. We base our conjecture that public VCs might be less involved in successful networks, on the fact, that they are driven by less-aligned incentives schemes compared to private VC firms, and that the decision-making might me subject to more political pressure, which make cooperation on an syndicated investment project more costly - due to control and transaction costs between the partners. In line with this prediction, we formulate our first research hypothesis:

Hypothesis 1: Public VC firms have worse network properties than the private VC firms.

In the second step, in case we establish that there are indeed differences in the network characteristics between public and private VC, we will ask the question of whether these differences are responsible for the difference performance of portfolio companies. And in turn, whether these differences are directly explained by the network characteristics.

In the third and final step, we look at our research questions again and perform the analysis separately for direct and indirect government VCs. We expect direct VCs to perform worse than hybrid VCs. We expect the differences to be related to at least two main points: firstly, in indirect funds, the government acts less directly in the decision-making process; while some influence is present, it is much less than in case of direct VCs. We base this conjecture, on the literature stressing the role of different incentive structures between public and private VCs (Jääskeläinen et al, 2007), resulting in the latter outperforming the former when it comes to selection and management of investee companies. Secondly, indirect VC could be subject to stronger "positive" selection effects, essentially investing in private funds, which have already been successful in the past (perhaps due to good management). Through this channel, a fund-of-fund might be more likely to invest in well-known funds, which are more successful and have better selection and management processes, which in turn means that the investee companies are more successful as well. If this channel is strong enough, one could even expect the hybrid funds to be more successful than private VCs, by combining the best practices from private VC, with selection of best opportunities and leveraging private capital, and even potentially also crowding in more funds through the reputation effect. While the research on hybrid VC is still scarce, there is some evidence of performance differences between hybrid and private VCs e.g., in Standaert and Manigart (2018).

Hypothesis 2: Indirect public VC firms perform better than direct public VC firms.

We will further compare results regarding network properties gathered from the analysis of private VCs with the ones from indirect public firms. We expect these properties to similar, because we assume that due to prudence of fund-of-fund managers, funds will be chosen which are already established and have strong networks. The latter claim would further imply, that EIF-funded funds might be more connected than the average private funds. If this holds true, it would be an indication that there is no direct influence in fund strategies as well as it could point out that there EIF financing is simply a windfall gain, which does not stimulate the economy.

Hypothesis 3: Indirect public VC firms have similar network properties to private VC firms

Because of the fact, that most direct public VC firms are structured as co-investments they are often involved in deals with VCs, which are particularly open to co-investing. These investors might be very central, but it might be that the public VC is used to leverage capital and better performing deals are done with other (less central) cliques. We hypothesize this, because private VCs have fully aligned (or at least very comparable) incentive structures within themselves, and when it comes to outperforming deals these incentive structures matter for important decisions more than in normal deals. This is the reason, we claim, that the public VCs, which typically have different incentive schemes, do not enter the best performing investment syndicates and cliques.

Hypothesis 4: Direct public VC firms hardly enter the best performing cliques

4. Data and methods

4.1. Data

Several data sources will be combined for this paper. The main data source is the Preqin database. The Preqin database encompasses comprehensive information about diverse aspects of global venture capital markets. It contains information about 6,300 investors worldwide, more than 110,000 venture capital deals and more than 50,000 buyout deals. Moreover, it contains detailed information on 10,000 fund managers, about their background, investment criteria, funds raised, and key contacts. Each entry consists of a particular deal, in which the portfolio company is identified together with all investors, who took part in this deal. The size of the deal and total known funding of a portfolio company are also given. We use data for deals in the years 2000 to 2018 in Western Europe and Nordic countries.[1] The total number of deals in the sample used in this paper is about 20,000. We use the location of the investee company to assign an investor to a country rather than the location of the funds, as it measures more correctly how local networks are formed.

---

[1] Countries in the sample are: Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and UK. Some

This data is further combined with Orbis database to assess the performance of companies, and to look at the structure of venture capital firms in the dataset. We look at the development of sales in the years 2010 to 2019 (or respectively the last available year if the company closed operations). About 7,000 companies were found in the database, which have been matched with the deal data. For the investor companies, we extract the information about the controlling entities. In certain cases, we can, thus, directly gain information about investors, whose controlling entity is a public organ, such as the state or a regional government. In other cases, we hand collect the data about the respective investors and venture firms from their websites.

Further, Crunchbase will be used for additional information about the deals, and in particular, for exits. Crunchbase keeps track of exits via initial public offerings and mergers and acquisitions. As of April 2021, Crunchbase had collected records on more than a million companies, 31,687 initial public offerings (IPO) and 115,547 acquisitions. The current status declared by the companies, is provided by the variable "status". This categorical variable can take four distinct values: operating, acquired, IPO or closed and is available for all companies. With this information we track exits through an IPO or an acquisition of a company.

Regarding the differences in the performance of private and public VC firms, the unique feature of this paper is the hand-collected dataset. We have hand collected the data for all investors in the sample from the websites and further sources (such as registry entries) regarding their status and ownership. Overall, we covered about 5,000 investors in Europe and some US investors investing in Europe. University funds were generally coded as private or public dependent on whether the university is private or public. Regional authorities are coded as public firms. Public Private Partnerships (PPPs) are coded either as public or as private, depending on who has more power or who specifically, the private counterparts are.

if, e.g. a public entity invests together with two banks and the website indicates, that there is a regional political purpose of the fund, we coded it as public.

Finally, to analyze the effect of indirect VC, and in particular the European investment strategy, as mentioned in the introduction, we combine the data with portfolio investments by the European Investment Fund (EIF), which is collected from the official EIF sources. While the EIF offers several different products (e.g., equity, debt, and microloans), we focus our attention on venture-capital equity investments in funds. These investments are parts of several European programs, such as the European Fund for Strategic Investments (EFSI) ("Juncker Plan"), EIB Risk Capital Resources (RCR), Joint European Resources for Micro to Medium Enterprises (JEREMIE), Midcap facility, and others. This data has been hand-collected from the information published by the European Investment Fund.

4.2. Methods and models

Social Network Analysis

According to our hypothesis, two factors could be responsible for the differences between performance of investments by private and public VCs. Either are public VC firms worse connected and, thus, according to financial literature cannot use all the benefits from syndication. Alternatively, public funds have hard time entering cliques of investors, which are characterized by access to best available deals in the market.

Network analysis aims to describe the structure of networks by focusing on the relationships that exist among a set of economic actors. A key aim is to identify influential actors. Influence is measured by how "central" an actor's network position is, based on the extent of their involvement in relationships with others (Hochberg et al, 2007). Network analysis formalizes the concept of centrality and develops several measures, which help identify key actors in a network. We use two concepts of centrality: eigenvector centrality and betweenness, to measure different aspects of the central role of investors.

Moreover, further methods will be used to assess the network properties of public and private investors. For instance, existence of "cliques", in which best deals are struck and to which public investors do not have access, can explain different performance of their investments. This channel has been also briefly discussed by Hochberg et al (2007). A clique is defined as a maximal complete subgraph of a given graph—i.e., a group of people where everybody is connected directly to everyone else.

It is conceptually not clear, which measure of existence of closed or cohesive groups should be used in this case. The concept of a clique is a complete sub-graph, which means that in a clique, each member has direct ties with each other member or node. In many a case this definition would be too restrictive. Therefore, other concepts have been introduced.

Luce (1950) introduced the distance base cohesion groups called n-clique (or k-clique), where n is the maximum path length between each pair of vertices. A n-clique is a subset of vertices C such that, for every i, j∈ C, the distance d(i, j) ≤ n. The 1-clique is identical to a clique, because the distance between the vertices is one edge. The 2-clique is the maximal complete sub-graph with a path length of one or two edges. The path distance of two can be exemplified by the "friend of a friend" connection in social relationships. Since the total European network is small we will focus on 2-clique relationships.

Outcomes

We measure performance of companies using several outcomes, which are typical for this literature. First, we look at the development of sales before and after a venture capital firm's involvement. Secondly, we look at the probability of receiving more rounds of financing, which can be consider a success outcome of a venture. The latter outcome is also related to the literature suggesting that receiving financing from GVCs can be considered a badge of quality, which in turn crowds in further investments by private agents. Finally, we look at the probability of a successful exit through an IPO or an acquisition.

Econometric models

Survival

Given the literature linking the performance of funds and companies to networks of VC firms, we shall analyze whether properties of syndicates affect the survival rates of portfolio companies (see also Hochberg et al, 2007). We define survival of a portfolio company at the probability of obtaining one more round of financing. Most of the financing rounds can be arranged in an ordered fashion, indicating a growth of the portfolio company, with the following two exceptions: first, Add-On and Growth funds can be granted at any stage of the portfolio company's lifecycle so they cannot be ordered; second, Grant, Venture Debt and Unspecified Round will be excluded on similar grounds. The other financing rounds are arranged as follows: Angel, Seed, Series A/Round 1, Series B/Round 2, Series C/Round 3,Series D/Round 4, Series E/Round 5, Series F/Round 6, Series G/Round 7, Series H/Round 8, Series I/Round 9, Series J/Round 10, Series K/Round 11, each receiving a value of between one (first round) and 13 (second to last round). Finally, any of the events: Merger, PIPE, Pre-IPO, and Secondary Stock Purchase is valued as the ultimate success of a company and given a value of 14. The measure of survival involves a relative number of financing rounds a firm has received. Since some companies receive their first financing round at a later stage than seed (an average portfolio firm in the database starts with a Series A financing), we calculate in each case the number of rounds a company has survived starting from its first round.

In the main specification, we use a standard Poisson regression of the form

$$log(E(Y|x))=\theta' x,$$

where x is a vector of independent variables. This corresponds to

$$E(Y|x)=exp(\theta' x),$$

defining the predicted mean of the Poisson distribution. The model can be estimated by numerical maximum likelihood methods. Moreover, we estimate panel probit models, in which a binary variable takes the value 1 if a company "survived" one round of financing.

Performance

To analyze the development of sales, we employ an event study methodology. For each company, we code as time=0 the event of a deal. In case of subsequent deals, each is coded as 0. Other observations in the data are than coded relative to this event, e.g., sales one year after the deal, two years after the deal etc. Since we are specifically interested in how the structure of the deal – syndication or centrality of partners – affects the development, we interact these measures with the time before and after the event. The estimated equation has the form:

$$log(sales_{t,i}) - log(sales_{t-1,i}) = \sum_{n=-N}^{n=N} \gamma \times I_n + X_{t,i} + YE_t + u_{i,t}$$

where n=1,2,3,… is the index denoting years[2] before or after the deal (year 0 is the normalization year), g is the measure of centrality, X is a vector of further control variables, YE are the year effects capturing overall macroeconomic trends affecting the whole sample, and u is the error term.

Probability of Exit

Probability of a successful exit it modelled with a (panel) binary outcome, in which an exit event – IPO or M&A - is coded as 1.

Control variables

Several control variables are added to the models. For the models explaining the rounds of financing and a probability of a successful exit we include as control variables the

[2] Since the actual deals are given in daily format, we assume a balance sheet reporting day to be the end of the year on all countries. We calculate the number of months between the deal and the reporting day and summarize them into years, whereas anything below 12 months corresponds to Year 0, 12 to 23 months corresponds to Year 1 and so on. Additional control variables are country and year effects, sales before the deal, total known funding, and the size of the syndicate for each deal.

total known funding obtain by the company, the size of the syndicate in each deal and the expertise of the VC firm, measured as the number of previous successful exits within the same industry as the current deal. In additional specification we also add the stage of financing, as there are systematic differences between the stages by public and private VCs and the EIF-backed investments. For the sales regressions we additionally control for the (logarithm of) the deal size and for sales at t-1. All regressions come with country and industry fixed effects and sales regression additionally include the year effects.

5. Results

5.1. Descriptive statistics

The final dataset contains information about 3,412 investment funds situated in Europe. Table 1 presents the structure – whether a fund is private or public and whether it has been supported by the European Investment Funds.

[Table 1]

Of the total of 3,412 funds settled in Europe in our sample, there are 174 direct VCs (GVCs). European Investment Funds (EIF) invested in 221 private funds, which corresponds to indirect public VC. Finally, in six deals the European Investment Fund invested directly in the portfolio company – which corresponds in the table to the one observation being classified as public VC and an EIF investment. Regarding the stages of investments, there are significant differences between the public and the private partners.

[Figure 1] [Figure 2]

In the figure, time 1 corresponds to angel investment, time 2 to the seed round, time 3 to Series A and so on. It is visible and in line with theoretical arguments for direct public investments, that public funds invest much more often in seed rounds: more than 35 percent of public investments are seed investment, whereas the number is at 25 percent for private funds. This category is also the most frequent one for public investments, whereas private funds invest most often in, already less risky, Series A. Similarly, there are differences between the structure of investments of private VCs and indirect public VCs, as presented in Figure 2. The European Investment Funds invests primarily in Series A and later rounds and only about 15 percent are seed investments. On the other hand, the average of seed investments for private funds is at slightly less than 30 percent.

5.2. Network Properties of private and public VCs

Centrality

Table 2 compares the centrality measures of public and private VC firms in all countries in the sample.

[Table 2]

In line with our initial hypotheses there are differences between the centrality measures between public and private VC firms, which are in most cases significant. For the total sample betweenness of public VC firms is about 90 percent lower in public VC firms, meaning that public funds are significantly less likely to be brokers of information between other funds. The t-Test is high at 7.742. The differences in eigenvector centrality are much less pronounced but still at 57 percent and significant at 5 percent level. The differences within individual countries are at times even more pronounced. With regards to betweenness the only country in which public funds have a higher value is Belgium.[3] In some countries, such as Austria, or Portugal the differences are small or zero – whereas this is related to little variation in the particular values of betweenness (the latter fact being also responsible for low t-Test values in certain countries, where not many observations are available). In all other countries are public funds characterized by much lower betweenness than the private ones. In

[3] This high value is driven by exceptionally high centrality of the German Hightech-Gründerfonds investment in stem-cell company Ncardia. If we disregard this observation, the average for public funds investing in Belgium is in fact at -.177 and thus lower than for private funds.

Germany, UK and Sweden the differences are significant, but these are also substantial in Ireland, Switzerland or Finland. Similar pattern arises for the values of eigenvector centrality, which measures how many "important" connections each VC firm has. In all countries in the sample (besides Iceland with marginally positive value) public funds are significantly less well-connected to other important investors compared to private funds. Most substantial differences exist in Finland, UK, Austria and Italy, less substantial ones in France and the Netherlands. Given that eigenvector centrality comes with many more unique values, the differences are significant at 5 percent level in most countries.

Cliques

For the measurement how good an investor is linked to others, we use the k-Cliques approach. Specifically, we measure 2-cliques, that is structures in which every pair of vertices (investors) is connected by a path of length two or less. We argue that the relationship "friend of a friend" as a basis for the definition of the clique corresponds best to the problem of investors at hand. To incorporate a measure of "being a member of a 2-clique" into the econometric model, we propose two indicators. First, we simply count the number of 2-cliques to which a particular investor belongs. Belonging to more cliques measures a more impact a particular investor has in the scene. Secondly, we measure the relevance of a particular 2-clique by taking the maximum value of centrality in each 2-clique and assigning it to all members of this 2-clique. By this we essentially want to test whether belonging to a 2-clique whose members are well connected is associated with more successful investments. For the second measure we use both eigencentrality and betweenes We find, nearly all over Europe, that the number of 2-cliques a fund is member of, is significantly higher for private VCs than for GVCs (Table 3).

[Table 3]

Exceptions are found in Germany and France. In Germany, it can be explained by the very central role of the Hightech Gründerfonds (HTGF) within the German VC ecosystem. Additionally, IBB Beteiligungsgesellschaft and KfW play a very active role and are very well connected in the German ecosystem. HTGF works under very precise terms, clear and non-bureaucratic rules for choosing investment targets more comparable to private VCs, and a strict co-investment obligation, which makes it a preferred co-investor for private VCs. On the other end of scale, we find Portugal with an average of 9.296 2-cliques of a fund. The most prominent GVC player in Portugal is Portugal Ventures, which had no strict co-investment obligation. This fact paired with an ecosystem which is hardly on the radar of international investors likely results in such a low number. It must be mentioned though, that Portugal has become more visible in the last years and recent numbers will look more promising in that matter. Another interesting observation is that especially in Sweden (22.648) and Denmark (14.190) GVCs are not included in many cliques, but their private counterparts are very well interconnected (176.483/116.751). This shows that private VCs play a much more important role in these countries than in others. It must be mentioned though that these results might not perfectly reflect the networks in Denmark, as in Denmark Vaekstfonden, the biggest GVC, does fund-of-funds investments which are not coded in our dataset. The overall difference in favor of the GVCs in the total sample is driven by the impact of Germany and France, which at the same time have the largest number of observations.

The maximum centrality in a 2-clique shows the highest centrality of a clique-member, which could be interpreted as the best-connected co-investor you have. The results show that nearly all GVCs are well-connected to best connected players in the market. On the other hand, private players are at times less well-connected and thus have overall lower average centrality. In detail, this is again explained by the co-investment obligations. An outstanding result can be found in Portugal, where the GVC reaches the maximal possible number of 1. Recalling our results for the number of cliques, we can now state even more clearly that this is because of a not very strongly developed venture capital ecosystem.

Betweeness shows an opposite picture to centrality: private VCs belong on average to cliques with much higher betweenness than the public ones. So as opposed to having many well-connected connections (this is what eigencentrality measures), betweenness measuring in how many cases a particular node connects to other nodes, is better in cliques of purely private VCs. The overall picture that emerges, is that although public VCs belong to more central cliques – likely because of co-investing obligations – private VCs control the information flow between different nodes and in many more cases, compared to public VCs, are the significant link between different investors. Exceptions are, again, Germany, Ireland, and Finland. In Germany this might be explained again with the very central role of the HTGF within the German VC ecosystem.

[Table 4]

For all three measures of centrality a clear picture emerges when it comes to the indirect public investments by the EIF (Table 4). In most countries the VCs, which received the indirect public financing from the EIF belong to the most central cliques (in terms of eigencentrality), cliques that have the highest betweenness and belong to most 2-cliques in general.

5.3. Effects

5.3.1. Follow-up financing and survival

To determine the chances that a company "survives" another round of financing, we run in the main specification a Poisson with industry and location fixed effects.[4] The

[4] Provided by Stata command *PPMLHDFE*, see Correia et al (2019)

dependent variable is the number of rounds, which the company received. We include as independent variables the total funding obtained by the company, the size of the syndicate, the stage of financing (as there are significant differences between the distribution of financing between public and private VCs),[5] a dummy variable whether a public VC has been an investor, whether EIF has been (indirectly) invested in the company, as well as diverse centrality measures. In the latter case, we run several models, in which we wither include centrality measures of the funds, or their 2-clique measures (we standardize the number of cliques by the maximal number in each country to remove the effect of the country size), as well as we include interactions of these variables with either the GVC dummy or the EIF dummy. All models include location and industry effects, and results are presented in Tables 5 and 6.[6]

[Table 5] [Table 6]

Financing by a GVC is strongly and negatively associated with the maximum number of rounds, while financing by EIF shows a strong positive correlation – both compared to the private VC investments. Also, if we add the stage of financing – which is systematically different between EIF, GVC and other investments - the results hold. All measures of network importance are strongly positively associated with the maximum number of financing rounds survived by the portfolio company. As a robustness check, Table A.2. in the Appendix reports the probit regressions, in which the dependent variable is the chance of surviving more than one round of financing and the results remain the same. To assess the interrelation between the GVC and EIF investments and centrality measures we calculate the marginal effects of EIF/GVC at diverse levels of centrality measures (Tables 7 and 8, Figure 3). In this, we can assess whether there is an additional benefit of receiving an EIF investment (penalty for

[5] We add this variable in the robustness specification as many deals do not provide information about the stage, in this case we lose about 10,000 observations.
[6] Following Greene (2004) we decided to run a unconditional probit model with industry and location dummies, as he shows that even with fairly small T, the incidental parameter bias might be lower than in the case of a random effects model.

receiving a GVC investment) beyond the fact that EIF investors are more central (GVC investors are less central). Results are presented in Figure 3. When it comes to the marginal effects of GVC conditional on the centrality measures, it is clear, that the overall negative coefficient does not change much for the different values of the number of 2-cliques and betweenness. This means that independently of the importance of the investors' networks an investment by a GVC is consistently associated with lower performance compared to a private VC. The case is different for the investments with the EIF involvement. The positive association of EIF investments with a maximum number of financing rounds is given mostly for the lower levels of network importance, while whenever the importance of the network of the investor is high (either measured by the number of 2-cliques or the betweenness of the cliques), the additional positive correlation between the EIF's involvement and surviving more financing rounds becomes insignificant.

[Table 7] [Table 8] [Figure 3]

5.3.2. Sales performance

We run several specifications, in which we look at the development of sales before and after a deal involving a public, indirect of private VCs. For each deal, we assign a value of the most central fund as the determinant. Also, for instance, if three investors invest in a portfolio company and one of them is public, the deal is classified as involving a public VC.

Table A.1. with several specifications is provided in the Appendix. Since it is not easy to decipher the actual marginal effects of the variables of interest in the years after the deal, we present them here in graphical form. Figures 4 and 5 present the development of sales before and up to five years after the deal, for the cases GVC vs private VCs and for EIF-financed private VCs vs other private VCs. In the first case, red line shows the case of GVCs, and the black line of private VCs. It shows that while the differences in the sales growth before the deal are not significant, it is the case after the deal. Starting from year 1, that is one (balance sheet) year after the deal, sales slows down, but they do more so for the deals involving a public VC. They keep slowing down in the years two to five, and in each year, the pace is slower for deals involving public VCs compared to the private ones. The case of EIF involvement shows the opposite picture: sales slows down less quickly after deals, in which EIF partners were involved compared to other private VCs. However, in this case, one more thing can be established: the confidence intervals of sales growth before the deal overlap but less so, than for the case of GVCs. This means, that EIF is more likely to be involved in deals, for which the sales growth was more promising – but this difference in not very statistically significant. This could be a further suggestion, that EIF deals involve a high level of windfall gains for the portfolio companies, but not necessarily make an additional growth possible. Further two results (Figures 6 and 7) consider the impact of centrality measures on the development of sales. We take the estimates from the fixed-effects regression and evaluate the marginal effects at five levels of the measure: the 25th, 50th, 75th, 90th and 95th percentile. For the case of the number of 2-cliques there is some evidence, that more connected VCs perform financially better, and the differences are significant. If a deal involved a partner, who has is am member of a high number of 2-cliques (at 90th or 95th percentile) the sales after the deal grow at the same pace in the years one to five, as in the deal year. For deals involving partners with few 2-cliques, the sales growth slows down considerably. This is not the case for betweenness of the 2-clique.[7] Here the difference between the sales performances after the deal is not significantly different from each other.

[Figure 4] [Figure 5] [Figure 6] [Figure 7]

---

[7] We did not perform this calculation for the eigencentrality, since most deals involve a partner with very high eigencentrality of the 2-clique, so after double aggregation of the data, not enough variation is left to perform this analysis.

5.3.3. Exits

We run probit models where the dependent variable equals 1 if a company had a successful exit in form of an initial public offering or a merger/acquisition. The set of independent variables is the same as for the case of financing rounds as explained in Section 5.3.1. Tables 9 and 10 presents the results of several specifications taking the event of a successful exit through an M&A or an IPO as a dependent (binary) variable. The results are qualitatively comparable to the case of financing rounds. Throughout all specifications GVC investments are associated with lower probability of exit, while EIF investments correlate significantly with higher chances of exits. All measures of network importance correlate strongly positively with a higher chance of an exit. Similar patterns can be found for interaction effects between EIF/GVC and network measures (Tables 11 and 12, Figure 8). For the case of GVC there is a weak interaction effect and the overall negative correlation remains fairly constant. In the case of the EIF similar results to the financing rounds can be found: the higher the network importance of the investor, the lower the additional positive correlation between the EIF's involvement and the probability of an exit.

[Table 9] [Table 10] [Table 11] [Table 12] [Figure 8]

5.3.4. Endogeneity concerns

While for the case of GVCs endogeneity is not an issue, the other variable of interest in this study could be associated with an endogeneity bias. This likely considers the case of EIF investments, where unobservable characteristics of funds, other than the network properties, could be simultaneously driving the probability of EIF investments and the performance of portfolio companies. In such a case, the true coefficient would be larger than suggested by the estimations, and the true effect of the EIF involvement on performance underestimated.

To deal with this issue, we use the fact that as identified by Pavlova and Signore (2021), companies are more likely to receive an EIF funding, if they are located *farther away* from a nearest functional urban area centroid. This fact has to do with the investment strategy of the European Union, which involves using regional funds, which are targeted to less developed areas. We can use this information to instrument for the probability of receiving an EIF investment with the distance of the company from the center of the nearest urban area. The geographical location affects the probability of receiving an EIF investment, but it likely does not affect the performance of the company other than through the channel of a company being close to the fund, which has received the EIF financing. As the literature on VC hubs, e.g., Chen et al (2010), shows, companies, which have been financed in a hub tend to perform better. This is due to lower informational asymmetries between the fund and the company if company is closely located. Controlling for this variable should, therefore, exclude this channel of transmission and guarantee the exclusion restriction. Moreover, EIF tends to invest in more well-known funds, but the crucial part is to find a relationship which describes the fact of being an established fund, but at the same time satisfying the exclusion restriction. We argue that the overall number of deals of a VC fund is a good measure, provided we control for other channels, which would directly affect the performance of the companies. We do so, by including the expertise of the fund, the distance of the company and other variables. Thus, we argue using as an additional instrument to overall number of investments is valid, as it, controlling for expertise, only affects the portfolio companies through the channel of the EIF investment. Results are presented in Table 13. We can see that all the main conclusions regarding the impact of EIF investments on the diverse performance indicators still hold. First-stage regressions also show that the theoretical considerations about the impact of the distance and the overall size of the fund hold true and enter the first-stage equations with a positive sign. Also, the Kleibergen-Paap statistics suggest that the excluded instruments are strong. In most specifications, as expected, the coefficient on the EIF investment is larger than in the main specifications.

[Table 13]

6. Conclusions

Our paper sheds some new light on the question of whether entrepreneurship and innovation can be stimulated with the means of governmental venture capital. Two results stand out: firstly, direct governmental venture capital does not seem to perform well compared to private venture capital in a broad cross-country sample of European deals. This confirms some previous results in the literature but we additionally show a channel driving this result, i.e. interconnectedness of the fund, which has not so far been explored in the literature. Secondly, and that is also a new result, we find that indirect venture capital investments by the European Investment Fund perform much better than the average private VC deals. We can confirm this result also by explicitly considering the endogeneity of the EIF investments. Nevertheless, as we explore the question of why this is the case, we conclude that likely an amount of windfall gain is driving the results: in the cases in which the fund is well connected, there is little additional gain from the EIF investment.

In specific cases, such as for the German Hightech Gründerfonds (HTGF), we find that the performance is much better than for average GVCs. We link this observation to their clear and incentive-compatible investment strategy and co-investment obligations, which makes this fund a much more attractive partner for private investors. This shows, that while generally direct GVCs do not perform well, in some cases, they can be a good option. In terms of policy recommendations, this means that European GVCs should be organized following the best practice by the HTGF.

Our results point to a limited role of direct GVCs in stimulating innovation. Nevertheless, in special cases, such as a new and underdeveloped market or particular investment goals (such as e.g. deep tech in Europe), it could provide support – provided that good institutional design is followed. On the other hand, in case of established markets, indirect VC investments are a better instrument, but the policymakers must be aware, that high windfall profits mean that the invested money is not necessarily always efficiently spent.

Conflict of interest Statement

At the time of preparing this manuscript, Ms. Stefan Köppl was employed at Tecnet Equity, which is a government-backed venture capital fund in Austria.

Bibiliography

Alperovych, Y., Quas, A., & Standaert, T. (2018). Direct and indirect government venture capital investments in Europe. *Economics Bulletin*, *38*(2), 1219-1230.

Bertoni, F., & Tykvová, T. (2015). Does governmental venture capital spur invention and innovation? Evidence from young European biotech companies. *Research Policy*, *44*(4), 925-935.

Brander, J. A., Du, Q., & Hellmann, T. (2015). The effects of government-sponsored venture capital: international evidence. *Review of Finance*, *19*(2), 571-618.

Chen, H., Gompers, P., Kovner, A., & Lerner, J. (2010). Buy local? The geography of venture capital. *Journal of Urban Economics*, 67(1), 90-102.

Christofidis, C., & Debande, O. (2001). Financing innovative firms through venture capital. EIB Sector Papers.

Christopoulos, D., Köppl, S., & Köppl-Turyna, M. (2022). *Syndication networks and company survival: Evidence from European venture-capital deals* forthcoming *Venture Capital*.

Christopoulos, D., Project: Investment Funds for Technology Based Startups in Vienna.

Colombo, M. G., Cumming, D. J., & Vismara, S. (2016). Governmental venture capital for innovative young firms. *The Journal of Technology Transfer*, *41*(1), 10-24.

Correia, S., Guimarães, P., & Zylkin, T. (2019). ppmlhdfe: Fast Poisson estimation with high-dimensional fixed effects, arXiv. org.

Cox, D. R. (1972). Regression models and life-tables. *Journal of the Royal Statistical Society: Series B (Methodological)*, *34*(2), 187-202.

Croce, A., Martí, J., & Reverte, C. (2019). The role of private versus governmental venture capital in fostering job creation during the crisis. *Small Business Economics*, *53*(4), 879-900.

Cumming, D. J. (2006). The determinants of venture capital portfolio size: empirical evidence. *The Journal of Business*, *79*(3), 1083-1126.

Cumming, D. J., & Johan, S. A. (2013). Venture capital and private equity contracting: An international perspective. Academic Press.

Cumming, D. J., & MacIntosh, J. G. (2006). Crowding out private equity: Canadian evidence. *Journal of Business venturing*, *21*(5), 569-609.

Cumming, D. J., Grilli, L., & Murtinu, S. (2017). Governmental and independent venture capital investments in Europe: A firm-level performance analysis. *Journal of corporate finance*, *42*, 439-459.

Cumming, D., & Johan, S. (2008). Information asymmetries, agency costs and venture capital exit outcomes. *Venture capital*, *10*(3), 197-231.

Cumming, D., & Johan, S. (2016). Venture's economic impact in Australia. *The Journal of Technology Transfer*, *41*(1), 25-59.

Cumming, D., & Johan, S. (2019). Government venture capital research: fake science and bad public policy. *Venture Capital*, *21*(1), 121-131.

Cumming, D., Johan, S., & MacIntosh, J. G. (2017). A drop in an empty pond: Canadian public policy towards venture capital. *Economia e Politica Industriale*, *44*(1), 103-117.

Da Rin, M., Hellmann, T., & Puri, M. (2013). A survey of venture capital research. In *Handbook of the Economics of Finance* (Vol. 2, pp. 573-648). Elsevier.

Grilli, L., & Murtinu, S. (2014). Government, venture capital and the growth of European high-tech entrepreneurial firms. *Research Policy*, *43*(9), 1523-1543.

Hochberg, Y. V., Ljungqvist, A., & Lu, Y. (2007). Whom you know matters: Venture capital networks and investment performance. *The Journal of Finance*, *62*(1), 251-301.

Hünermund, P., & Czarnitzki, D. (2019). Innovation Policy and Causality. *ifo DICE Report*, *17*(04), 3-6.

Jääskeläinen, M., Maula, M., & Murray, G. (2007). Profit distribution and compensation structures in publicly and privately funded hybrid venture capital funds. *Research Policy*, *36*(7), 913-929.

Kraemer-Eis, H., Signore, S., & Prencipe, D. (2016). The European venture capital landscape: an EIF perspective. *EIF Research & Market Analysis*.

Leleux, B., & Surlemont, B. (2003). Public versus private venture capital: seeding or crowding out? A pan-European analysis. *Journal of Business Venturing*, *18*(1), 81-104.

Pavlova, E., & Signore, S. (2021). *The European venture capital landscape: An EIF perspective. Volume VI: The impact of VC on the exit and innovation outcomes of EIF-backed start-ups* (No. 2021/70). EIF Working Paper.

Pierrakis, Y., & Saridakis, G. (2017). Do publicly backed venture capital investments promote innovation? Differences between privately and publicly backed funds in the UK venture capital market. *Journal of Business Venturing Insights*, *7*, 55-64.

Standaert, T., & Manigart, S. (2018). Government as fund-of-fund and VC fund sponsors: effect on employment in portfolio companies. *Small Business Economics*, *50*(2), 357-373.

Szkuta, K., Stamenov, B., & Cunningham, P. (2020). Evidence of impact of public equity instruments on firms' outputs. *foresight*.

Appendix

Table A.1: Sales growth over time

	(1)	(2)	(3)	(4)
Sales at -1	-0.04**	-0.04**	-0.04**	-0.04**
	(-2.52)	(-2.43)	(-2.51)	(-2.41)
(log) Deal Size	0.02	0.02	0.02	0.02
	(0.81)	(0.83)	(0.88)	(0.86)
Syndicate Size	-0.02	-0.01	-0.01	-0.01
	(-1.49)	(-1.10)	(-1.17)	(-1.02)
Total Known Funding	0.00**	0.00**	0.00**	0.00**
	(2.50)	(2.38)	(2.28)	(2.55)
Deal GVC	-0.19			
	(-0.61)			
Year -2=1	-0.14	-0.21	-0.31	-0.19
	(-0.68)	(-0.91)	(-1.15)	(-0.65)
Year -1=1	-0.05	-0.04	-0.14	-0.18
	(-0.24)	(-0.20)	(-0.52)	(-0.61)
Year 1=1	-0.38*	-0.43*	-0.56**	-0.51*
	(-1.90)	(-1.96)	(-2.13)	(-1.84)
Year 2=1	-0.48**	-0.51**	-0.74***	-0.65**
	(-2.42)	(-2.32)	(-2.83)	(-2.39)
Year 3=1	-0.57***	-0.58**	-0.77***	-0.53*
	(-2.79)	(-2.52)	(-2.84)	(-1.83)
Year 4=1	-0.60***	-0.66***	-0.76***	-0.69**
	(-2.84)	(-2.86)	(-2.71)	(-2.31)
Year 5=1	-0.80***	-0.66**	-1.07***	-1.12***
	(-3.48)	(-2.55)	(-3.34)	(-2.68)
Year -2=1 # Deal GVC	-0.18			
	(-0.49)			
Year -1=1 # Deal GVC	-0.03			
	(-0.09)			
Year 1=1 # Deal GVC	-0.25			
	(-0.79)			
Year 2=1 # Deal GVC	-0.31			
	(-0.94)			
Year 3=1 # Deal GVC	-0.14			
	(-0.44)			
Year 4=1 # Deal GVC	-0.26			
	(-0.81)			
Year 5=1 # Deal GVC	-0.76*			
	(-1.81)			
Deal EIF		-0.21		
		(-0.78)		
Year -2=1 # Deal EIF		0.28		
		(0.87)		
Year -1=1 # Deal EIF		0.04		
		(0.12)		
Year 1=1 # Deal EIF		0.31		
		(1.08)		
Year 2=1 # Deal EIF		0.31		
		(1.10)		
Year 3=1 # Deal EIF		0.15		
		(0.54)		
Year 4=1 # Deal EIF		0.35		
		(1.17)		
Year 5=1 # Deal EIF		0.03		
		(0.08)		
Number of cliques			-0.99*	
			(-1.67)	
Year -2=1 # Number of cliques			0.92	
			(1.38)	
Year -1=1 # Number of cliques			0.50	
			(0.78)	
Year 1=1 # Number of cliques			0.99	

			(1.60)	
Year 2=1 # Number of cliques			1.33**	
			(2.16)	
Year 3=1 # Number of cliques			1.06*	
			(1.68)	
Year 4=1 # Number of cliques			0.90	
			(1.36)	
Year 5=1 # Number of cliques			1.53**	
			(2.16)	
Betweeness				-1.13
				(-0.98)
Year -2=1 # Betweeness				0.54
				(0.40)
Year -1=1 # Betweeness				0.93
				(0.66)
Year 1=1 # Betweeness				1.10
				(0.92)
Year 2=1 # Betweeness				1.41
				(1.17)
Year 3=1 # Betweeness				0.12
				(0.10)
Year 4=1 # Betweeness				0.88
				(0.71)
Year 5=1 # Betweeness				2.40
				(1.47)
Constant	0.78***	0.76***	0.96***	0.86***
	(2.90)	(2.70)	(3.05)	(2.74)
Observations	2487	2570	2481	2481

p<0.1 *, p<0,05**, p<0,01***; Fixed-effects regressions; Not reported: 15 country dummies, year effects and 15 industry dummies; t-Statistics in parentheses; standard errors clustered at portfolio level

Table A.2: Surviving at least one round of financing (i.e. more than one financing round obtained)

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	4.32***	4.33***	4.30***	4.27***	4.24***	4.16***
	(3.57)	(3.59)	(3.58)	(3.56)	(3.51)	(3.48)
Syndicate Size	0.11***	0.11***	0.11***	0.11***	0.11***	0.11***
	(8.23)	(8.33)	(8.23)	(8.03)	(7.97)	(8.02)
Expertise	0.02***	0.02***	0.02***	0.01***	0.02***	0.02***
	(8.72)	(8.06)	(8.04)	(5.72)	(7.48)	(6.66)
GVC=1	-0.19***		-0.12***	-0.15***	-0.14***	-0.14***
	(-5.69)		(-3.62)	(-4.51)	(-4.27)	(-4.15)
EIF=1		0.26***	0.25***	0.21***	0.22***	0.18***
		(10.87)	(10.05)	(8.56)	(9.04)	(7.15)
Number of cliques				0.34***		
				(6.69)		
Centrality of cliques					0.52***	
					(6.70)	
Betweeness of cliques						0.95***
						(7.69)
Constant	-0.28***	-0.33***	-0.32***	-0.39***	-0.77***	-0.41***
	(-5.13)	(-6.05)	(-5.81)	(-6.65)	(-8.61)	(-7.16)
Observations	21732	21732	21732	21454	21454	21454

p<0.1 *, p<0,05**, p<0,01***; Not reported: 15 country dummies and 15 industry dummies; z-Statistics in parentheses; the number of observations in columns (4) to (6) lower, because, for some venture funds no 2-clique could be identified; standard errors clustered at deal level[8]

[8] The results in all cases and all respective tables remain the same if we cluster the errors at the investor's level.

Table 1: Public and private VC funds in Europe

GVC\EIF		0	1	Total
	0	3,016	221	3,237
	1	174	1	175
Total		3,19	222	3,412

Table 2: centrality measures of the VC funds: GVCs vs private funds

	Betweeness			***Eigencentrality***		
Location	**GVC=1**	**GVC=0**	**t-Test**	**GVC=1**	**GVC=0**	**t-Test**
Austria	-0,222	-0,222		-0,107	0,299	2,180
Belgium	-0,017	-0,121	-1,5348	-0,105	-0,024	1,083
Denmark	-0,222	-0,116	0,9794	-0,107	-0,107	
Finland	-0,222	-0,086	1,5435	-0,098	0,466	2,514
France	-0,018	0,010	0,4919	-0,107	-0,090	0,768
Germany	-0,182	0,044	7,1934	-0,100	0,013	3,878
Iceland	-0,222	-0,222		-0,107	-0,107	3,540
Ireland	-0,222	-0,176	1,7649	-0,101	0,077	2,992
Italy	-0,116	-0,111	0,0600	0,048	-0,053	1,035
Netherlands	-0,047	0,013	0,7466	-0,107	-0,082	0,694
Portugal	-0,222	-0,222		-0,107	-0,107	1,540
Spain	-0,116	-0,077	0,5535	0,127	-0,056	2,422
Sweden	-0,222	-0,062	1,6008	-0,083	-0,037	0,884
Switzerland	-0,106	0,029	1,2082	-0,101	-0,054	0,922
UK	-0,120	-0,003	3,1577	0,041	-0,049	2,954
Total	**-0,143**	**-0,014**	**7,742**	**-0,059**	**-0,025**	**1,926**

Table 3: Cliques statistics: direct GVCs vs private VCs

	Number of cliques				***Centrality***				***Betweeness***			
Location	**GVC=1**	**GVC=0**	**Difference**	**T-test**	**GVC=1**	**GVC=0**	**Difference**	**T-test**	**GVC=1**	**GVC=0**	**Difference**	**T-test**
Austria	19,189	79,121	59,932	3,676	0,980	0,906	-0,074	-2,396	0,146	0,161	0,015	1,652
Belgium	37,143	125,561	88,418	5,108	0,999	0,992	-0,007	-1,082	0,157	0,182	0,025	3,794
Denmark	14,190	116,751	102,561	3,203	0,884	0,980	0,096	4,416	0,176	0,221	0,045	4,650
Finland	18,713	101,782	83,069	4,131	0,955	0,765	-0,190	-5,158	0,250	0,226	-0,024	-2,871
France	389,211	304,245	-84,966	-6,129	0,992	0,986	-0,006	-1,067	0,112	0,139	0,028	5,260
Germany	452,007	217,777	-234,230	-35,731	0,997	0,974	-0,023	-5,737	0,178	0,170	-0,008	-3,494
Ireland	54,422	104,071	49,650	4,077	0,998	0,966	-0,032	-3,100	0,328	0,307	-0,021	-4,674
Italy	36,753	59,017	22,264	1,436	0,912	0,891	-0,021	-0,700	0,152	0,150	-0,001	-0,252
Netherlands	36,316	109,074	72,758	4,274	0,969	0,879	-0,090	-3,732	0,110	0,148	0,038	4,335
Portugal	9,296	92,213	82,917	2,112	1,000	0,868	-0,132	-2,108	0,253	0,221	-0,032	-1,818
Spain	61,075	88,282	27,207	2,286	0,940	0,948	0,008	0,476	0,158	0,171	0,012	2,429
Sweden	22,648	176,483	153,835	4,881	0,969	0,943	-0,027	-1,046	0,174	0,207	0,033	3,217
Switzerland	69,020	139,882	70,861	3,361	0,904	0,954	0,050	2,483	0,130	0,156	0,026	2,894
UK	239,775	267,514	27,739	2,482	0,914	0,913	-0,001	-0,080	0,117	0,122	0,004	1,010
Total	**260,818**	**217,107**	**-42,880**	**-9,466**	**0,968**	**0,943**	**-0,024**	**-7,579**	**0,167**	**0,153**	**-0,014**	**-7,885**

Table 4: Cliques statistics: indirect GVCs (EIF) vs private VCs

	Number of cliques				***Centrality***				***Betweeness***			
Location	**EIF=1**	**EIF=0**	**Difference**	**T-test**	**EIF=1**	**EIF=0**	**Difference**	**T-test**	**EIF=1**	**EIF=0**	**Difference**	**T-test**
Austria	183,254	57,997	-125,256	-7,453	0,967	0,894	-0,073	-2,165	0,196	0,154	-0,041	-4,054
Belgium	237,044	90,183	-146,861	-10,083	1	0,989	-0,011	-1,822	0,229	0,167	-0,061	-11,173
Denmark	268,333	64,517	-203,816	-9,472	0,997	0,974	-0,023	-2,077	0,275	0,202	-0,073	-12,435
Finland	192,977	63,337	-129,640	-6,161	0,982	0,674	-0,307	-8,520	0,275	0,205	-0,069	-8,325
France	430,307	242,409	-187,898	-28,723	0,998	0,980	-0,018	-6,178	0,194	0,112	-0,081	-32,616
Germany	349,629	159,820	-189,809	-33,465	0,999	0,964	-0,036	-8,494	0,214	0,151	-0,063	-32,165
Ireland	162,058	74,404	-87,654	-5,555	0,986	0,956	-0,031	-2,270	0,316	0,303	-0,013	-2,266
Italy	144,601	40,180	-104,421	-7,955	0,879	0,894	0,016	0,615	0,178	0,144	-0,034	-6,609
Luxembourg	278,143	170,449	-107,694	-1,829	0,967	0,718	-0,248	-2,789	0,214	0,118	-0,096	-3,861
Netherlands	154,282	86,372	-67,909	-4,954	0,970	0,833	-0,137	-7,265	0,190	0,127	-0,063	-9,620
Norway	351,255	39,263	-311,993	-13,297	1	0,865	-0,135	-2,955	0,282	0,141	-0,141	-10,880
Portugal	112,389	85,842	-26,547	-0,482	0,919	0,852	-0,067	-0,763	0,253	0,211	-0,041	-1,696
Spain	137,446	72,918	-64,528	-8,400	0,943	0,950	0,006	0,560	0,176	0,169	-0,007	-2,256
Sweden	294,883	118,190	-176,694	-9,195	0,996	0,916	-0,080	-5,064	0,268	0,177	-0,090	-15,959
Switzerland	288,838	91	-197,838	-15,833	1	0,939	-0,061	-4,880	0,207	0,140	-0,067	-11,938
UK	393,921	246,693	-147,228	-16,818	0,991	0,901	-0,090	-15,680	0,225	0,105	-0,120	-39,179
Total	**329,901**	**180,760**	**-149,211**	**-43,967**	**0,988**	**0,928**	**-0,061**	**-23,640**	**0,215**	**0,133**	**-0,081**	**-64,101**

Table 5: Maximum number of rounds, Poisson regressions

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	1.09***	1.10***	1.09***	1.09***	1.09***	1.09***
	(9.82)	(9.97)	(10.03)	(10.13)	(10.19)	(10.17)
Syndicate Size	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(4.72)	(4.75)	(4.67)	(4.53)	(4.49)	(4.44)
Expertise	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(7.10)	(6.70)	(6.69)	(5.56)	(6.51)	(5.96)
GVC =1	-0.13***		-0.11***	-0.11***	-0.12***	-0.11***
	(-5.48)		(-4.40)	(-4.48)	(-4.62)	(-4.53)
EIF=1		0.09***	0.08***	0.08***	0.07***	0.05***
		(6.70)	(5.57)	(5.34)	(4.87)	(3.52)
Number of cliques				0.06*		
				(1.82)		
Centrality of cliques					0.31***	
					(7.21)	
Betweeness of cliques						0.40***
						(5.15)
Constant	0.64***	0.60***	0.62***	0.62***	0.33***	0.57***
	(22.13)	(21.02)	(21.11)	(19.86)	(6.86)	(17.69)
Observations	21740	21740	21740	21458	21458	21458

p<0.1 *, p<0,05**, p<0,01***; Results with *ppmlhdfe* Stata program for running Poisson regression models with fixed effects; Not reported: 15 country dummies and 15 industry dummies; z-Statistics in parentheses; the number of observations in columns (4) to (6) lower, because, for some venture funds no 2-clique could be identified; standard errors clustered at deal level

Table 6: Maximum number of rounds, Poisson regressions including stage.

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	0.91***	0.93***	0.92***	0.92***	0.92***	0.91***
	(7.75)	(7.87)	(7.87)	(7.97)	(8.03)	(7.98)
Syndicate Size	0.02***	0.02**	0.02**	0.02**	0.02**	0.02**
	(2.58)	(2.56)	(2.55)	(2.44)	(2.36)	(2.38)
Expertise	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(6.61)	(6.27)	(6.27)	(5.21)	(6.03)	(5.59)
Stage	0.09***	0.09***	0.09***	0.09***	0.09***	0.09***
	(10.55)	(10.64)	(10.52)	(10.41)	(10.55)	(10.41)
GVC=1	-0.14***		-0.12***	-0.13***	-0.13***	-0.13***
	(-6.25)		(-5.23)	(-5.39)	(-5.57)	(-5.37)
EIF=1		0.07***	0.06***	0.06***	0.05***	0.04**
		(5.08)	(4.02)	(3.67)	(3.13)	(2.18)
Number of cliques				0.06*		
				(1.66)		
Centrality of cliques					0.36***	
					(7.22)	
Betweeness of cliques						0.37***
						(4.51)
Constant	0.40***	0.37***	0.38***	0.38***	0.05	0.34***
	(8.78)	(8.21)	(8.48)	(8.01)	(0.80)	(7.25)
Observations	16853	16853	16853	16624	16624	16624

p<0.1 *, p<0,05**, p<0,01***; Results with *ppmlhdfe* Stata program for running Poisson regression models with fixed effects; Not reported: 15 country dummies and 15 industry dummies; z-Statistics in parentheses; the number of observations in columns (4) to (6) lower, because, for some venture funds no 2-clique could be identified; standard errors clustered at deal level

Table 7: Maximum number of rounds, Poisson regressions: interaction models

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	1.09***	1.09***	1.09***	1.09***	1.09***	1.09***
	(10.14)	(10.19)	(10.18)	(10.12)	(10.19)	(10.17)
Syndicate Size	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(4.53)	(4.48)	(4.41)	(4.56)	(4.49)	(4.44)
Expertise	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(5.57)	(6.50)	(5.95)	(5.44)	(6.51)	(5.96)
GVC=1	-0.11***	-0.12***	-0.12***	-0.05	-0.21	-0.14***
	(-4.48)	(-4.62)	(-4.63)	(-1.29)	(-1.52)	(-3.44)
EIF=1	0.08***	-0.08	0.16***	0.07***	0.07***	0.06***
	(3.51)	(-0.48)	(4.61)	(5.14)	(4.89)	(3.59)
Number of cliques	0.06*			0.08**		
	(1.75)			(2.48)		
EIF=1 # Number of cliques	-0.01					
	(-0.19)					
Centrality of cliques		0.31***			0.31***	
		(7.02)			(6.91)	
EIF=1 # Centrality of cliques		0.15				
		(0.92)				
Betweeness of cliques			0.54***			0.39***
			(6.12)			(4.85)
EIF=1 # Betweeness of cliques			-0.52***			
			(-3.47)			
GVC=1 # Number of cliques				-0.27***		
				(-2.89)		
GVC=1 # Centrality of cliques					0.09	
					(0.65)	
GVC=1 # Betweeness of cliques						0.14
						(0.71)
Constant	0.62***	0.34***	0.55***	0.61***	0.34***	0.57***
	(19.78)	(6.84)	(16.86)	(19.80)	(6.79)	(17.62)
Observations	21458	21458	21458	21458	21458	21458

Table 8: Maximum number of rounds, Poisson regressions: interaction models including stage

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	0.92***	0.92***	0.92***	0.92***	0.92***	0.92***
	(7.97)	(8.03)	(7.98)	(7.96)	(8.03)	(7.99)
Syndicate Size	0.02**	0.02**	0.02**	0.02**	0.02**	0.02**
	(2.44)	(2.36)	(2.34)	(2.44)	(2.36)	(2.38)
Expertise	0.01***	0.01***	0.01***	0.01***	0.01***	0.01***
	(5.18)	(6.03)	(5.58)	(5.21)	(6.03)	(5.59)
Stage	0.09***	0.09***	0.09***	0.09***	0.09***	0.09***
	(10.42)	(10.55)	(10.43)	(10.41)	(10.55)	(10.41)
GVC=1	-0.13***	-0.13***	-0.13***	-0.13***	-0.06	-0.15***
	(-5.42)	(-5.57)	(-5.50)	(-3.73)	(-0.34)	(-3.87)
EIF=1	0.07***	0.06	0.16***	0.06***	0.05***	0.04**
	(2.83)	(0.32)	(4.15)	(3.67)	(3.12)	(2.22)
Number of cliques	0.07*			0.06		
	(1.88)			(1.61)		
EIF=1 # Number of cliques	-0.05					
	(-0.79)					
Centrality of cliques		0.36***			0.36***	
		(7.11)			(7.09)	
EIF=1 # Centrality of cliques		-0.01				
		(-0.04)				
Betweeness of cliques			0.52***			0.36***
			(5.72)			(4.28)
EIF=1 # Betweeness of cliques			-0.57***			
			(-3.70)			
GVC=1 # Number of cliques				0.00		
				(0.05)		
GVC=1 # Centrality of cliques					-0.08	
					(-0.48)	
GVC=1 # Betweeness of cliques						0.15
						(0.73)
Constant	0.38***	0.05	0.32***	0.38***	0.05	0.34***
	(8.01)	(0.79)	(6.82)	(8.01)	(0.74)	(7.26)
Observations	16624	16624	16624	16624	16624	16624

Table 9: Binary model: exit though an IPO or a M&A

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	1.18***	1.21***	1.18***	1.18***	1.17***	1.16***
	(6.06)	(6.16)	(6.10)	(6.07)	(6.01)	(5.95)
Syndicate Size	0.05***	0.05***	0.04***	0.05***	0.04***	0.04***
	(4.86)	(4.97)	(4.79)	(4.77)	(4.68)	(4.69)
Expertise	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(20.07)	(19.88)	(19.76)	(18.35)	(19.44)	(18.78)
GVC=1	-0.18***		-0.15***	-0.16***	-0.17***	-0.16***
	(-5.63)		(-4.67)	(-4.74)	(-5.03)	(-4.92)
EIF=1		0.13***	0.11***	0.10***	0.09***	0.08***
		(5.59)	(4.63)	(4.42)	(3.98)	(3.27)
Number of cliques				0.03		
				(0.59)		
Centrality of cliques					0.38***	
					(5.59)	
Betweeness of cliques						0.43***
						(3.64)
Constant	-1.04***	-1.08***	-1.06***	-1.06***	-1.40***	-1.10***
	(-21.28)	(-21.90)	(-21.57)	(-20.70)	(-17.66)	(-21.50)
Observations	28437	28437	28437	27933	27933	27933

p<0.1 *, p<0,05**, p<0,01***; Not reported: 15 country dummies and 15 industry dummies; z-Statistics in parentheses; the number of observations in columns (4) to (6) lower, because, for some venture funds no 2-clique could be identified; standard errors clustered at deal level

Table 10: Binary model: exit though an IPO or a M&A including stage.

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	0.75***	0.77***	0.76***	0.77***	0.77***	0.76***
	(3.69)	(3.82)	(3.74)	(3.81)	(3.79)	(3.75)
Syndicate Size	0.01	0.01	0.01	0.01	0.01	0.01
	(0.91)	(0.93)	(0.89)	(0.91)	(0.84)	(0.89)
Expertise	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(16.55)	(16.38)	(16.29)	(15.10)	(16.01)	(15.45)
Stage	0.08***	0.08***	0.08***	0.08***	0.08***	0.08***
	(6.75)	(6.77)	(6.70)	(6.60)	(6.60)	(6.55)
GVC=1	-0.17***		-0.14***	-0.15***	-0.16***	-0.15***
	(-3.85)		(-3.05)	(-3.18)	(-3.50)	(-3.35)
EIF=1		0.12***	0.11***	0.11***	0.09***	0.08***
		(4.53)	(3.87)	(3.78)	(3.23)	(2.76)
Number of cliques				-0.01		
				(-0.15)		
Centrality of cliques					0.39***	
					(4.20)	
Betweeness of cliques						0.39***
						(2.65)
Constant	-1.07***	-1.10***	-1.09***	-1.09***	-1.45***	-1.14***
	(-14.72)	(-15.16)	(-14.98)	(-14.37)	(-12.97)	(-15.05)
Observations	16757	16757	16757	16531	16531	16531

p<0.1 *, p<0,05**, p<0,01***; Not reported: 15 country dummies and 15 industry dummies; z-Statistics in parentheses; the number of observations in columns (4) to (6) lower, because, for some venture funds no 2-clique could be identified; standard errors clustered at deal level

Table 11: Probability of an Exit through an IPO or a M&A: interaction models

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	1.19***	1.17***	1.15***	1.18***	1.17***	1.16***
	(6.09)	(6.01)	(5.94)	(6.07)	(6.01)	(5.96)
Syndicate Size	0.04***	0.04***	0.04***	0.05***	0.04***	0.04***
	(4.76)	(4.68)	(4.69)	(4.77)	(4.68)	(4.69)
Expertise	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(18.25)	(19.43)	(18.76)	(18.37)	(19.43)	(18.79)
GVC=1	-0.16***	-0.17***	-0.17***	-0.16***	-0.03	-0.17***
	(-4.77)	(-5.04)	(-4.99)	(-3.34)	(-0.14)	(-2.74)
EIF=1	0.16***	0.34	0.15***	0.10***	0.09***	0.08***
	(4.60)	(1.03)	(3.00)	(4.40)	(3.95)	(3.27)
Number of cliques	0.07			0.03		
	(1.39)			(0.59)		
EIF=1 # Number of cliques	-0.20**					
	(-2.15)					
Centrality of cliques		0.39***			0.39***	
		(5.66)			(5.56)	
EIF=1 # Centrality of cliques		-0.25				
		(-0.75)				
Betweeness of cliques			0.53***			0.43***
			(3.93)			(3.52)
EIF=1 # Betweeness of cliques			-0.38			
			(-1.61)			
GVC =1 # Number of cliques				-0.01		
				(-0.07)		
GVC =1 # Centrality of cliques					-0.14	
					(-0.56)	
GVC =1 # Betweeness of cliques						0.04
						(0.12)
Constant	-1.07***	-1.41***	-1.11***	-1.06***	-1.41***	-1.10***
	(-20.77)	(-17.62)	(-21.50)	(-20.68)	(-17.40)	(-21.43)
Observations	27933	27933	27933	27933	27933	27933

Table 12: Probability of an Exit through an IPO or a M&A: interaction models including stage.

	(1)	(2)	(3)	(4)	(5)	(6)
Total Known Funding	0.78***	0.77***	0.75***	0.77***	0.77***	0.76***
	(3.83)	(3.79)	(3.73)	(3.82)	(3.79)	(3.76)
Syndicate Size	0.01	0.01	0.01	0.01	0.01	0.01
	(0.92)	(0.85)	(0.87)	(0.91)	(0.84)	(0.89)
Expertise	0.04***	0.04***	0.04***	0.04***	0.04***	0.04***
	(14.98)	(16.00)	(15.42)	(15.13)	(16.01)	(15.48)
Stage	0.08***	0.08***	0.08***	0.08***	0.08***	0.08***
	(6.60)	(6.61)	(6.57)	(6.60)	(6.60)	(6.54)
GVC=1	-0.15***	-0.16***	-0.16***	-0.15**	-0.46	-0.32***
	(-3.22)	(-3.51)	(-3.43)	(-2.27)	(-1.10)	(-3.39)
EIF=1	0.18***	0.78*	0.21***	0.11***	0.09***	0.09***
	(4.19)	(1.65)	(3.18)	(3.78)	(3.25)	(2.94)
Number of cliques	0.05			-0.01		
	(0.74)			(-0.16)		
EIF=1 # Number of cliques	-0.24**					
	(-2.18)					
Centrality of cliques		0.42***			0.38***	
		(4.37)			(4.01)	
EIF=1 # Centrality of cliques		-0.70				
		(-1.47)				
Betweeness of cliques			0.55***			0.32**
			(3.30)			(2.16)
EIF=1 # Betweeness of cliques			-0.61**			
			(-2.14)			
GVC=1 # Number of cliques				0.01		
				(0.05)		
GVC=1 # Centrality of cliques					0.31	
					(0.73)	
GVC=1 # Betweeness of cliques						0.93**
						(2.12)
Constant	-1.10***	-1.47***	-1.16***	-1.09***	-1.44***	-1.13***
	(-14.48)	(-12.98)	(-15.17)	(-14.36)	(-12.75)	(-14.88)
Observations	16531	16531	16531	16531	16531	16531

Table 13: Instrumental variables' specifications

	(1) Exit IV Probit	(2) No Of Rounds IV Poisson CF	(3) At least one IV Probit	(4) Exit IV Probit	(5) No Of Rounds IV Poisson CF	(6) At least one IV Probit
EIF	**2.09*** **	**-0.07**	**1.59*** **	**2.11*** **	**0.14**	**1.75*** **
	(11.86)	**(-0.21)**	**(4.12)**	**(12.73)**	**(0.42)**	**(4.94)**
Total Known Funding	3.71**	10.00***	16.12***	1.06	10.59***	15.22**
	(2.58)	(9.23)	(3.65)	(0.60)	(7.86)	(2.52)
Syndicate Size	0.00	0.01	0.02	0.02	-0.02	-0.01
	(0.32)	(1.18)	(1.15)	(1.42)	(-1.62)	(-0.54)
Expertise	2.28***	0.32***	0.37***	1.85***	0.25***	0.36**
	(4.39)	(6.00)	(2.88)	(3.04)	(4.19)	(2.52)
Dist Source Target	0.00	-0.00	0.00	0.00	0.00	0.00
	(0.32)	(-0.26)	(0.49)	(0.94)	(0.59)	(1.00)
Stage				-0.03*	0.10***	0.07*
				(-1.82)	(6.58)	(1.83)
Constant	-1.53***	0.38***	-0.66***	-1.26***	0.11	-0.77***
	(-5.97)	(5.02)	(-7.17)	(-4.70)	(1.49)	(-6.45)
First stage						
Total Known Funding	0.94***	0.75***	0.96***	1.53***	1.24***	1.49***
	(4.30)	(3.28)	(4.00)	(4.76)	(4.09)	(4.65)
Syndicate Size	0.01***	0.01**	0.00	-0.00	-0.00	-0.00
	(2.86)	(2.25)	(1.24)	(-0.60)	(-0.10)	(-0.54)
Expertise	0.09***	0.08***	0.07***	0.06***	0.07***	0.06***
	(5.53)	(4.78)	(4.01)	(2.93)	(3.30)	(2.92)
Dist Source Target	0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.30)	(-0.34)	(-0.47)	(-1.23)	(-1.13)	(-0.90)
Log(hubdist)	0.01***	0.01*	0.01***	0.01***	0.01**	0.01***
	(4.27)	(1.78)	(3.01)	(3.52)	(2.09)	(2.58)
No of investments	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
	(4.63)	(6.14)	(4.05)	(2.98)	(5.04)	(3.66)
Stage				0.01**	0.02***	0.01**
				(1.97)	(2.85)	(2.09)
Cragg-Donald Wald F	22.995	20.569	13.722	9.043	14.450	9.043
Observations	17326	15443	15432	14148	14199	14189

p<0.1 *, p<0,05**, p<0,01***; Not reported: 15 country dummies and 15 industry dummies; z-Statistics in parentheses; the number of observations lower, because, for some portfolio companies and funds addresses could not be unambiguously identified; standard errors clustered at deal level. Cragg-Donald Wald F statistics from the corresponding linear models.

Figure 1: Investments by stage by private (incl. indirect VC) and direct public VCs.

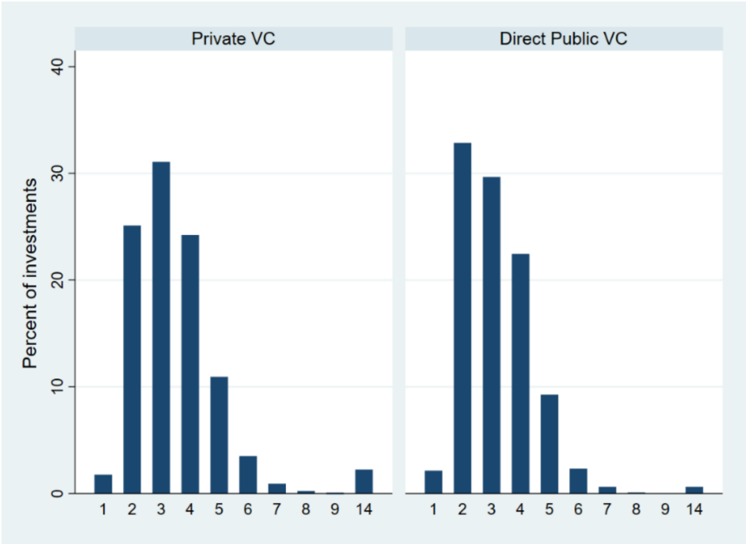


Figure 2: Investments by stage by private and indirect public VCs (excl. direct VC).

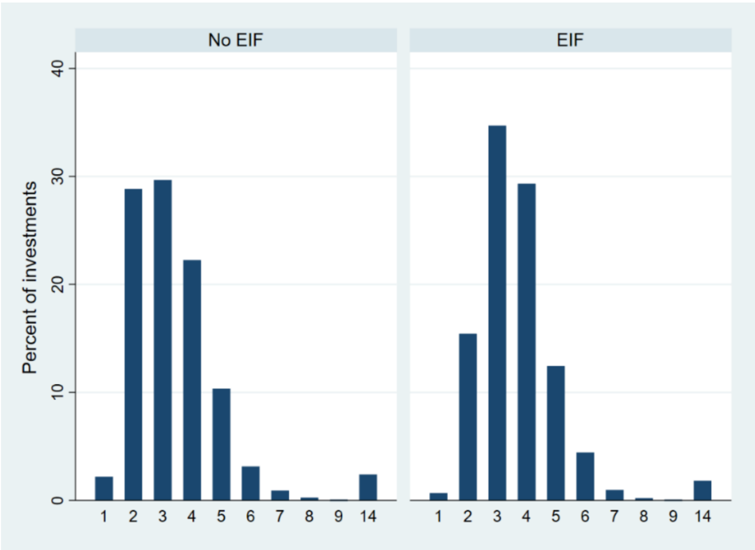


Figure 3: Marginal effects from Poisson regressions (the effects of GVC upper panel; the effects of EIF lower panel)

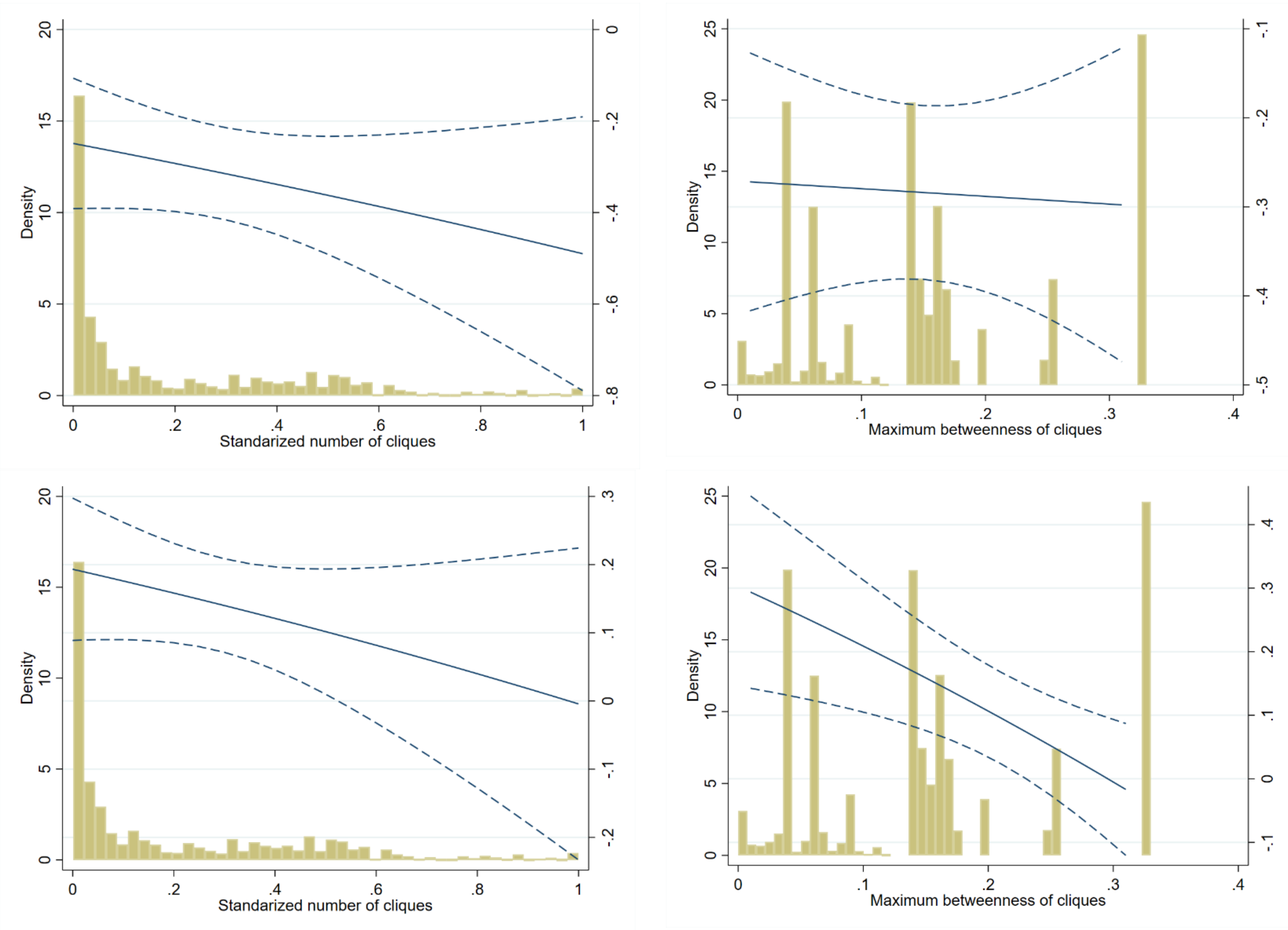


Figure 4: Sales development: GVCs vs private VCs

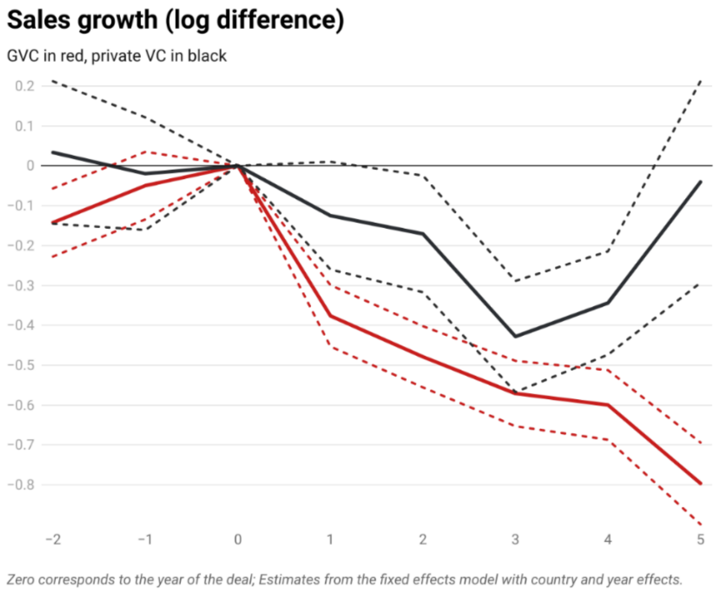


Figure 5: Sales development: indirect public VCs (EIF) vs other private VCs

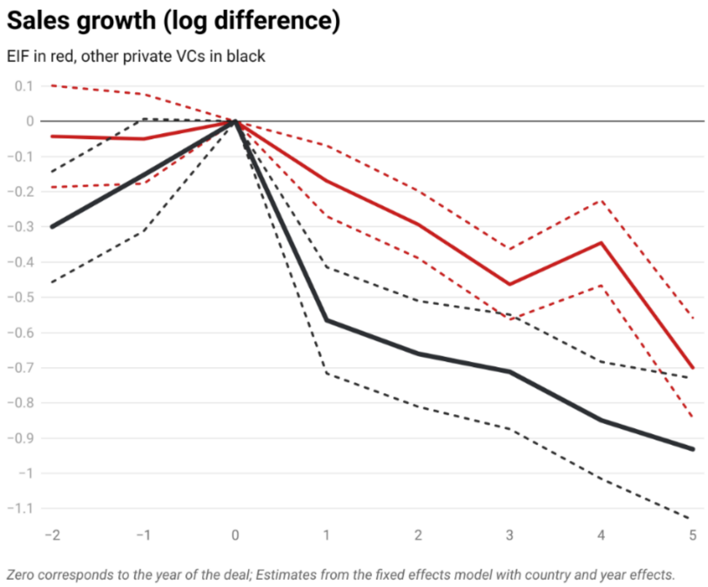


Figure 6: Sales development dependent on the number of 2-cliques

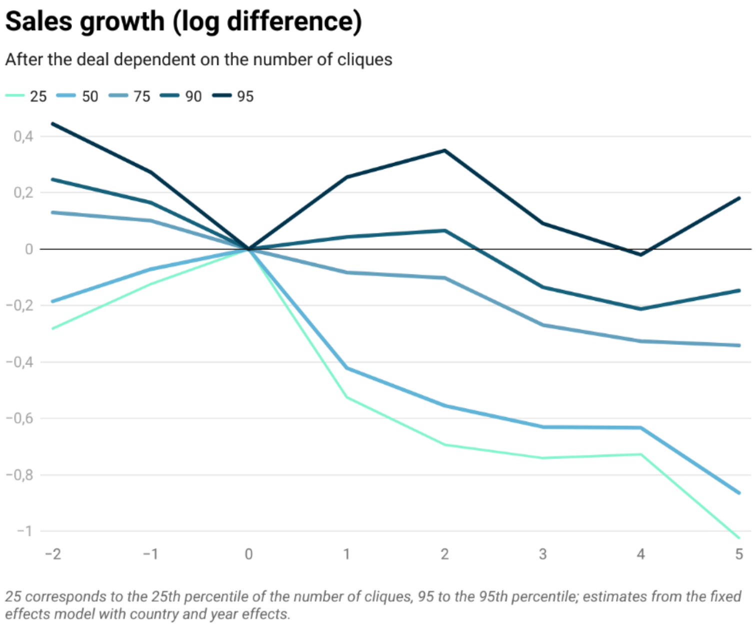


Figure 7: Sales development dependent on the maximum betweenness in the 2-cliques

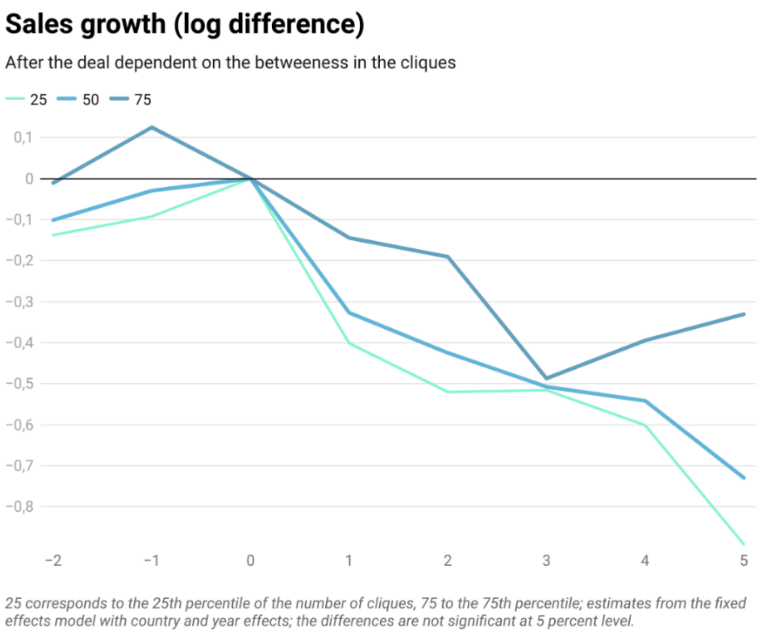
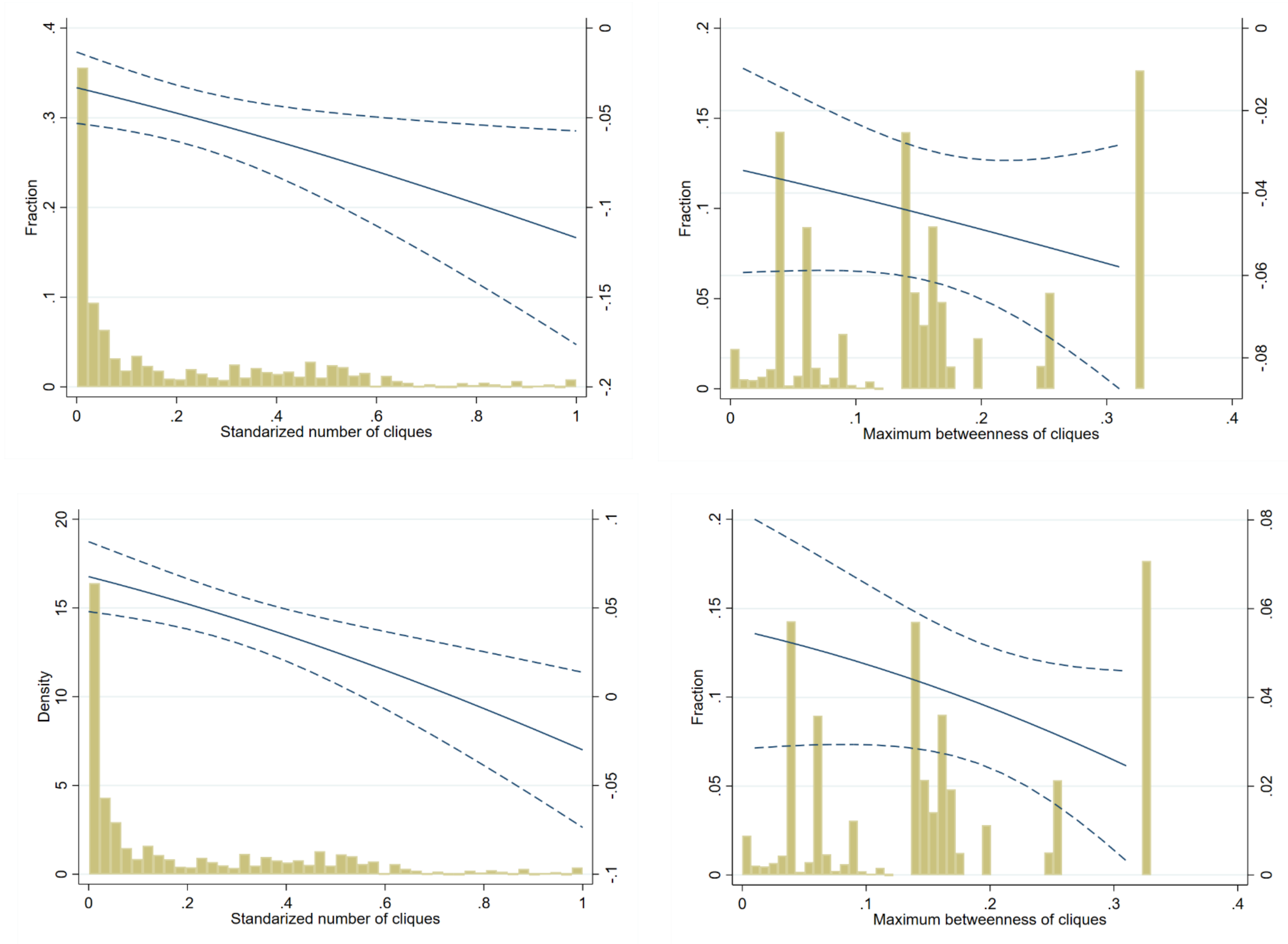


Figure 8: Marginal effects on probabilities of exit (the effects of GVC upper panel; the effects of EIF lower panel)



www.ecoaustria.ac.at