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The business angel portfolio under the European Angels Fund: An empirical analysis

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EIF Research & Market Analysis

Working Paper **2020/62**

The Business Angel portfolio under the European Angels Fund: An empirical analysis

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Abstract[1]

This paper analyses the Business Angel (BA) portfolio of the European Angels Fund (EAF), an initiative of the European Investment Fund, which engages in co-investment relationships with experienced business angels across Europe. It uses EIF's proprietary database to shed light on a specific subset of the European BA sector. The first section covers the basic characteristics of EAF's BAs and draws comparisons with existing studies wherever possible. In addition, it provides a basic description of EAF's investment portfolio, outlining the geographical distribution of its portfolio companies and the sector in which they are active. The next section focusses on BAs' investment practices. For example, we take a closer look at the geographical and sectoral investment strategies, and investigate aspects related to investment timing. We also examine the innovative capacity of the investees, by analysing patenting activity during the first years of the EAF program. Finally, a brief descriptive analysis provides an overview of the post-investment growth patterns experienced by EAF's investee companies.

Keywords: EIF; business angels; venture capital; equity financing

JEL codes: G24; G38; L25

[1] We would like to extend our gratitude to Daniel Beck, Julien Brault, Andrea Crisanti, Helmut Kraemer-Eis, Elitsa Pavlova and Simone Signore for their helpful suggestions and discussions. All errors are our own.

1. Introduction

This paper analyses the combined investment portfolio of all Business Angels (BAs) associated with the European Angels Fund (EAF). Angel financing forms an important source of early stage funding for highly innovative companies. By some estimates of the total investment amounts in Europe, the Angel financing market matches the institutional Venture Capital (VC) industry (EBAN, 2018; Kraemer-Eis et al., 2019b). Understanding the modus operandi of BA investors can inform policy makers' efforts to design tailor-made policy tools to promote this crucial segment of VC finance supply and improve the availability of patient capital to small and medium-sized enterprises (SMEs). However, the market of Angel financing is notoriously opaque and information about this important market segment is scarce. This paper contributes to the body of evidence-based literature on their investment methods and practices, by exploiting the EAF's unique deal-level database, containing information of nearly 500 investments made by over 100 European BAs who choose to engage in a co-investment agreement with the EAF. The paper supplements an earlier EIF study that detailed the results of a survey conducted among EAF's Angels (Kraemer-Eis et al., 2019a).[2]

A vibrant VC ecosystem is widely regarded as a crucial prerequisite for the development of an innovative, competitive economy (Kraemer-Eis et al., 2016). VC suppliers, in all their shapes and forms, constitute the most important source of capital during the crucial initial growth stages of innovative companies. While formal VC funds are the most visible and recognised source of early stage venture financing, recent decades have seen a surge in attention for suppliers of *informal* VC, commonly referred to as BAs. This study targets a subset of these BAs, whom we define as "private individual[s], often of high net worth, and usually with business experience, who directly invests part of [their] personal assets in new and growing private businesses. Business angels can invest individually or as part of a syndicate where one angel typically takes the lead role." (European Commission, 2016).[3]

Due to their unique investment methods, BAs form an important funding source for SMEs. BAs are often claimed to fill a financing gap left by formal VC investors. Their ability to do so stems from one of their defining characteristics, which holds that, in contrast to VC managers, BAs invest their own money. This renders BAs better equipped to deal with traditional agency problems, which typically characterise the investee-investor relationship (Lerner et al., 2018). This is particularly relevant in the case of early stage innovation financing. It leads them to follow a more personalised approach to investing, placing higher emphasis on elements such as investor fit (Mason and Stark, 2004), strategic readiness and passion of the entrepreneur (Hsu et al., 2014). This defining characteristic makes them better equipped than traditional VC supplier to deal with the youngest and smallest of SMEs (Kraemer-Eis and Schillo, 2011).

[2] Both the analysis of the BA survey presented in Kraemer-Eis et al. (2019a), as well as the present analysis, both pertain to the EAF. While the present analysis uses administrative data, and therefore covers all BAs that have signed a co-investment agreement with the EAF, the response rate of the EAF survey fell short of full coverage. Hence, this could explain why some statistics presented in Kraemer-Eis et al. (2019a) deviate from the analysis in this paper.

[3] For a very similar definition, see Mason and Harisson (2008), who define a BA as "a high net worth individual, acting alone or in a formal or informal syndicate, who invests his or her own money directly in an unquoted business in which there is no family connection and who, after making the investment, generally takes an active involvement in the business, for example, as an advisor or member of the board of directors."

Apart from occupying a unique space in the SME financing spectrum, Angel investments are able to withstand adverse shocks in economic activity significantly better than formal VC (Capizzi, 2015), because they are not dependent on the market to finance their investment activities. Therefore, the importance of Angel financing has increased further in the aftermath of the financial crisis (Mason and Harrison, 2015). A vibrant Angel financing eco-system is a crucial element of a healthy VC ecosystem, as it is able to smooth out the cyclical fluctuations that characterises the traditional VC financing sector.

Despite its importance, the European BA market remains underdeveloped compared to other markets, most notably the United States. Carefully designed government support programs can be a catalyst for further developing the European market and improve the supply of Angel financing available to innovative high growth companies (Kraemer-Eis and Schillo, 2011). Recent years have seen a significant expansion of government supported co-investment initiatives, like the EAF. Such programs are crucial to push the European Angel market through its initial development stage, as historically, most VC markets have emerged with some form of government assistance (Lerner, 2009).

Informal VC reaches much beyond what this article is able to cover. First, Angel investors come in different shapes and forms. The broadest interpretation includes investors with close personal ties to the entrepreneurs, such as family and friends. Such investments, often coined as '*love money*', are generally small-scaled capital injections, on a one-off basis and often without return expectations. While they constitute a significant source of capital supply for young ventures, [4] they do not form the target of the study at hand. This study focusses on a more narrow interpretation of informal VC and considers only experienced Angel investors, investing their own money with the aim of generating a financial return. This is merely a subset of the aggregate Angel financing market and hence, some of the investment principles described here will be idiosyncratic to the specific investor group under consideration.

Second, the data is limited to experienced Angel investors who decided to engage in a formal co-investment agreement with the EAF. At the time of writing, over 100 BAs had opted into the program, overseeing a combined portfolio of more than 600 investees. This is just a fraction of the aggregate European BA market, which by some estimates exceeds over 300,000 investors. Therefore, it lies outside the scope of this paper to provide a general market overview, or to discuss the extent and size of the European Angel investing market. Rather, by exploiting the richness of the EAF's BA portfolio dataset, the present study aims to further develop the understanding of the investment principles adhered to by the BAs under consideration.

By analysing our unique dataset of EAF supported BAs and their investment portfolio, we aim to answer Cumming and Zang's (2016) call for business angel research with more credible data to shed light on BA investment habits. In doing so, this article supplements earlier studies that contributed to the documentation of the Angel financing market, in Europe and beyond (see OECD, 2012; Cumming and Zhang, 2016; Bonini et al., 2018, among others).

[4] Some studies estimate the share of the friends and family segment as high as 90% of total informal VC supply (Kelley et al., 2012).

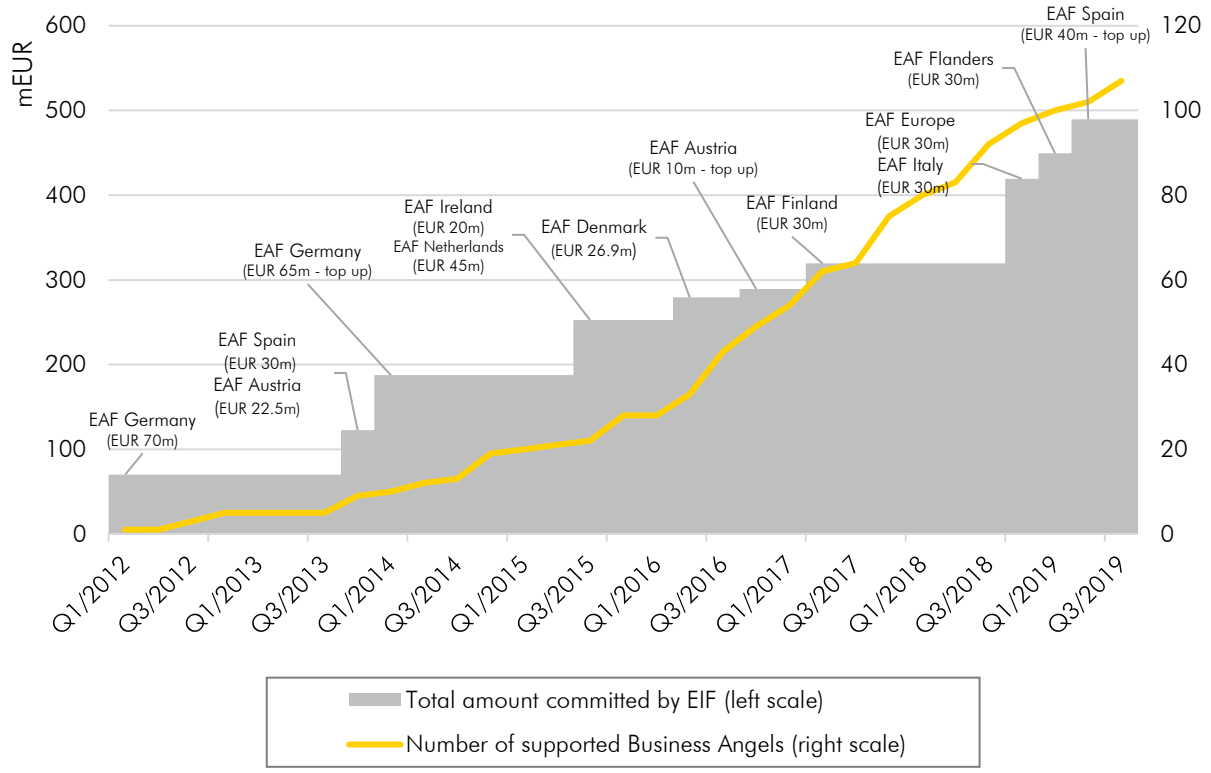
The remainder of this article is divided into four main parts. The first part briefly elaborates on the history of the EAF and its modus operandi, and provides some basic characteristics of EAF's BAs and a brief description of their combined investment portfolio. The second part digs deeper into the data and aims to uncover in detail some of the BAs' favourite investment strategies, touching upon topics such as geographical investment behaviour, investment timing and innovation potential of their investee companies. The third part covers the post-investment growth trajectories of some of EAF's portfolio companies. The final chapter concludes.

2. The European Angels Funds

2.1 Brief history and main investment principles

The European Angels Fund (EAF) was launched early 2012 to channel financing through selected and qualified private, non-institutional investors, to European SMEs. Through national cooperative schemes, EIF seeks to leverage existing investment networks in member state countries by increasing BAs' investment capacity to provide seed capital and to invest in early or growth stage enterprises. For example, EAF Germany, the pilot project, was established in 2012 in close cooperation with Business Angel Netzwerk Deutschland with an initial fund size of EUR 70m. The program turned out to be successful and two years later, the amount was topped up to EUR 135m. Also the Austrian program, initiated in 2014, was expanded three years following its creation. With the launch of EAF Flanders (Belgium), early 2019, EAF now counts nine national BA initiatives. In addition to the national programs, a pan-European program (EAF Europe) supports cross-border investments within the EU. Figure 1 illustrates the timeline of the deployment of the respective national EAF programs.

Figure 1: The deployment of the European Angels Fund and the evolution of supported BAs



Source: Internal EIF data

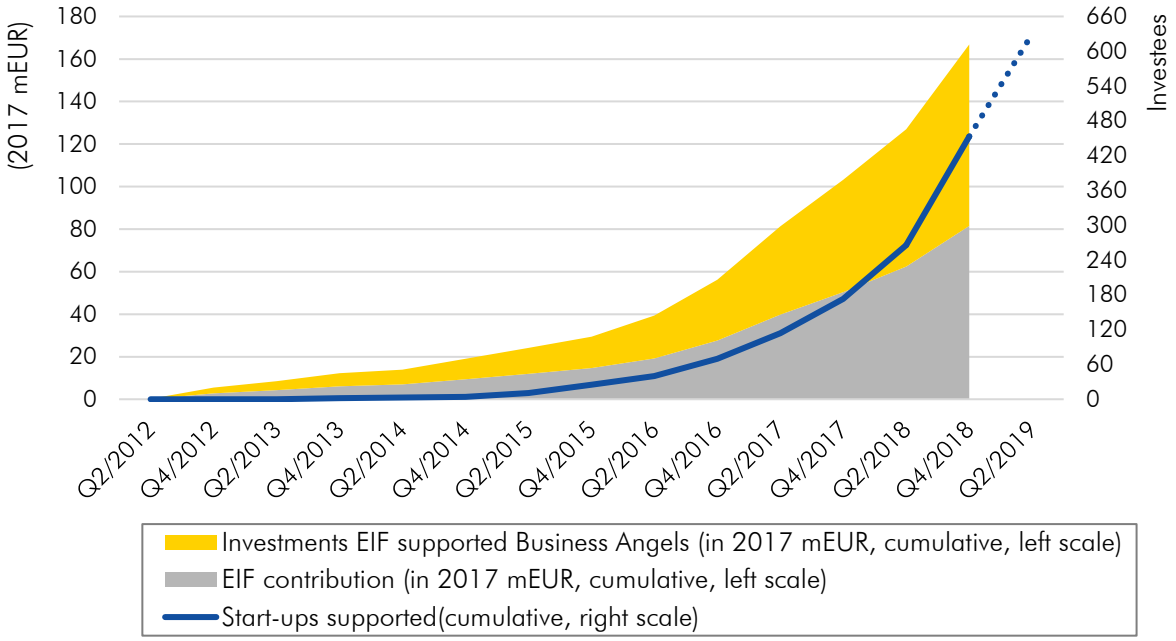
After applying to one of EAF's national co-investment schemes, BAs are selected taking into account their prior investment experience. Once selected, the EAF co-invests pari-passu with its Angels, typically on a one-to-one basis. The program envisions a 10-year time horizon, which provides the Angels with patient capital, allowing them to pursue a long-term investment strategy. There is no deal-by-deal review by the EAF and investment decisions are fully delegated to the BA. Their independence is the key asset of the program, because it gives the Angels the freedom to follow their preferred, often non-standard investment approach.[5]

[5] For more details about the investment model see Kraemer-Eis and Schillo (2011).

The co-investment agreement between the BA and the EAF is nevertheless subject to a few operating principles as BAs are encouraged to invest in local, early stage companies. The expected co-investment volume for an individual BA is flexible and can vary from 0.25 up to EUR 15m.

Early 2019, the total amount committed to the different EAF programs reached EUR 490m, with 106 BAs participating. While the majority of participating BAs are solo-investors, 12 of EAF's partners have opted into the program as a team.[6] About 75 of them had reported at least one co-investment, with EAF. The remaining BAs have signed up to the program recently and therefore have yet to initiate their first co-investment. By the end of 2018, cumulated over the entire period considered, they supported over 438 investee companies, providing them with EUR 167m of Angel financing (Figure 2[7]). The number of investee companies continued to grow exponentially during 2019 and reached 633 by the end of the year.[8]

Figure 2: EAF recipient companies and total received investment amounts (2017 mEUR)



Note: All investment amounts are expressed in 2017 mEUR and are deflated using gross fixed capital price indices, made available by Eurostat. The dotted line represents preliminary figures.
Source: Internal EIF data

Apart from injecting capital in the European VC ecosystem, the EAF also serves as an informal BA network (BAN). BANs contribute to individual BAs' effectiveness in stimulating economic growth by reducing information deficiencies and coordinating larger capital flows to opportunities. Through events like Connect Angels, the EAF aims to promote knowledge spill-overs within the BA community, by bringing together BAs from across Europe to share their investment experiences.

[6] For the most part, these concern duo BA teams. In two cases, the team consists of four individual investors. For the sake of simplicity, the remainder of the analsyis will refer to EAF's investors in singular form, whether referring to solo-BAs or BA teams.

[7] Figure 2 includes only those BAs that had signed an agreement with the EAF at the end of Q4/2019, and does not include the most recent approvals for which the signature was pending at the time of writing. Hence, the total number of BAs is expected to rise in the near future as nine more approved BAs will sign into their respective national BA programs.

[8] Due to a delay in data reporting, the remainder of the analysis will focus on the 438 investee companies that were in the EAF portfolio prior to end of year 2019.

2.2 EAF's BAs and their combined portfolio at a glance

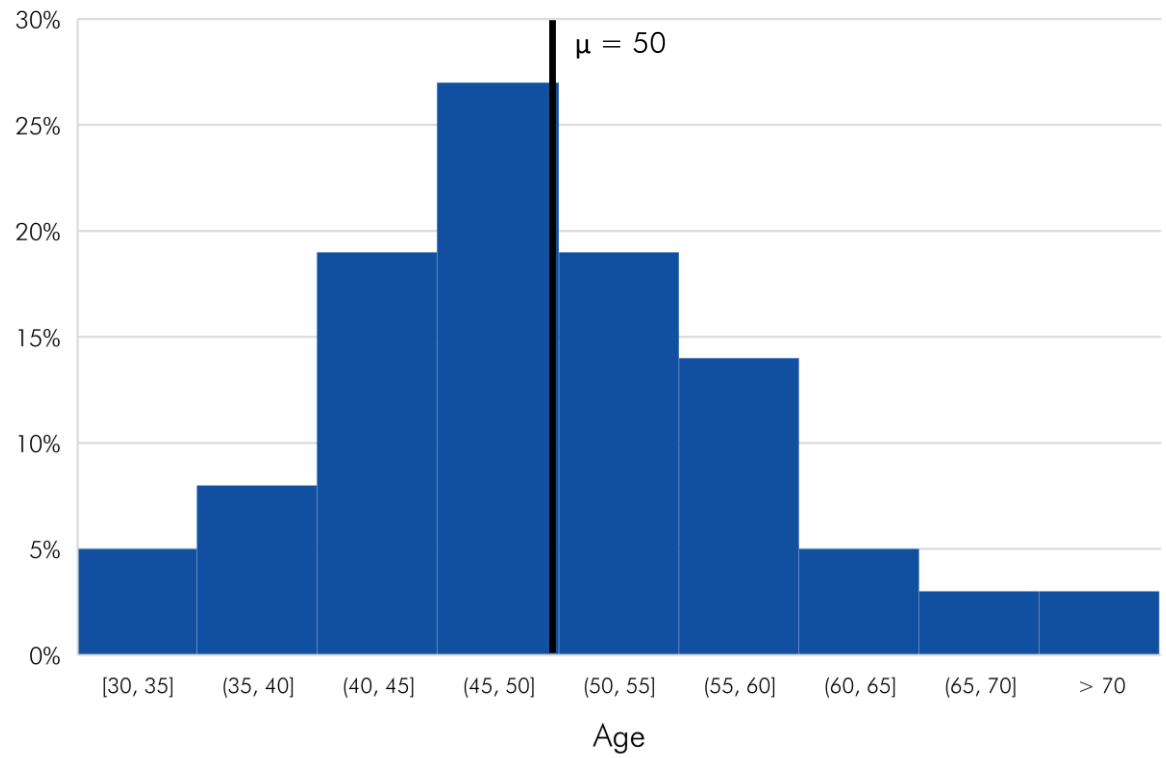
EAF's BAs

The typical BA that enters into a co-investment agreement with the EAF is male, around the age of 50 at the time of signing, highly educated and has either a significant amount of entrepreneurial and/or investment experience. This is in line with the BA profiles described in earlier studies (Morisette, 2007).

The nationality distribution of EAF's BAs reflects the organisation and dynamics of the EAF. With the German program being both the largest and longest running program, nearly half of the BAs that have partnered with EAF have the German nationality. The geography of EAF's BAs and their portfolio is discussed at greater length in Section 3.1.

Figure 3 illustrates in detail the distribution of BAs' age. That the typical BA is middle aged is not unusual. After all, accumulating the entrepreneurial experience and capital that is required to become successful as a BA takes time. Nevertheless, the EAF also cooperates with a few relatively young BAs, the youngest of which was 30 years old at the time of signing.

Figure 3: Distribution of BAs' age at signature time



Source: Internal EIF data

All BAs had substantial prior investment experience upon signature date.[9] The average number of years of experience as an individual investor was about 10 years, significantly higher than the average of 7.5 years reported by Ali et al. (2017). On average, upon signing, the BAs had already injected Angel financing into 13 ventures. This implies an investment rate of about one investee per year. This is relatively modest compared to VC funds whose investment intensity could be as high as

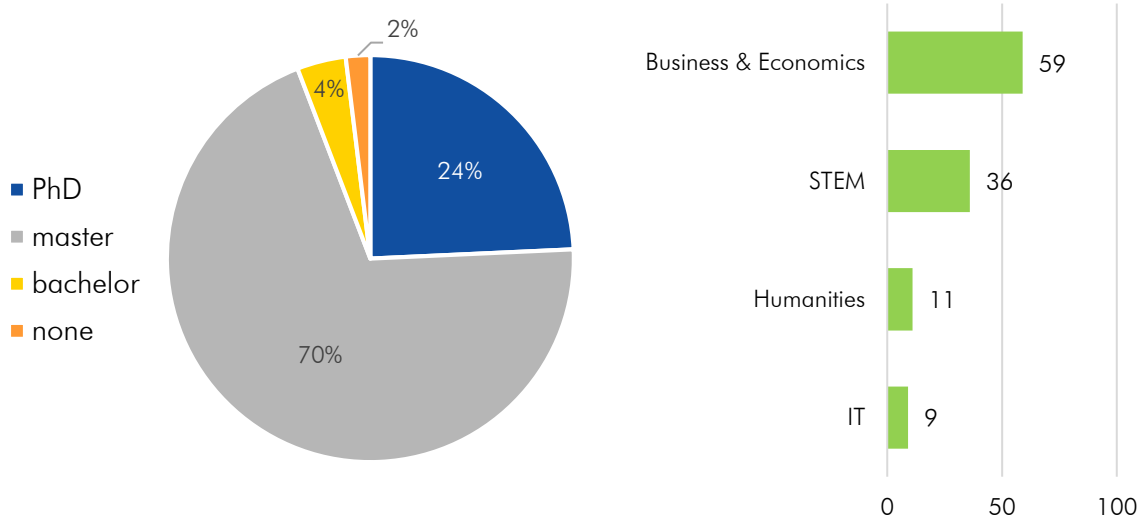
[9] The EAF only enters co-investment arrangements with experienced investors that have a proven track record, with a clear pattern of succesful investments.

5-10 deals per year (Morisette, 2007). This is in line with our prior notion that BAs, investing their own funds, are patient investors who avoid rush judgement and carefully deliberate their investment decisions. Nevertheless, compared to other studies focussing on Angel investments, this investment intensity is relatively high. This is likely to be caused by EAF's focus on seasoned, experienced investors. In addition to having previous Angel experience, a minority (15%) of BAs also acquired investment experience at a VC firm before signing their co-investment agreement with EAF.

EAF's BAs are highly educated. Seventy percent of them hold at least one master degree, while 24 percent obtained a PhD. Clearly, the notion that BAs are rarely educated at the master level or above (Ramadani, 2009) is not supported in this sample. BAs' educational focus often was cross-disciplinary, as 13 BAs[10] held multiple degrees in different fields of study. Figure 4 (right panel) illustrates the distribution of those fields. The majority of BAs obtained some formal education in the field Business and Economics (59), whereas one in three followed a STEM-related education. Humanities and IT were the least popular fields of study. A significant share of BAs already obtained some international exposure during their studies, with 15 percent of BAs graduating from a university abroad.

In addition to being highly educated and having built up extensive investment experience, BAs typically dispose of a substantial entrepreneurial background. Three in four BAs reportedly founded or co-founded a start-up themselves, or occupied a managing position in a company, prior to or during their investment activities. This is significantly higher compared to the European average found in a recent study by the European Commission, where only 40 percent of respondents claimed to have some entrepreneurial experience (Ali et al., 2017). The entrepreneurial experience of EAF's BAs can guide them in their due diligence activities and help them assess the growth potential of their investee companies.

Figure 4: BAs higher education level and field of study



Note: The education level refers to the highest obtained degree (within the BA team, where applicable). The right hand side panel refers to the field in which the BAs obtained their degrees. BAs can hold multiple degrees. Moreover, members of a BA team can be educated in different fields. Hence, the amount of fields depicted in the right hand side panel exceeds the number of BA investors (103).
Source: Internal EIF data

[10] Or different members of a BA team.

The BAs in our sample are predominantly male. While this is a common finding in the literature on BA investing, the gender imbalance among EAF's BAs is particularly pronounced. Only three percent of EAF's BAs are women. This falls short from the female proportion reported in a recent study (Tooth, 2018), covering six Western European countries, that estimated it between five (France and Portugal) and 23 percent (Italy). A number of factors can explain the gender imbalance in Angel investing. For example, because entrepreneurial experience is an important driver of Angel investment activity (Tooth, 2018), the BA gender imbalance can reflect existing gender imbalances in entrepreneurial activity. EAF's focus on experienced Angels is another potential mechanism that could reinforce the gender imbalance. Other potential drivers of the lack of female Angels include life-stage related priority motives (Tooth, 2018), lack of awareness or a higher degree of risk-aversion typically associated with women (Eckel and Grossman, 2008). These drivers are more general by nature, and not specific to the EAF program.

While in their essence, BAs are solo investors, they often choose to associate themselves with Business Angel investment Networks (BANs). BANs can contribute to the effectiveness of Angels' investment strategies by promoting information spill-overs, or pooling capital resources for combined investment efforts in order to scale up their investments. BANs can provide an opportunity for less experienced investors to connect with more experienced counterparts, thus improving their human capital and knowledge on how to implement effective value creating investment decisions. About 35 percent of EAF's BAs self-disclosed a BAN affiliation. This is slightly below what is found in other studies (see Table A1 in the Annex). BANs are frequently used by less-experienced BAs to leverage on other members' investment experience (Bonini et al., 2018). The lower affiliation rate can thus be explained by the fact that EAF's BAs are relatively experienced and hence less likely to rely on BANs. Table 1 summarises the various characteristics of EAF's BAs discussed in the preceding paragraphs, whereas Table A1 (Annex) benchmarks some of our findings with the results of a number of earlier studies on Angel investing.

Table 1: Summary of various EAF BA characteristics

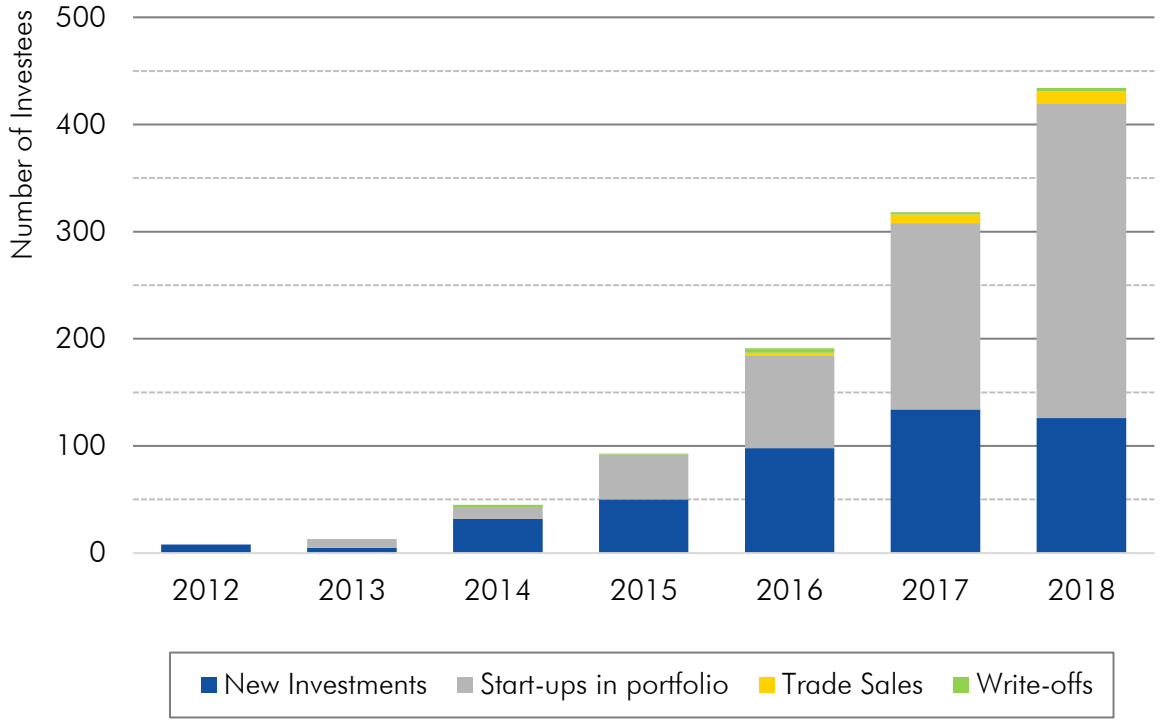
Gender	Female	3%
	Male	97%
Nationality	Germany	45%
	Netherlands	13%
	Austria	12%
	Spain	11%
	Other	19%
Prior entrepreneurial experience	Yes	73%
	No	27%
Prior VC experience	Yes	15%
	No	85%
BAN affiliation	Yes	36%
	No	64%

Source: Internal EIF data

… and their combined portfolio

Figure 5 illustrates the evolution of EAF's BA portfolio from the launch of EAF Germany in 2012 to 2018. It distinguishes between companies currently in the portfolio and companies that have exited during any given year. Current investees are further subdivided into new investments and companies that have been in the portfolio for at least one year. The number of portfolio companies grew from just eight in 2012 to well over 400 by the end of 2018. As much of the national programs are still in their infancy, combined with the fact that Angel financiers focus on patient long-term investments, the number of recorded exits has been limited: combined over the entire period considered, 23 investee companies were successfully sold, whereas 12 have been written off. Most exit events took place from 2016 onwards.[11]

Figure 5: Evolution of EIF's BA investees by portfolio status



Source: Internal EIF data

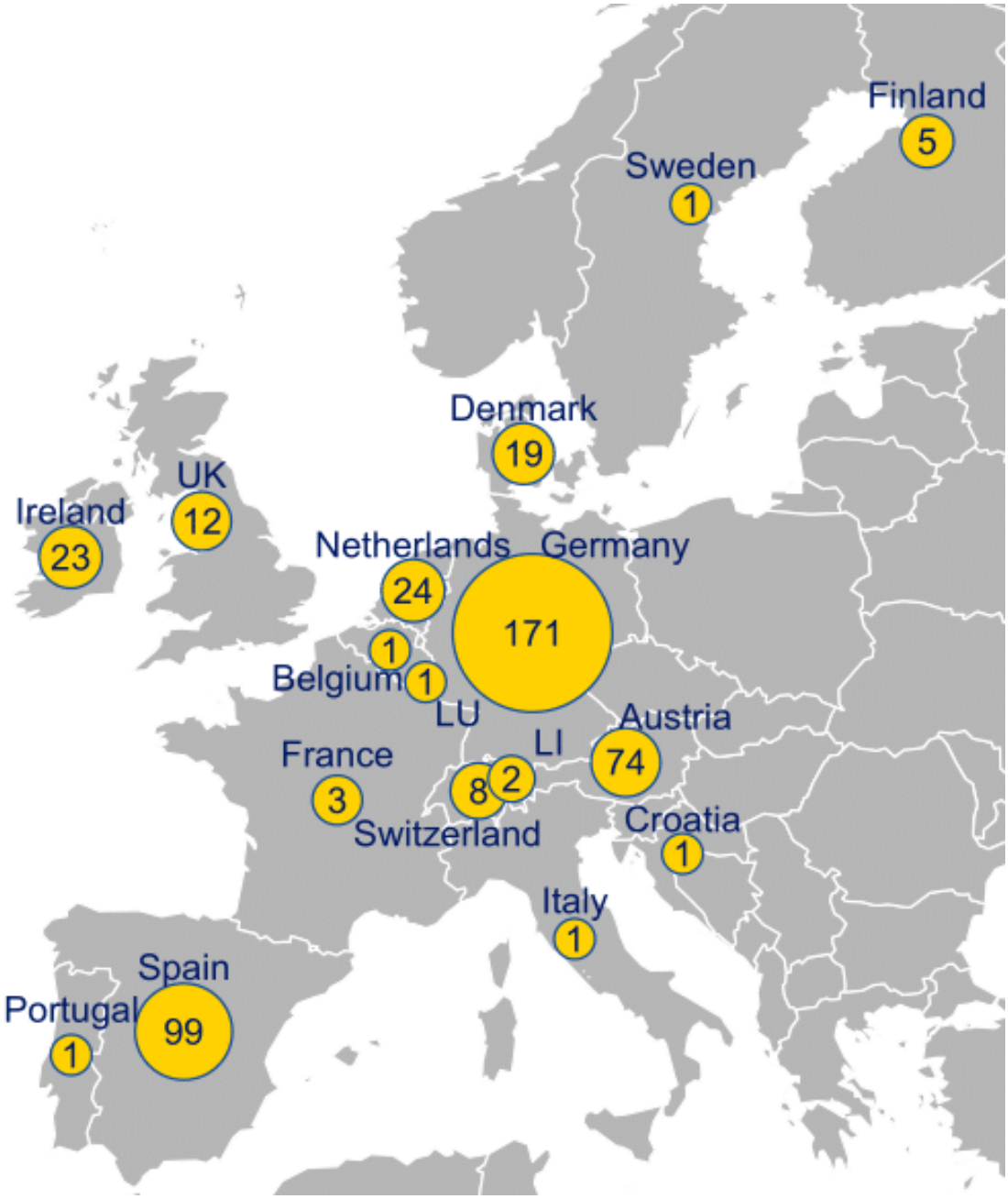
The geography of EAF investee companies (Figure 4) largely reflects the distribution of national EAF programs. This is in part driven by a limit on the share of total investments that can flow abroad.[12] However, it is unlikely that in absence of this limitation the geographic distribution would have been much different, as BAs typically focus their investment efforts on the local economy.[13] Therefore, it is not surprising that the vast majority of investee companies are headquartered on the European continent, in particular in Germany, Spain and Austria, the three countries with the longest running initiatives. A few investments made it beyond the European borders, with six investees located in the United States and two in Mexico. EAF's portfolio also includes one Indonesian and one South-African investee company.

[11] Many of EAF's Angel investors have only recently signed a co-investment agreement, which explains the rarity of exit events.

[12] Depending on the national EAF initiative, the share of foreign investments is limited from 20 to 50 percent of total investment volume.

[13] See Section 3.1 for a more elaborate analysis on the geographic aspects of the BAs' investment behaviour.

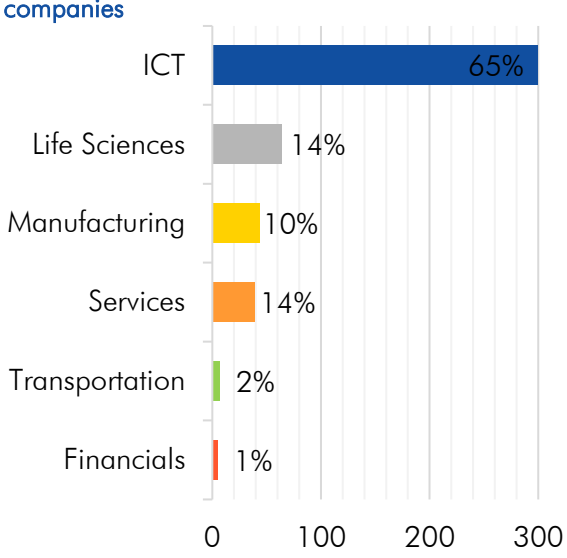
Figure 6: Geographical distribution of EAF portfolio companies



Note: The map is limited to investee companies who are headquartered in Europe and excluded investee companies from the United States (9), Mexico (3), South Africa (1) and Indonesia (1).
Source: Internal EIF data

EAF aims to foster innovation. Hence, the sectoral distribution of the affiliated BAs' investments reflects this policy objective (Figure 7). The vast majority of EAF's beneficiary companies are active in the highly innovative ICT (65%) and Life Sciences (14%). The remaining 21% of the portfolio is distributed between the Manufacturing, Services, Transportation and Financial sector.

Figure 7: Sector distribution of EAF's investee companies



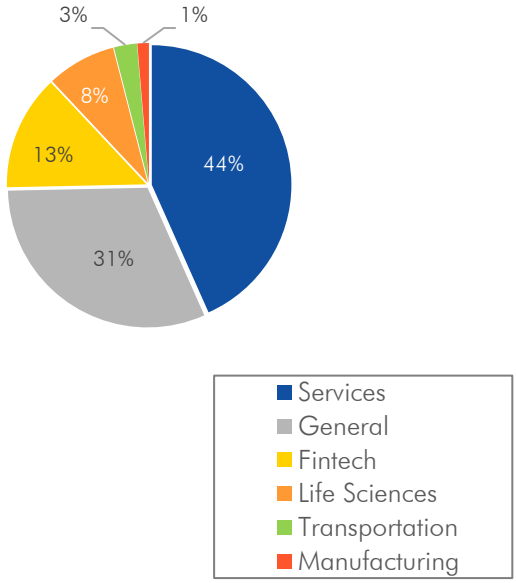
Note: When available, the sector classification proceeds based on the NACE classification method, as derived from the Orbis database. For the remaining companies for which no Orbis match could be identified, the sector classification was based on a manual web search, using sources such as the companies' personal webpage or LinkedIn profile, or information available on the Crunchbase platform.

Source: Internal EIF data

Even in traditional sectors, the vast majority of EAF investees' business models are aimed at disrupting existing industry structures by developing highly innovative products or business applications. Nine of EAF's manufacturing investees, for example, focus on Clean-tech technology, such as the development of environmentally friendly paint products or the development of renewable energy sources. Other manufacturing investees are engaged in high-tech activities such as laser or 3D-printing technology. This observation also holds true for EAF investees active in the transport sector. All five of them are dedicated to the environmental cause, as they aim to reduce the transport sector's ecological footprint by developing innovative Clean-tech technology with applications in Transport.

While the bulk of EAF investee companies were classified as ICT companies, the expanding importance of IT technology in all sectors of the economy has increasingly blurred the line between ICT activities and traditional sectors. The importance of IT innovations reaches well beyond the boundaries of its sector classification. To gain better insight into the disruptive potential of EAF's ICT companies, we classified them manually according to the application field of their respective IT technologies (see Figure 8). The largest share of ICT companies developed applications aimed to serve the Service industry (44%), such as online platforms aimed at reducing frictions in the retailing sector. Other applications (31%) had a more general application area, spanning a variety of sectors, such as software development for recruitment activities, to give but one example.

Figure 8: Probable application areas of EAF's ICT technologies



Note: the classification based on area of application proceeded manually and is based on the personal assessment of the authors.

Source: Internal EIF data

This exercise further revealed the true extent of EAF's involvement in the financial sector. Forty additional investees could be unambiguously identified as Fintech companies, running crowdfunding platforms or developing mobile payment processing apps. In addition, a fair share (8%) of EAF's ICT applications flows to the Life Sciences sector.

3. Investment strategies

3.1 Geographical strategy: a preference for local companies

Mapping EAF's BAs and portfolio companies

BAs invest in what they know. Their investment decisions derive from personal contacts and informal meetings. This often leads them to follow a localised investment strategy (Harrison et al., 2010). BAs choose investments near them, sometimes even using the "one-hour-distance" rule (Kraemer-Eis and Schillo, 2011; Morrissette, 2007). This section investigates to what extent this hypothesis also holds true for EAF's BAs. For this analysis, fund locations were geocoded based on the physical location of the BAs, which can differ from their legal headquarters and therefore can lie outside of the territory of the country in which the EAF program was deployed. Investee locations were determined based on the city of their legal headquarters, which was retrieved from the Bureau van Dijk Orbis database[14] or through manual internet search queries.

The median distance between a BA's headquarter and their investment target is 124km.[15] The intercontinental outliers[16] create a significant wedge between the median and the mean investment distance, as the latter materialises at 458km. Ninety-five percent of investments occur within the limits of a 945km radius. These statistics are slightly higher compared to other estimates reported in the literature, such as Mason and Harrison (1994), for example, who report a median investment distance of about 80km, or Reitan and Sörheim (2000) who find a median distance of about 50km for Norwegian BAs.

Figure 9 illustrates the geographic distribution of EAF's BAs and their portfolio investments at the regional NUTS-3[17] level. The size of the bubbles illustrates the total number of BAs/investees. The colour intensity refers to total mobilised capital, calculated as the sum of EAF's co-investment commitment to its signed BAs and the BAs' own committed capital (panel a) , or investees' combined received investment amounts (panel b).

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[14] Orbis is an aggregator of firm-level data gathered from over 75 national and international information providers. Data is sourced from national banks, credit bureaus, business registers, statistical offices and company annual reports.
There are several advantages in using the Orbis database over similar data sources (Kalemli-Ozcan et al., 2015). Orbis provides harmonised balance sheet and profit and loss data, covering many more small and private companies compared to e.g. Compustat. As of April 2019, Orbis tracks 300 million companies in over 90 countries. Only 1% of these are listed.

[15] Both BAs' and investees' headquartered are geocoded at the level of the city. To ensure anonimity, all geographical analysis in this paper proceeds at the NUTS3-level. In absence of exact adress coordinates, the distance between a BA and his investee that are headquartered in the same NUTS3-region is calculated like $d_{ij} = (2/3)\sqrt{area_i \backslash \pi}$ as in Head and Mayer (2000), which assumes BAs and investees are randomly located within a circular shaped area. While these assumptions are unmistakably strong, it avoids setting internal distances to 0, which would significantly underestimate the true distance between the BAs and their investee companies.

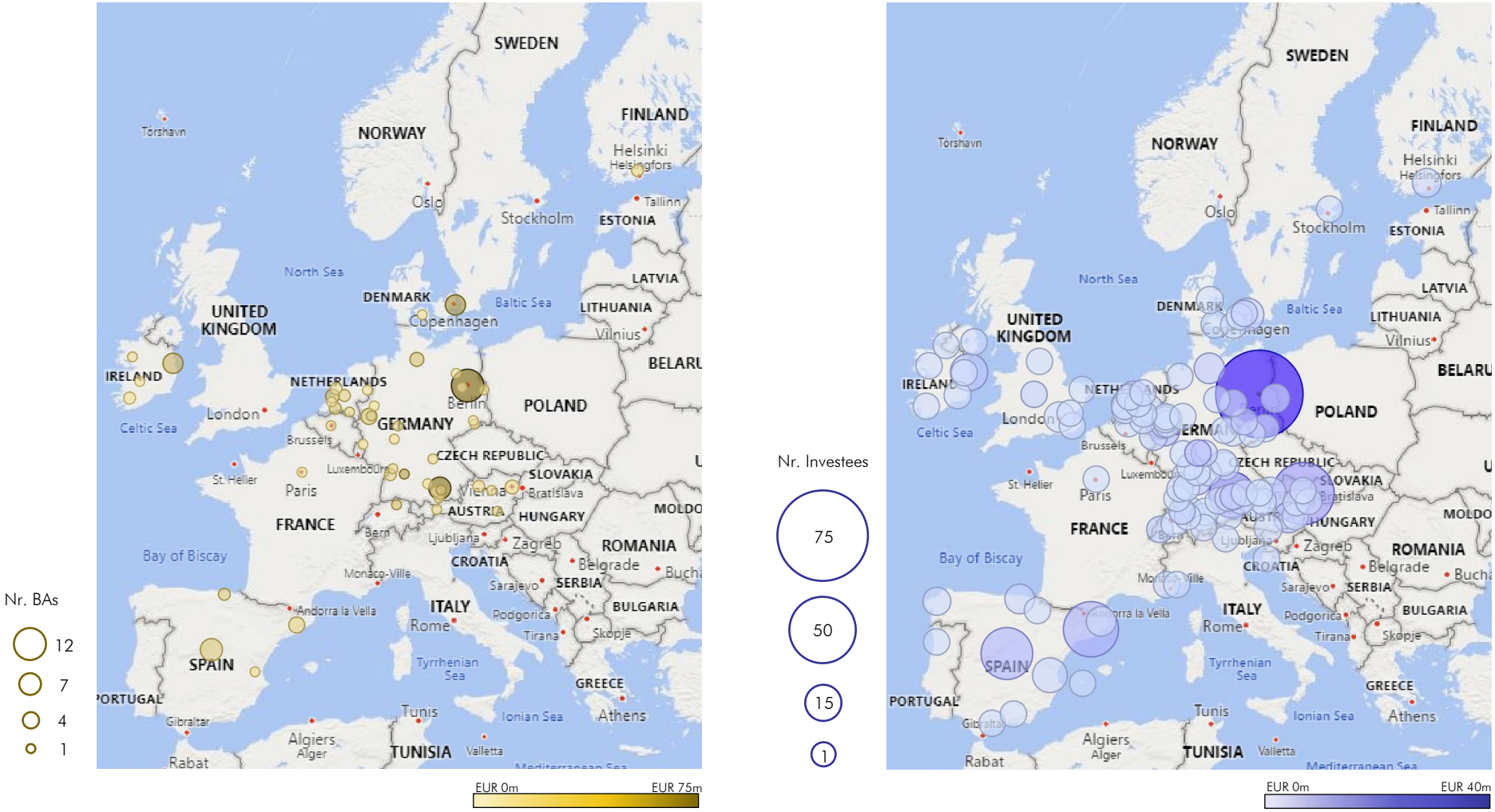
[16] Since the NUTS classification only exists for European countries, international investees were geocoded using the cetroids of their respective cities.

[17] The Nomenclature of Territorial Units for Statistics (NUTS; French: Nomenclature des unités territoriales statistiques) is Eurostat's regional classification method. The classification consists of three levels, the third level being the most disaggregated. NUTS divisions favour existing territorial administrative division set by the member states, the choice of which is determined using minimum and maximum population threshold. The minimum and maximum threshold for the NUTS-3 level are set at 150,000 and 800,000, respectively, and therefore the NUTS-3 delineation should not exceed one functional urban area.

Figure 9: The source and destination of EAF investment capital (Europe, NUTS3 level), per Q2/2019

a) Geographical distribution of EAF's mobilised capital supply

b) Geographical distribution of EAF's investee portfolio



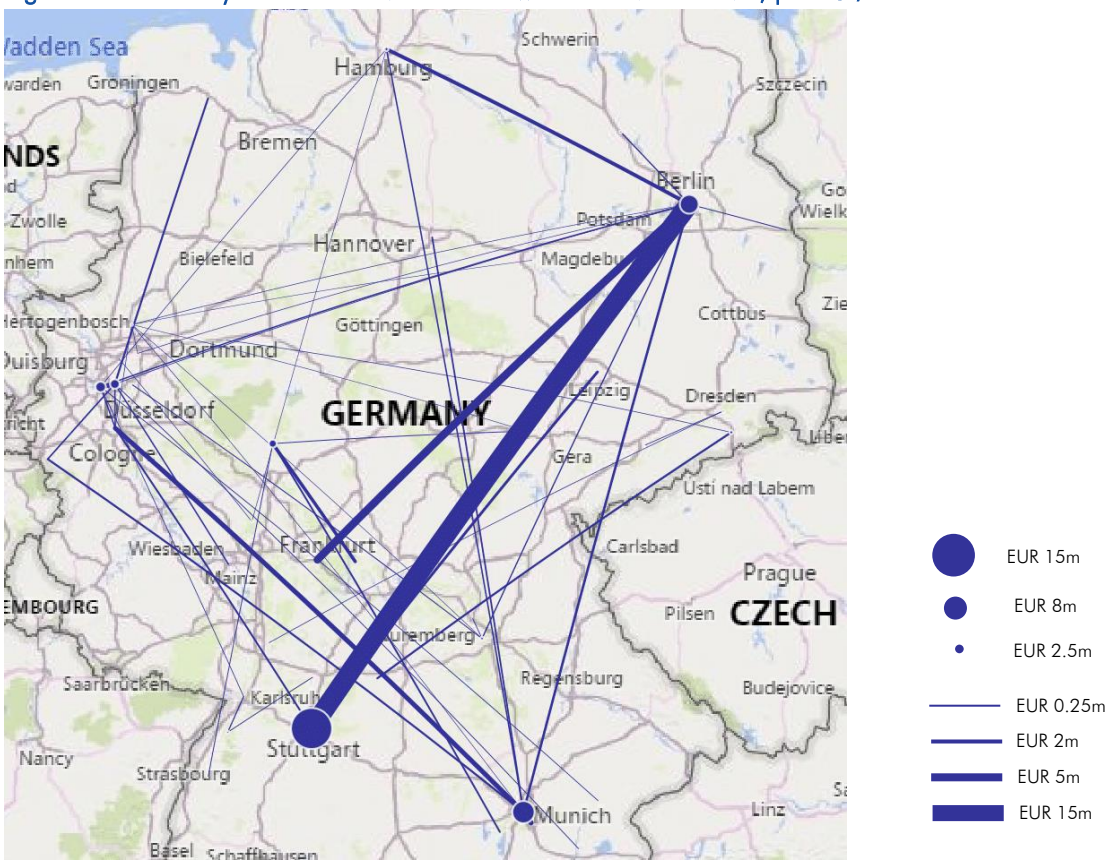
Note: Both BAs as well as their investees are geocoded using the centroids of the NUTS3 region in which they are headquartered. Mobilised capital supply is expressed as the total signed amount of EAF's investment contribution combined with the co-investment share of the BAs, expressed in current prices. The right hand side panel illustrates the total amount of investments into companies as of Q2/2019, expressed in 2017-prices.

Source: Internal EIF data

EAF's BAs are located mostly in large urban areas (Figure 9, panel a). The German capital region is the most popular location, with 12 BAs located in Berlin and three more in the surrounding NUTS3 regions, mobilising a total of EUR 87m of risk capital. The Munich area mobilised the second highest amount (EUR 86m), followed by the metropolitan area of Copenhagen (EUR 45m), Stuttgart (EUR 37.5m) and Düsseldorf (EUR 29m). That four out of five top areas are located in Germany is easily explained by EAF Germany being the longest running and largest program to date. Other notable supply hotspots are Madrid, Dublin and The Hague.

EAF's regulations stipulate that BAs must dedicate the lion share of their investments to the domestic market. Even though an individual BA's portfolio can consist anywhere from 20% to 50% out of international investments, de facto this share is significantly smaller. Measured at 12%, it lies well below the boundaries of what is contractually permitted. This reflects BAs' natural tendency to invest locally. This highly localised investment strategy is reflected in the fact that over 1 in 4 of BA investments occur within the borders of their own municipality and about 4 in 10 of investee within the same NUTS3 region. This in turns implies that the concentration of EAF's BAs in the capital regions reflects itself in the geographic distribution of investee companies across Europe (Figure 9, panel b).

Figure 10: Germany's domestic investment flows at the NUTS3 level, per Q2/2019[18]

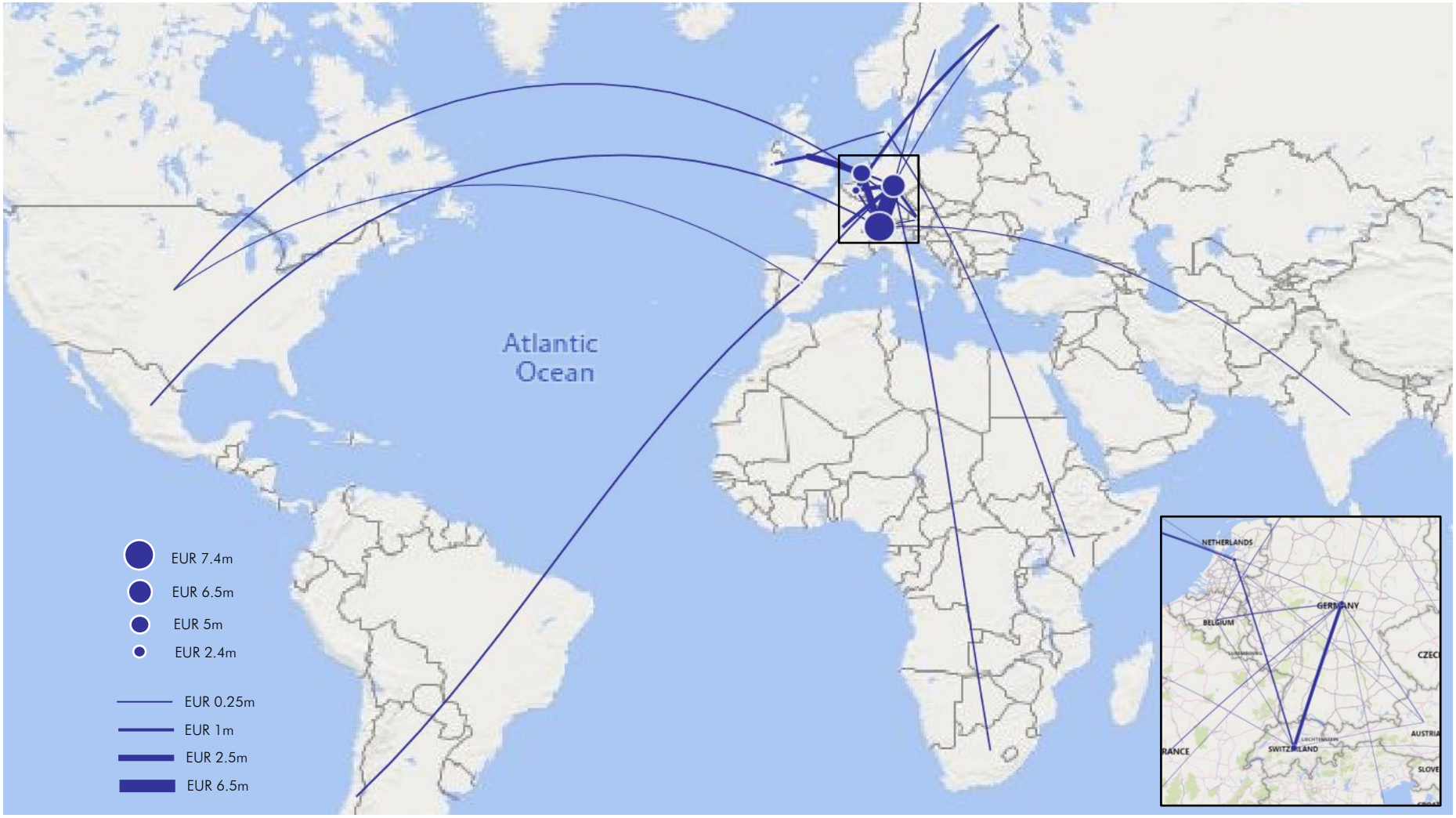


Note: BAs and their investees are geocoded using the centroids of the NUTS3 region in which they are headquartered. The size of the dots represents the total outgoing domestic investment flow. When a bilateral flow runs between two NUTS3 areas, only the greater of the two is illustrated.

Source: Internal EIF data

[18] Two of EAF Germany's BAs are located in Belgium and Switzerland, respectively. The contractual geographical restriction related to the maximum share of international investments pertains to the program's country, as opposed to the BA's physical location. Consequently, the majority of their investments will flow to Germany.

Figure 11: Outgoing international investment flows from EAF supported countries



Note: The dots represent the size of the outgoing international investment flows. All investment amounts are deflated using gross fixed capital formation price indexes and expressed in 2017-prices. The legend refers to the main map only as the enlarged section on Central Europe serves to illustrate in detail the exact origin and destination of the investment flows. When a bilateral flow runs between two countries, only the greater of the two is illustrated.

Source: Internal EIF data

Over the entire program period considered, the German capital region received the highest capital influx. Seventy-seven companies in the Berlin NUTS3 area received a capital inflow of EUR 35m. The greater Munich region received the second highest amount of investment inflows (EUR 14m for 24 investees), followed by Vienna (EUR 10m for 43 investees), Barcelona (EUR 7m for 36 investees) and Madrid (EUR 7m for 32 investees).[19] While about 40 percent of BA investment targets are located within the same NUTS3, they receive just 33 percent of investment capital. This implies that investment size increases when crossing a regional border (see section 3.1 for a more elaborate analysis of the relationship between distance and investment amount).

While a significant share of their investment activity remains within a commutable distance from their physical headquarters, BAs frequently expand their investment horizons beyond their own region, in search for unique investment opportunities. Nevertheless, the vast majority of investments remains within national borders: about 88 percent of investee companies are headquartered in the same country as their investor, receiving 81 percent of total invested capital. Here too, the less than proportionate amount of domestic investment capital flows indicates a positive relationship between distance and investment size, as international investments are on average higher. About 45 percent of domestic flows are intra-NUTS3, while the remaining 55 percent flow between different NUTS3 areas.

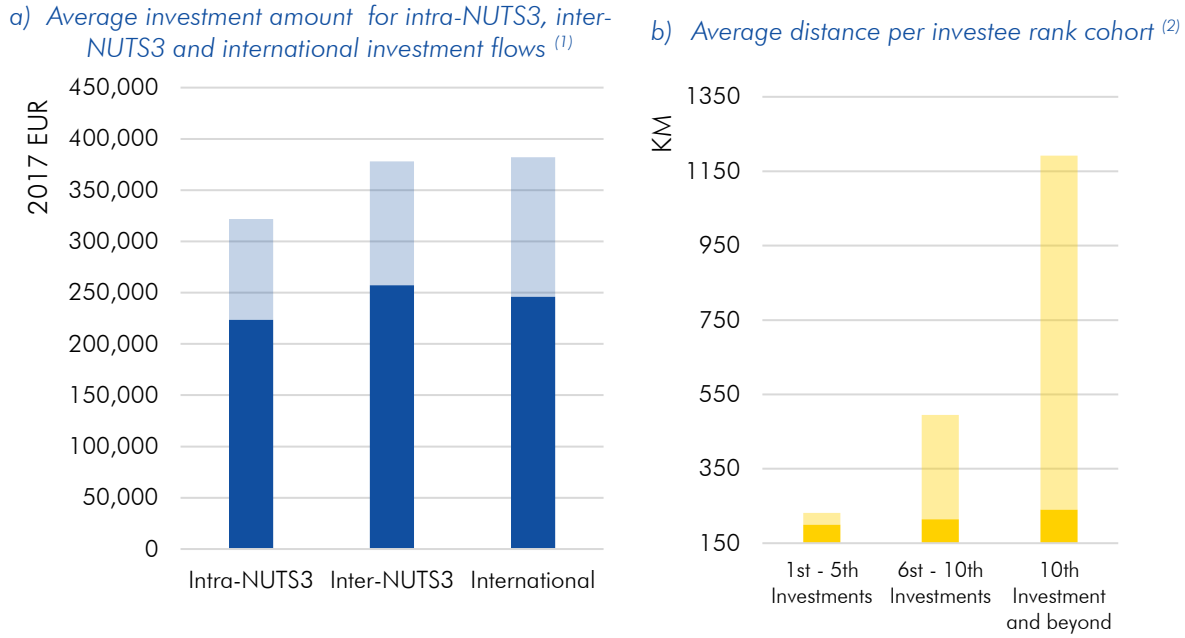
Figure 10 (page 18) illustrates these intra-NUTS3 investment flows for the German market, EAF's largest and longest running program. Investment activity is clearly centred on a few metropolitan areas, which is in accordance with an earlier study that documented the geographical distribution of EIF's VC portfolio (Kraemer-Eis, Prencipe and Signore; 2016).

About 12 percent of EAF's portfolio companies are international investees. Together, they account for nearly 20 percent of total portfolio size. Figure 11(page 19) illustrates EAF's outgoing cross-border investments. To ensure anonymity, international flows are aggregated up to the country level. The size of the bubbles represents the total size of outgoing international flows for the respective countries, and the width of the flow lines refers to size. It is clear that the vast majority of international investments remain within the EU, with just a few EAF investees headquartered outside. The relatively large flows that run from Switzerland and Belgium to Germany, despite these two countries having no EAF programs, are explained by the two BAs signed to EAF Germany headquartered there.

The mapping exercise above already revealed that on average a disproportionate amount of investment capital flows outside of the regional/national borders. Figure 12 (panel a) illustrates this by comparing the average ticket size of intra-NUTS3, domestic inter-NUTS3 and international investment flows. Investment capital flows within the same NUTS3 region are on average 15 percent smaller than domestic inter-NUTS3 flows, confirming our earlier hypothesis that distant investments are often larger. International investments are also higher than domestic investment, but the difference is negligible. Excluding the top five percent largest investments, to account for the influence of outliers (dark shaded area of the bars), interregional domestic NUTS3 flows are still 13 percent larger than intraregional flows, but international flows are actually five percent smaller than interregional domestic flows.

[19] All city names mentioned in this paragraph refer to their respective NUTS3 region.

Figure 12: Factors affecting investment flow distance: investment size and portfolio dynamics



Note: (1) Investment size is calculated as the total investment of a BA into one investee, summed over all rounds. The dark area of the bar chart represents the average investment amount, excluding the top 5% largest investments. The light shaded area uses the entire sample. (2) The dark area of the bar chart represents the average distance, excluding the top 5% most distant investments.

Source: Internal EIF data

BAs' preference for local investments should also be reflected in their portfolio dynamics. A localised investment strategy implies that BAs will have the tendency to look for distant investment only after local investment opportunities have been exhausted. Figure 12 (panel b) illustrates this in more detail by subdividing a BA's investment portfolio by timing rank, into classes of five, and comparing the average distance to his first five EAF co-investments, to the second group (6th to 10th co-investment), and so on. The average distance increases significantly as the BAs co-investment portfolio grows. This is especially the case when considering the entire portfolio (including the light shaded areas). The distance to the first through fifth EAF co-investment amounts to 230km, on average. The distance to the fifth through 10th investment is 112 percent higher at nearly 500km. Finally, the average investment of the 10th investment and beyond is close to 1200km (+142%). While the trend becomes less pronounced after eliminating the top five percent most distant investments, it is still present (dark shaded bars), providing evidence in support of the hypothesis that BAs first exhaust local investment opportunities, before expanding their investment horizons to more distant regions.

Factors related to geographical investment radius

To examine BAs geographical strategies beyond the simple two-way relationships like those presented in Figure 12, a conditional correlation analysis can shed further light on the factors determining BAs investment distance. Table 2 provides a short overview of possible determinants and their hypothesised relationship, including some references to earlier studies that have examined this subject. Table 3 contains the results of the correlation analysis.

After simultaneously controlling for a number of potential determinants, only four out of nine factors remain significantly associated with investment distance. The coefficients on BAs' education and investment size are not significantly correlated with distance, neither is the amount of earlier investment experience gathered as a BA.

Table 2: Potential determinants of investment distance

Investment specific characteristics

Portfolio growth	A preference for local investment should be reflected in this basic relationship: a positive correlation between *the time* an investee entered the portfolio, as measured by the rank at which the investee entered the BAs portfolio (*RANK*), vis-à-vis the BA's other co-investments, and *the distance* between that investees and its BA investor.
Investment amount	A positive relationship between the distance to investment targets and investment size (*INV_AMOUNT*) is a stylised fact that often emerges from the existing literature (see for example, Harrison et al. (2010) for the case of BAs). Such a relationship can be explained by the presence of fixed costs, where due diligence expenses increase with distance so that distant targets would require a larger investment to increase the probability of a positive return.
Familiarity with the investee's business model	Distant investees are also more likely to operate in a sector in which the BA already acquired investment experience. Berchicci et al. (2011), for example, show that BAs invest locally, without specific sectoral preferences. However, when they expand their investment radius, they select investee companies that are active in sectors they are familiar with from earlier investment experience. In a similar vein, Table 3 tests the effect of familiarity with an investee's business model by relating a similarity measure of the BA's educational background and his investee's sector (*SIMIL*) to the geographical investment distance. The similarity indicator equals one for the following (education, macrosector) matches: (IT, ICT); (Business & Economics, Financial); (STEM; Life Science & Manufacturing). Based on Berchicci et al. (2011), this relationship is expected to be positive.
Investment Stage	As information asymmetries are more pronounced for very young companies, distant investments often flow to older companies. The analysis includes a variable indicating whether an investee is a seed company (*SEED*). The correlation with distance is hypothesised to be negative (Harrison et al., 2010).

BA specific characteristics

BA Gender	To the best of our knowledge, there exist no previous studies that examine gender preferences in geographical investment strategies. Despite of the limited representation of women in our BA sample (n=3), we supplemented the correlation analysis with a binary gender indicator (*MALE*).
BA experience	Earlier studies that have tested the relationship between previous investment experience and distance have returned mixed results. On the one hand, more experienced investors might be better equipped to deal with the added information shortfalls of long distance investing (Harrison et al., 2010; Berchicci et al., 2011). On the other hand, one could also make the argument that more experienced investors are better aware of the associated pitfalls and hence will invest more locally. Therefore, the correlation between investment experience and investment distance is difficult to establish a priori. The analysis includes two measures of investment experience. The first indicator measures the number of years of VC Fund experience the BA enjoyed prior to establishing a co-investment relationship with the EAF (*YEARS_VCEXP*). The second measure indicates whether his co-investments with EAF constitute his first individual BA investment experience (*NEWTEAM*).
BA education	Also the educational level can impact a BA's geographical investment strategy. We test whether education affects the investment radius by including a dummy variable indicating whether the BA's highest obtained degree is a PhD (*PHD*) as well as a dummy variable indicating the BA has obtained an MBA (*MBA*).
Generic country-specific factors	Because the domestic investment component of the EAF program is important by design, it is essential to control for country-specific differences in the average investment difference, as BAs operating in larger countries will invest more distantly by construction. If there are important country-level differences in BA characteristics, these are likely to pick up this country effect.

The growth stage of a company is only weakly correlated to distance and not significant at conventional cut-off levels, although the magnitude of the coefficients is arguably economically meaningful: an invested seed company is located, on average, 287km closer compared to early and later stage companies. The analysis also detected a significant gender difference in average investment distance. Women investors tend to invest more locally. Investments made by EAF's male BAs flow on average 52km further compared to female BAs.

As opposed to prior expectations, being familiar with an investees business model (*SIMIL*) does not overcome the challenges imposed by distant investing. On the contrary, investments done in a company that operates in a sector that leans closely to a BA's formal education are significantly more local.

Finally, the local investment strategy of EAF's BAs is best reflected by the result that as a BA's portfolio grows, the average investment distance increases accordingly. The highly significant coefficient on *RANK* indicates that, for every additional company that is added to the portfolio, the average distance between a BA's HQ and that newly added investee grows by about 54km. This means that even after controlling for all other factors listed in Table 2, BAs first exhaust local investment opportunities, before venturing out to find new ones in more distant regions.

Table 3: Factors related to investment radius for the conditional correlation analysis

	OLS estimates of correlations between the determinants and investment distance between the BA *b*'s location and investee *i*'s HQ. *(Standard errors in parentheses)*
$RANK_{bi}$	48.1*** *(14.1)*
INV_AMOUNT_{bi}	-0.00005 *(0.00007)*
$SIMIL_{bi}$	-186.7** *(73.5)*
$SEED_{bi}$	-295.45 *(188.3)*
$MALE_{bi}$	54.6** *(22.9)*
$YEARS_VCEXP_{bi}$	-2.2 *(10.9)*
PHD_{bi}	16.8 *(215.4)*
MBA_{bi}	170.4 *(115.3)*

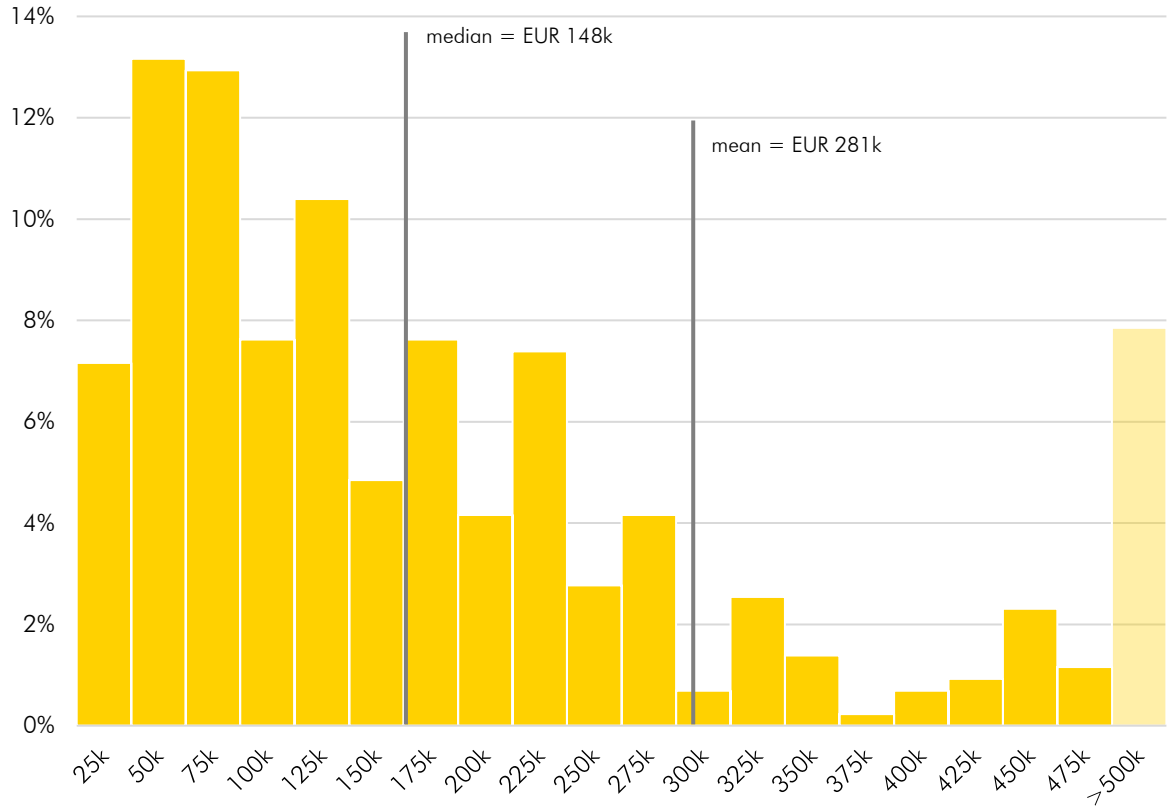
- Significance levels are indicated by: $*\ p < 0.1$, $**\ p < 0.05$, $***\ p < 0.01$
- Reported standard errors are clustered at the level of the BA's country. The specification includes country dummies.
- Estimates are based on a sample of 430 investments into 405 companies by 70 BAs between Q2/2012 and Q1/2019.
- As all variables are expressed in absolute numbers, the coefficients are to be interpreted as the average change in investment distance (km) that results from a 1 unit change in the respective determinants, conditional on all other control variables.

3.2 Investment size: invest in small

Typically, EAF's BAs invest less than EUR 200k in their investee companies (Figure 13). With a median investment size of EUR 148k and a mean of EUR 280k, the distribution of investment sizes is strongly skewed to the right. While for the most part, BAs focus on small-scaled investments, occasionally a larger opportunity arises. The largest recorded investment was EUR 5.25m.

Investment data is available at the transaction level. By applying a few assumptions, these transactions can be assigned to different investment rounds.[20] In 124 cases, a BA participated in multiple investment rounds of the same company. On average, these investment rounds follow each other with intervals of about 6 quarters. The median investment a company receives from one BA during the first investment round is about EUR 128k.

Figure 13: Distribution of investment sizes



Source: Internal EIF data

Investment sizes of EAF's investors slightly exceed what has been reported in earlier studies, who cite average BA investment amounts into companies in the range of EUR 40k to EUR 200k (Morissette, 2007; Capizzi, 2015). It is likely that the specific subset of Angel investors drives this discrepancy, as EAF only targets experienced Angel investors. They are more likely to have accumulated wealth during their past investment activities and hence focus on larger investment opportunities.

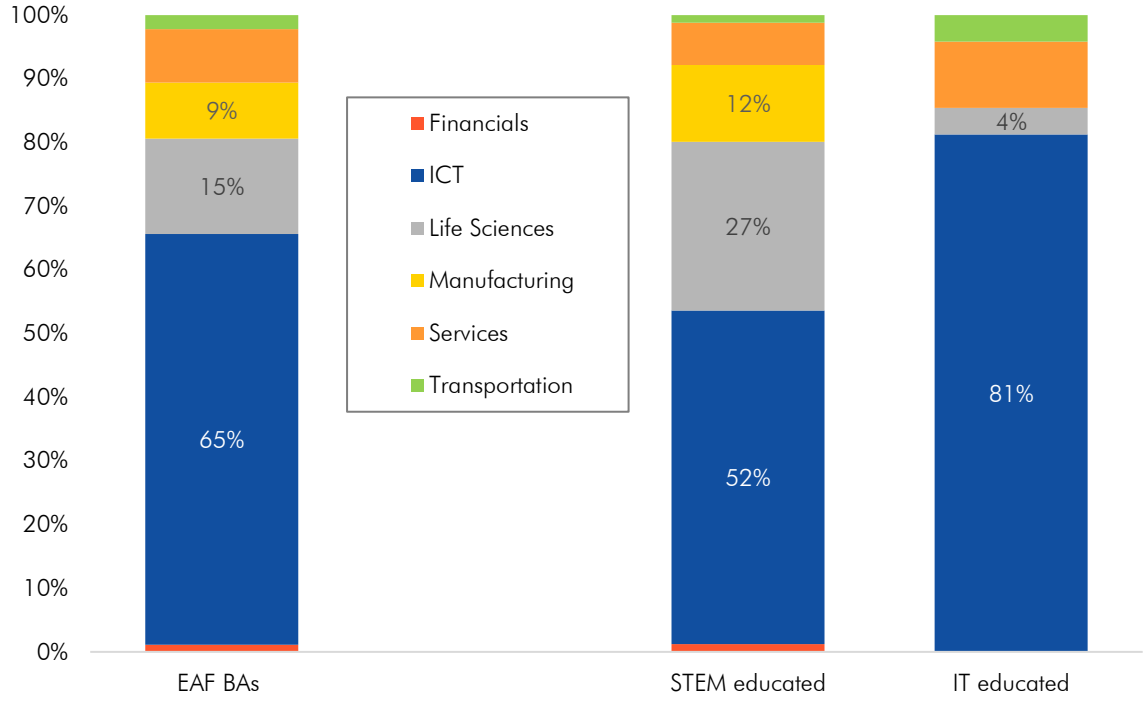
3.3 Sectoral strategy: a matter of personal expertise

The adage that BAs invest in what they know is also reflected in their sectoral strategy. Angels' investment choices are determined to a large extent by their personal expertise, experience and

[20] Annex A1 elaborates on how transactions are attributed to different investment rounds.

educational background (Mason and Stark, 2004). Figure 14 shows that BAs tend to adjust the sectoral mix of their investment portfolio based on their own educational background. STEM educated BAs tend to disproportionally focus on the Life Sciences and Manufacturing sector, whereas IT educated BAs' portfolio consists for more than 80 percent of IT-companies.

Figure 14: Sectoral distribution of portfolio companies by educational orientation: STEM vs IT



Source: Internal EIF data

3.4 Investment timing: invest in young

BAs are often claimed to focus disproportionally on seed and early stage financing, compared to formal VC investors. The reasoning goes that their personal approach to investing allows them to better mitigate the information asymmetries inherent to a more formal approach, implying they are better able to evaluate business opportunities at a very early stage. However, not all previous studies have been able to confirm this hypothesis. Dutta and Folta (2016), for example, found that VC-backed firms were actually slightly younger than Angel (group)-backed firms.

Figure 15 compares the stage focus distribution of EIF's VC portfolio[21] to EAF's portfolio and indeed highlights that BAs invest with a small bias towards Seed (32% vs 24% for VC) and Early Stage (57% vs 54% for VC) companies.

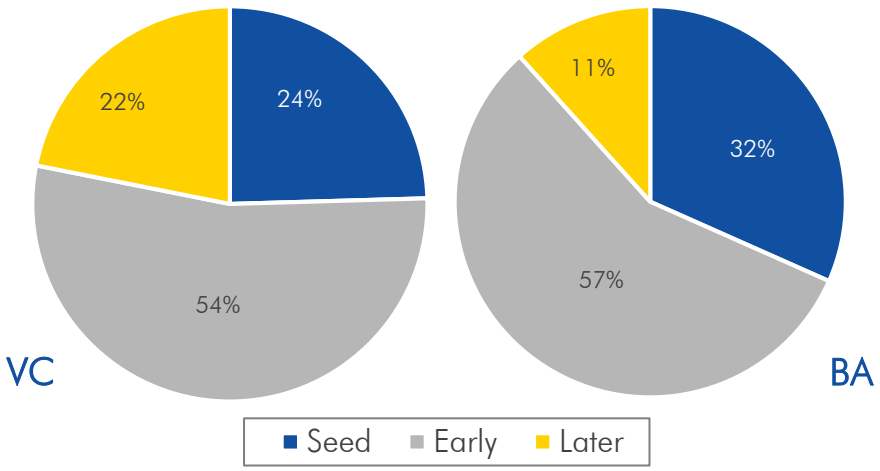
The difference in stage focus between BAs and formal VCs could indicate the existence of investment complementarities between the two investor groups, where the former first invest in the seed stage of a company and the latter subsequently follows up with later round investments.[22] Sequential investment can also occur in reverse order. BAs could potentially use the participation of formal VC funds in earlier funding rounds as a signalling device to participate in follow-up rounds. Finally, it is

[21] Excluding the population of BA investees. The difference in stage focus is likely partly rooted in the nature of the mandates governing BA and VC investment programs, whereas the latter are often more focussed on later stage investments.

[22] See Hellmann and Thiele (2015) for a formal model on BA and VC coinvestment behaviour.

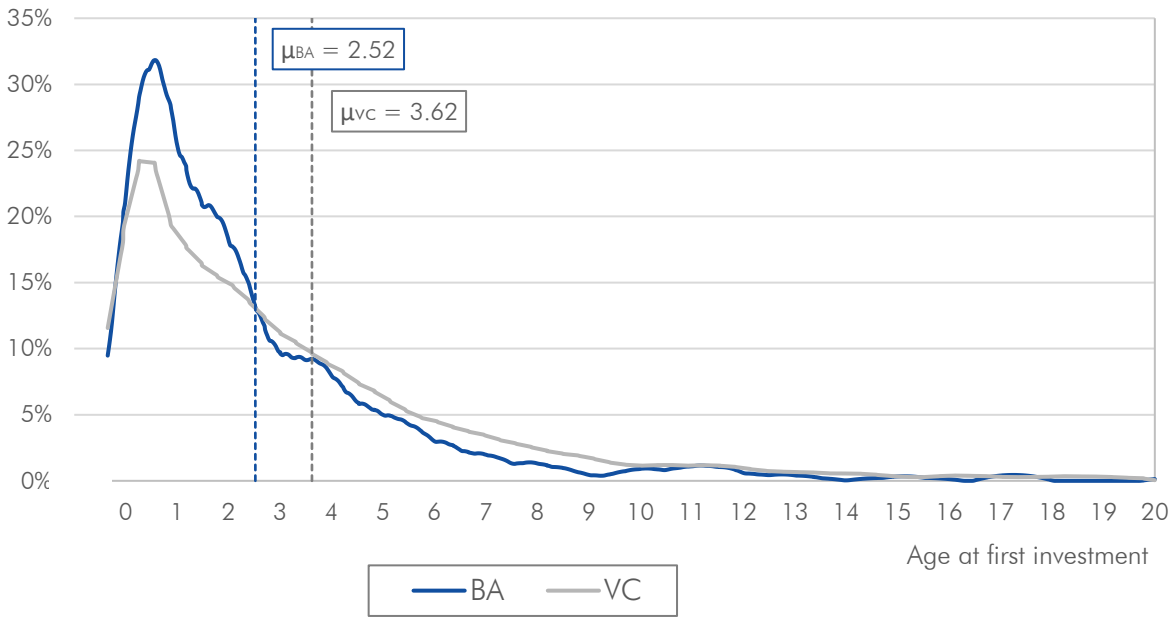
also possible for them to invest simultaneously with VC funds, where VC funds leverage BAs' knowledge and expertise (Harisson and Mason, 2000), and BAs can leverage the capital supplied by formal VC investors, who typically invest on a larger scale.

Figure 15: Stage focus, BAs vs VCs



Source: Internal EIF data

Figure 16: Distribution of company age at time of first investment



Note: The x-axis has been cut off at 20 (the maximum value for the BA sample) to avoid that the outliers in the distribution of the VC group clutter the relevant part of the density plots. The figure is based on the sub sample of companies for which a creation date is reported ($n_{BA} = 410$; $n_{VC} = 5567$).
Source: Internal EIF data

Since our data is confined to VC funds and BAs that have partnered with EIF/EAF at some point in the past, the scope of uncovering extensive investment patterns is limited. Moreover, we only record such investment patterns to the extent they occurred after the involved investors both engaged in a formal cooperation agreement with EAF/EIF. It is likely that the portfolio contains investees that might have been invested in by multiple EAF/EIF-backed investors, but were not indicated as such because one of those investments took place prior to the signature date. It should also be noted that it is not

possible to distinguish between independent investments in the same company, where two investors coincidentally invest in the same company, and formal co-investment agreements, where two investors conscientiously coordinated their investment efforts to target a specific company.

In spite of these caveats, we nevertheless uncovered a significant amount of sequential and simultaneous investments in our data (Table 4). Out of the 4,349 investee companies that entered EIF's VC and EAF's BA portfolio from 2012 onwards, 540 (or 12.4%) were invested in by more than one EIF/EAF-supported investor. Of these, just 47 investees involved both one of EAF's BAs as well as an EIF supported VC fund. Thirty-one of those cases concerned simultaneous investments, where the BA(s) and VC(s) participated in the same round.[23]

Table 4: Portfolio companies that received investments by multiple EAF/EIF supported investments

Total number of investees in EIF's VC portfolio (BA+VC)	4,349				
…with multiple EIF-backed investors (BA and/or VC)		540			
…of which only VC invested			489		
…of which only BA invested			14		
…of which BA+VC invested			47		
…of which sequential investments				16	
…of which VC-led					12
…of which BA-led					4

Note: The analysis only considers the timing of the first investment round for each investor-investee couple. Furthermore, it only considers investee companies that entered the portfolio starting 2012, the year the first EAF program was launched.
Source: Internal EIF data

The remaining 16 investees were invested sequentially. Four of those investments were BA-led, where the BA provided the first capital injection and a VC fund followed up in a later investment round. The other 12 were VC-led. Overall, this paints a mixed picture on the dynamics of VCs' and BAs' investment timing strategies. This evidence is in line with the conclusion drawn in Harrison and Mason (2000), who warn against treating BA and VC investments as two distinct markets, since a significant number of BAs invest in companies at a similar stage as formal VC funds do.

Finally, a few of EAF's investees (14) received funding from multiple EAF-affiliated BAs, six of which were sequential investments. In all but one cases, it concerned BAs that were signed to the same national program. Given the data at hand, however, it is not possible to establish a causal link between these investments and the EAF affiliation. Moreover, while it is certainly true that the EAF also serves as a formal BA network (BAN), and hence serves as a platform to exchange ideas and promote knowledge spill-overs, EAF's BAs are not actively encouraged to form investment alliances.

[23] Technically, the data at hand does not allow us to distinguish between investment rounds, as it just registers the transaction date of an investment. The data were partitioned into different investment rounds based on the assumption that a registered transaction consituted a new round if it was seperated at least 4 quarters from the initial registered investment.

3.5 Innovative capacity: patents as a signalling device

Angel financing is an important source of funding for highly innovative SMEs. This is because innovative SMEs, risky and opaque by nature, are often unable to secure financing through traditional bank channels and therefore rely disproportionally on VC to meet their external financing needs. BAs, with their hands-on and personalised investment approach, are an important source of innovation financing.

Arguably, the most important metric to gauge innovation creation by firms is patenting activity. This section uses patent data to demonstrate the extent to which EAF's portfolio companies engage in innovative activities. While doing so, we recognise that patent data is just one way to indicate innovativeness and that the absence of patenting activity does not automatically equate to absence of innovation.

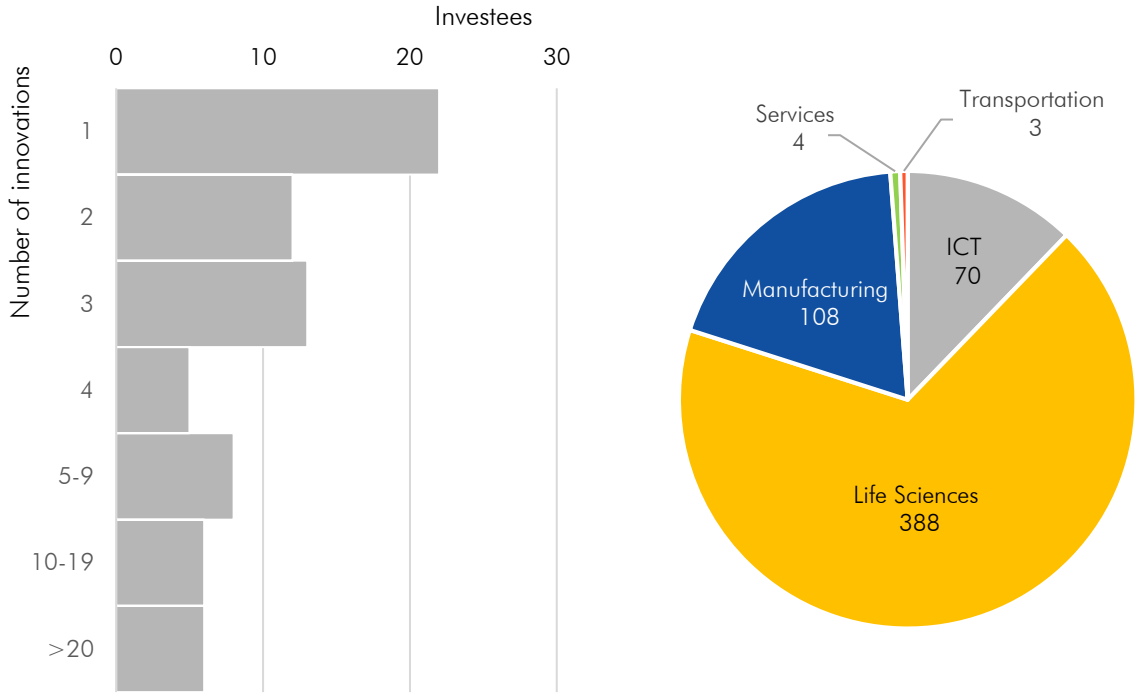
Patent data for this study mainly stems from Bureau Van Dijk's Orbis database and originates from the PATSTAT database, maintained by the European Patent Office (EPO). The unit of analysis are patent families, which we will refer to in the remainder of this section as innovations.[24] Because of the delay between the patent application (or priority date), the moment at which an innovation is effectively protected, and its publication in the PATSTAT database,[25] the analysis is not able to consider innovations that have been registered from 2017 onwards. Given the relatively young age of EAF's portfolio, as well as the young age of the companies within it, the patent count will be significantly biased downwards and should be considered a lower bound of the true amount of supported innovations. The patent count can be expected to increase significantly once patents that have been registered over the past three years start to appear in the PATSTAT database.

Keeping the caveats above in mind, at the time of writing we were able to identify 73 patent owners among EAF's portfolio companies, who together registered 573 innovations. To calculate patent intensity at the portfolio level, defined as the share of EAF's investee companies who engage in patenting activity, we disregard all investee companies that entered the portfolio from 2017 onwards.[26] This leaves 189 investee companies, 43 of which owned at least one innovation, implying a portfolio-level patenting rate of 23 percent.

The majority (65%) of those patenting investees held just a handful of patents, whereas a few investees patented substantially more intensely (Figure 17, left panel). Six investees patented at least 20 different innovations. One investee, operational in the Life Science sector, even owned 169, or about 30 percent of total EAF's innovations. In part, this contributed to the overrepresentation of the Life Science sector in EAF's innovation portfolio (Figure 17, right panel). While they account for just 14 percent of portfolio companies, they own 70 percent of EAF's innovations. The disproportionate contribution of the Life Science sector is consistent with the findings reported in Signore and Torfs (2017).

[24] For an elaboration on the technical details of the database, see Signore and Torfs (2017).
[25] Up to 30 months for patent applications at the European Patent Office.
[26] Which was approximately 30 months prior to retrieving the patent data from the PATSTAT database, a time span equal to the potential publication delay the patents are subject to. While it occurs in the data that more recent investee companies were matched with innovations that were already published, taking into account the most recent period will severely bias the patent rate downwards.

Figure 17: Distribution of innovation over investees (left panel) and over sectors (right panel)

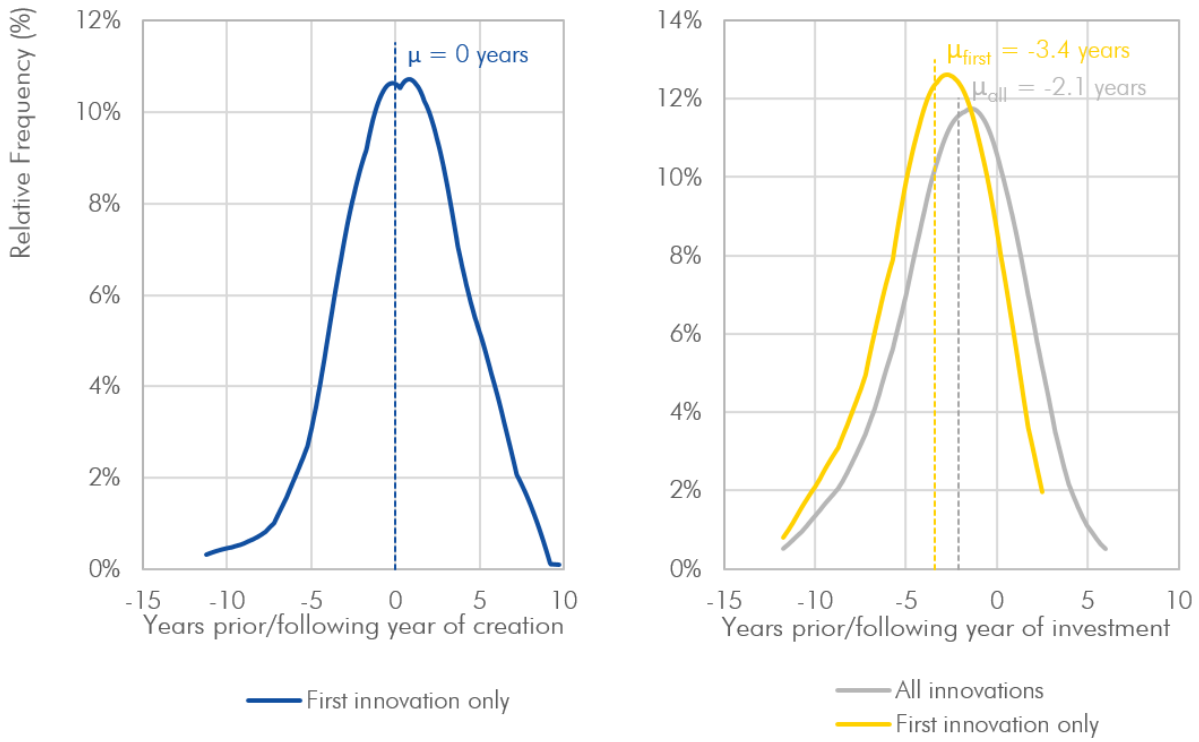


Source: PATSTAT and internal EIF data

Analysing how investees time their innovations with respect to company creation and capital injections can provide insights into how investors use patents to guide their investment choices. Figure 18 (left panel) shows how EAF investees time their first patented innovation around the time of company creation (year 0). The age distribution shows half (62) of innovations (registered by 47 investees) are registered prior to company creation. The remaining 66 innovations (registered by 26 investees) were patented after. Compared to EIF's VC portfolio (Signore and Torfs, 2017), the share of investees that register their invention before their date of incorporation is substantially higher.

The right panel of Figure 18 illustrates the distribution of investment timing vis-à-vis patent registration, for investees' first registered innovations as well as total innovations. Considering just the first registered innovation, Figure 18 makes it clear how very little companies initiated their patenting activities after they received Angel financing through the EAF co-investment scheme. In fact, all but one patenting investee already registered their innovation at the time of the deal an EAF BA. This can partially be explained by the fact that BAs seem to target companies that patent very early in the course of their life cycle. It can also indicate the importance BAs attach to patents as a signalling function, using it to guide their investment efforts towards the most innovative companies. When considering also follow-up patenting, Figure 18 shows that 25 percent of innovations are patented following EAF-back investment. This shows the duality in the relationship between funding and patenting, where initial innovative activities send a signal to investors indicating future growth opportunities, and the consequent capital injection can fund the sequential development of an investee's innovation capacity.

Figure 18: Innovation timing vis-à-vis company creation (left panel) and first investment by EAF BA (right panel)



Source: PATSTAT and internal EIF data

4. Post-investment growth patterns

Given the relative young age of EAF's BA portfolio, a full-fledged analysis of investees' exit outcomes is not yet feasible.[27] Instead, this section analyses post-investment growth patterns of EAF's investee companies, to the extent the data at hand allow this. The absence of a control group implies the outcome of this exercise is no to be interpreted as causal inference, rather, this it is a mere description of the evolution of post-investment company growth. A second important caveat relates to data-availability. Most of EAF investments are of recent date. The delayed availability of balance sheet data[28] limits the time scope of the exercise to two years following the year of first investment, as it was not possible to draw representative conclusions beyond that time window, due to small sample size. Therefore, the results should be interpreted with the necessary caution.[29]

We analyse post-investment growth patterns over the two years that follow the year of the first capital injection through a BA-EAF co-investment arrangement. We do so for three important company-level indicators, employment, total assets and turnover, which are all sourced from the Bureau Van Dijk Orbis database. Figure 19 illustrates the growth trajectories for these three variables for the aggregate EAF portfolio. To benchmark, Figure 20 compares the post-investment growth patterns of EAF's BA portfolio to the equivalent growth trajectory of EIF's VC portfolio. The growth patterns in these figures are expressed in terms of medians, to cast a better picture of how the typical BA company evolved post-investment, and to eliminate the influence of differences in the sample distribution between VC and BA companies. The bands around the growth trajectories illustrate the 95 percent confidence intervals of the calculated means. For more information on the calculation method, see Annex A1.

On average, upon receiving their initial EAF-backed investment, companies employed eight people.[30] A few larger companies in the sample hide the fact that the majority of investee companies was rather small at the time of investment. Hence, the median company was substantially smaller and employed just 5 people at the time of investment. Two years post-investment, employment of the average BA investee increased by 50 percent to 12. Comparing the median values of BA and VC investees (Figure 20), we find that the median VC company is only marginally larger at the time of investment, but grow at a comparable pace post-investment. The mean growth rate of the BA investees is significantly above the median (75% vs 50%), implying the presence of a limited number of relatively fast growing companies whose outlying value create a wedge between the mean and the median.

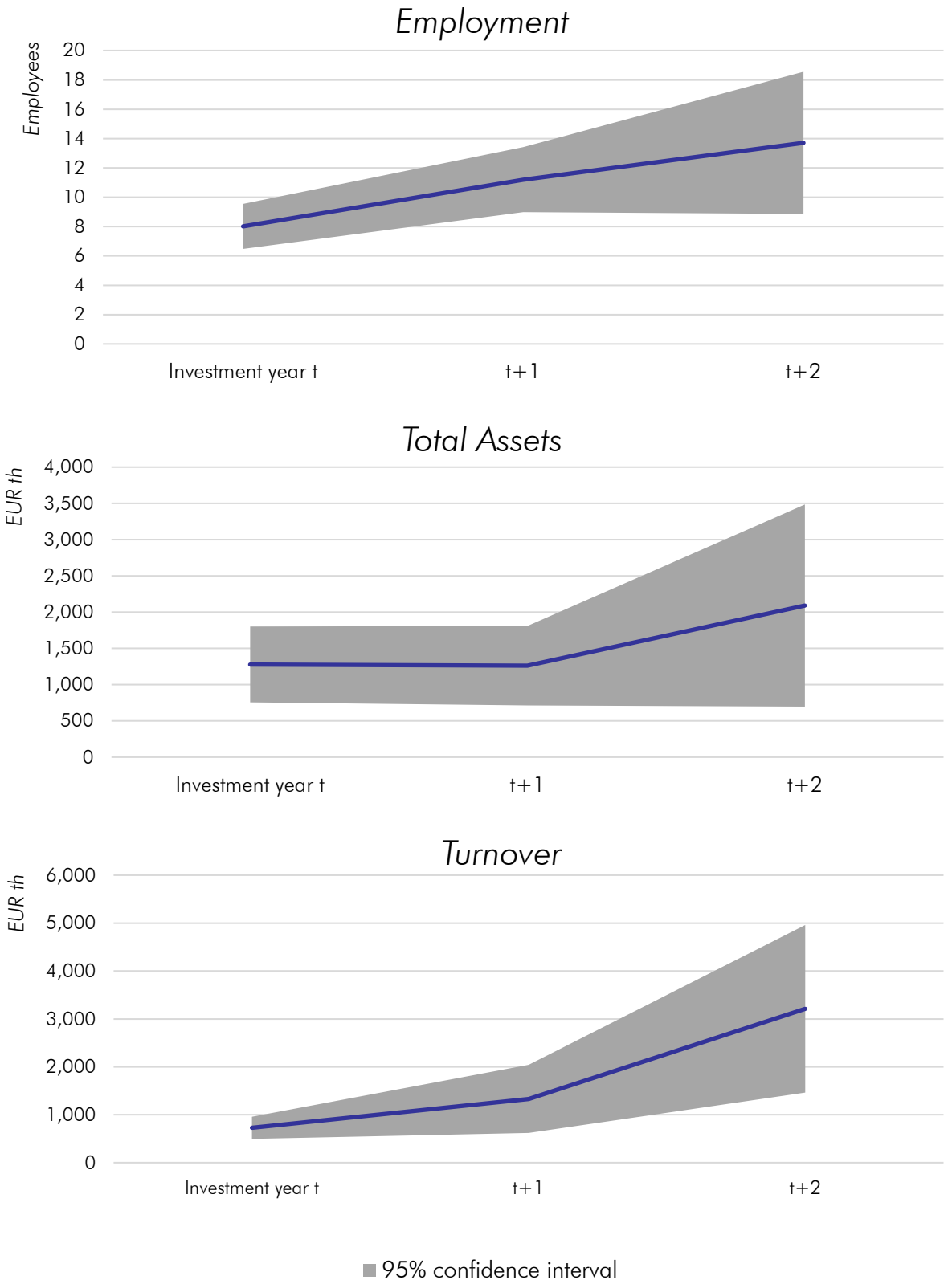
[27] The median time to exit for successful investments was four years (Mason and Harrison, 2014).

[28] Orbis balance sheet data, which form the basis of the analysis below, are generally made available with a significant time lag of up to two years.

[29] Generally, studies that examine post-investment company growth use time periods 3 years and longer (Bonini, Capizzi, and Zocchi, 2019)

[30] Three times more for VC, see Crisanti, Krantz and Pavlova (2019).

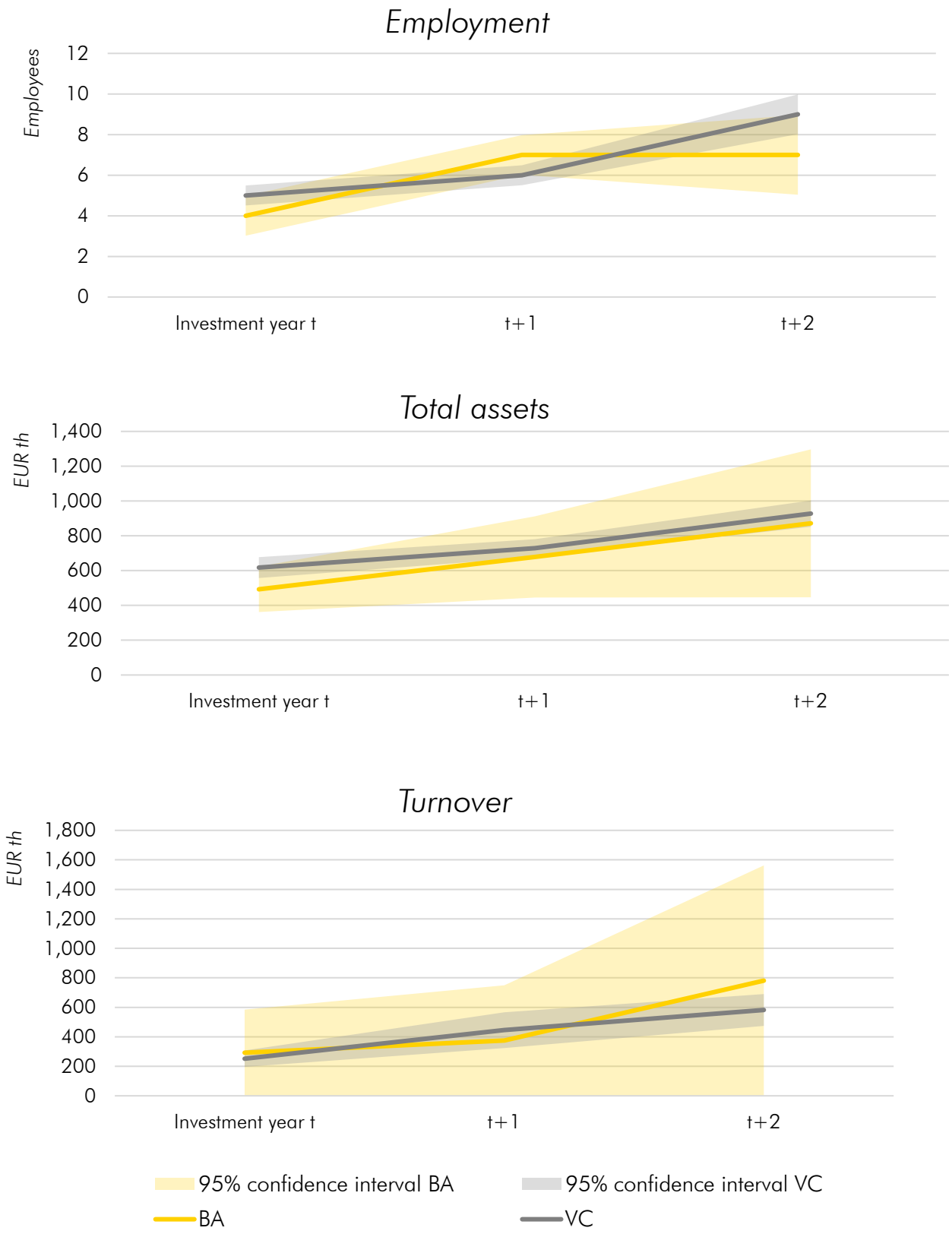
Figure 19: Post-investment growth trajectories of employment, total assets and turnover (mean)



Note: The figures above show the average of the indicators evolved after an EIF-backed BA investment. Statistics are computed using post-stratification weights, with country, industry and age at investment of the firm (Little, 1986). Methodological details can be found in (Signore, 2016). All monetary values expressed in constant EUR 2017 prices.

Source: Orbis and internal EIF data

Figure 20: Post-investment growth patterns: EAF's BA vs EIF's VC portfolio (median)



Note: The figures above show the average of the indicators evolved after an EIF-backed BA investment. Statistics are computed using post-stratification weights, with country, industry and age at investment of the firm (Little, 1986). Methodological details can be found in (Signore, 2016). All monetary values expressed in constant EUR 2017 prices.

Source: Orbis and internal EIF data

Investees had on average about EUR 1.3m of total assets on their balance sheet at the time of investment. Initially, during the first year after having received Angel financing, their balance sheet stayed roughly constant. After two years, however, average assets grew significantly to EUR 2m. The median BA investee (Figure 20), with just EUR 0.5m of assets, had a balance sheet that is substantially smaller compared to the mean investee. While initially the balance sheet of the median VC investees is marginally larger, the two converge over the next two years. EAF investees' average turnover nearly quadruples in the post-investment period. Unfortunately, the wide confidence intervals stop us from drawing any meaningful comparison.

5. Concluding remarks and discussion

Angel investments are an indispensable source of venture capital financing for young, small and innovative start-ups. BAs, with their unique investment approach, are able to fill in financing gaps left open by formal VC suppliers. To contribute to the body of knowledge regarding BAs' investment principles, this paper analysed the portfolio of the European Angels Fund (EAF), a co-investment scheme initiated by the EIF that partners with experienced BAs in selected European countries. In doing so, this study shed light on the modus operandi of a specific subset of BA investors, as the average EAF supported Angel financier is likely to be more experienced and wealthier, compared to the average BA. Therefore, one important caveat of this study is that our results are not generalisable to the general Angel market as such and need to be interpreted with caution.

A quick glance at EAF's investee portfolio showed how the geographical distribution of EAF's BAs is intrinsically connected to the rollout of the EAF co-investment scheme. Since the pilot project was initially launched in Germany, German Angels are over-represented in our sample. Following EAF Germany, national programs were launched in Spain, Ireland, Denmark, Austria, Finland and Belgium, as well as a pan-European program that specifically supports cross-border investments. Driven by BAs' preference for local investments, the location of EAF's portfolio companies correlates strongly with the geographical rollout of the program so far.

EAF's BAs are predominantly middle-aged males, a finding that is in line with earlier results from the empirical literature. More often than not, they have a strong entrepreneurial background, allowing them to leverage on their professional experience to improve the efficiency of their due diligence activities. They are also highly educated, as nearly one in four held a PhD and another 70 percent obtained a master degree. Consistent with their passion for investing, business and economics was the most common field of study.

The lack of female Angel investors commonly reported in the empirical literature is unfortunate. Female investors are more likely to finance female entrepreneurs, and therefore would help to close the entrepreneurial gender gap. This can in turn lead to more female Angels. Female Angels are also known to place greater emphasis on a venture's social impact (Huang et al., 2017). Since our analysis also made clear that female BAs tend to invest more locally, supporting select female investors could contribute to local economic development. There are a number of general reasons why women are underrepresented in the Angel ecosystem, but one feature of the EAF program could possibly, and unintentionally, aggravate the gender gap. EAF's focus on experienced investors might exclude female Angels from participation in the program, as they are for historical reasons, on average, less experienced.

EAF Angels almost exclusively target innovative high-tech start-ups. The majority of investee companies were active in the ICT sector, but a more in depth look at their business models showed applications in the field of finance (Fintech) and services (Retail). EAF investees active in the manufacturing or transport sector are heavily focussed on developing Clean-tech technologies. The sectoral analysis shows that co-investment schemes like the EAF have significant potential to contribute to the achievement of policy targets. For example, BAs' strong support for Fintech companies is likely to further facilitate the supply of finance to innovative SMEs (see Kraemer-Eis et al., 2019).

BAs invest in what they know. For example, Angels prefer to invest locally. Their preference for local investments implies that investee companies are headquartered disproportionally in large metropolitan areas, the preferred location of the Angels themselves. The median distance between an EAF BA and its investment target exceeds findings reported in earlier studies, a discrepancy driven by the specific characteristics of EAF's BAs. Their more experienced profile implies they are more likely to operate on a bigger scale compared to the average Angel financier and hence are more capable of overcoming the fixed costs that are associated with long distance investments.

Even after controlling for a list of relevant factors, we still find that BAs first exhaust local investment opportunities, before venturing out to find new ones in more distant regions: for every additional company that is added to the portfolio, the average distance between a BA's HQ and that newly added investee grows by about 54km. A likely driver for this finding relates to the presence of distance-related information asymmetries, as Angel investors are more familiar with the business environment in their immediate surrounding. Their strong local bias implies that if policy makers want to use co-investment schemes to target local VC eco-systems, and increase the supply of innovation financing in targeted areas, they should take into account partner investors' locations.

Angels' investment choices are determined to a large extent by their personal expertise. The sectoral composition of their portfolio reflects their educational background. This holds especially true for Angels with a STEM and IT background. Also this is a finding that is in line with earlier literature and supports the hypothesis that Angels are well-placed to overcome the information asymmetries that are characteristic to the investor-investee relationship in financing innovative companies.

EAF's Angels target mostly young companies. The average age of their portfolio companies was significantly below EIF's VC portfolio, confirming the hypothesis that BAs fill in a specific space in the VC financing spectrum. BAs and VCs are often thought to invest in a sequential pattern, where BAs deliver seed financing and VC fund then supply the capital needed for a company to further progress in the growth cycle. An analysis of the combined EAF/EIF BA/VC portfolio could not unambiguously detect such a pattern, although limitations with regard to the data source at hand likely inhibit a thorough analysis on the subject.

The analysis of Angels' investment strategies also shed some light on the innovative capacity of EAF's investment portfolio. While issues related to the delay of the publication of patent data render it difficult to perform a full-fledged innovation analysis, a look at the patenting activities of EAF portfolio companies revealed substantial innovative potential. It showed that patenting carries with it an important signalling function, as nearly all patenting investees were invested in after their first patent registration.

Finally, the analysis investigated EAF investees' post investment growth patterns in the two years after having received an EAF co-investment. EAF investees exhibit a positive growth trajectory for all three indicators considered: employment, total assets and turnover. In particular turnover was found to increase sharply. A comparison with EIF's VC companies confirmed that BAs disproportionally target smaller companies.

The evidence gathered throughout this paper confirms the hypothesis that Angel investors occupy a unique space in the European VC ecosystem. Therefore, it is likely that through its support of the Angel Ecosystem, the EAF contributes to enhancing the supply of finance to a particularly useful, but also vulnerable segment of the SME population: young, highly innovative start-up companies that operate on the cutting-edge of their respective technology fields.

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Annexes

A1: Data sources

The data that forms the basis of the analysis provided in this article derives from reports submitted by EAF's BAs to the European Investment Fund. The fund-level database results from combining internal reporting data with a number of other database freely available to the public.

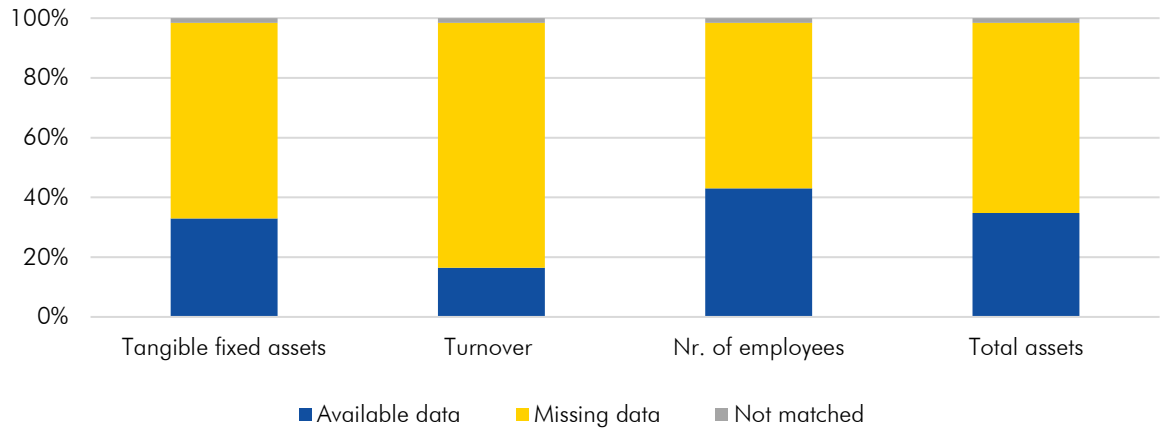
The EAF internal database contains some basic investor and investee information, and records all investment transactions (investments, sale and write off) on a quarterly basis. Unfortunately, the data does not explicitly distinguish between investment rounds, but rather contains records of all transactions BAs reported to EAF upon making an investment. Different transactions often refer to the same investment round, but are for some reason communicated to the EAF with a certain delay between them. This implies any analysis on how Angels spread their investments into one company over time necessarily must be based on a number of assumptions. We classified different transactions as different investment rounds if they met two criteria. First, they must be separated at least four quarters from one another. Second, the following transactions must be at least 20% of the size of the first investment round to be classified as a distinct round. If not, we consider it likely the data recorded a delayed financial transaction related to the initial investment round in which the BA participate.

Investee-level information was further enriched using a variety of data sources. First, investees were geocoded using information retrieved from the Crunchbase investment database or companies' websites. Second, time-varying balance sheet information was sourced from Bureau Van Dijk's Orbis database, wherever possible.

Prior to signing a co-investment agreement with the EAF, BAs are required to file a request for approval, which contains a series of personal data on the individual investors. Additional investor information was derived from LinkedIn. For each individual co-investment, BAs file a request with the EAF. These requests form the basis for the deal-level database, which apart from investment dates and amounts, also contains a number of basic, non-time varying investee level variables.

The two dataset were matched based on companies' characteristics: name, country, size, age, industry and list of investors. These characteristics were sufficient to identify them and link their information from both datasets. Figure A1 below provides further details on the results of this matching exercise. Most of the portfolio companies invested (98%) were found in the Orbis database. Given that the invested companies were often very young, a considerable share of information on matched companies is missing. In order to derive meaningful growth trends, number of matched companies were further reduced and only usable companies were left for the analysis. The concept of usable company was defined in (Kraemer-Eis et al., 2016): to be usable, companies must offer two or more data points: one in the baseline period and at least one in the follow-up period, to assess growth. The periods cannot overlap. The baseline is defined as the period occurring from one year before the first investment date, to one year after such date. The follow-up period starts from the first year after investment and adds up as long as the company is alive and actively invested. The rate of usable companies for this paper ranges from 17% for turnover to 43% for number of employees (see Figure A1).

Figure A1: Availability of usable data for growth



Source: Authors

A2: EAF BA characteristics benchmarking exercise

To shed more light on how EAF's BAs compare to the general population of BAs in Europe, table A1 benchmarks some of the key characteristics discussed in section 2.2, by comparing them with other studies covering comparable markets.

Table A1: Benchmarking EAF BA characteristics

	This paper	Huang et al. (2017)[31]	Capizzi et al. (2015)[32]	Mason & Botelho (2014)[33]	Månsson & Landström (2006)[34]	Kosztopulusz & Makra (2004)[35]	Stedler & Peters (2003)[36]	Reitan & Sörheim (2000)[37]
Average Age	*Around 50 at time of EAF co-investment*	58	48	45+	56	44	48	47
%Male	*96*	78	n/a	88	96	100	95	97
Education	*98% higher education*	73% higher than bachelors	6% High School or lower	76% higher education	69% higher education	86% higher education	n/a	Higher education
BAN affiliation	*47% (self-disclosed)*	66% from angel group	54%	90%	n/a	n/a	n/a	n/a
Entrepreneurial background	*73%*	55%	38%	59%	90%	93%	55%	46%

[31] Descriptive study based on survey data from 1,659 US-based BAs.
[32] Based on survey data of 625 Italian business angels from the Italian BAN.
[33] Descriptive study based on 238 Scottish BAs.
[34] Empirical paper based on 253 Swedish BAs.
[35] Quantitative and qualitative analysis of 14 Hungarian BAs from survey data.
[36] Empirical study based on 232 German BAs.
[37] Descriptive study based on survey data from 425 Norwegian BAs.

A3: List of acronyms

BA	Business Angel
BAN	Business Angel Network
EAF	European Angels Fund
EIF	European Investment Fund
ICT	Information and Communication Technology
NUTS	Nomenclature des Unités Territoriales Statistiques
SME	Small and Medium-sized Enterprise
VC	Venture Capital

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