

Spurring entrepreneurship with public venture capital in developing industries – evidence from Hungary

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Abstract

Purpose – Venture capital (VC) is an essential element in healthy entrepreneurial environments; therefore, many countries in developing entrepreneurial economies support the industry via direct or indirect government interventions. The purpose of this study is to examine through the example of the Hungarian market, whether direct or hybrid state involvement has contributed more to the growth of the invested enterprises. The findings are relevant in the design of government VC schemes and in the contracts mitigating the moral hazards inherent in government funding.

Design/methodology/approach – The basis of empirical research is a unique hand-collected database covering Hungarian government-backed VC (GVC) investments. Based on the financial data of investee firms, the authors investigate whether firms financed by hybrid VC involving market participants are able to outperform firms that receive pure public financing using panel regression.

Findings – Based on Hungarian evidence, hybrid VC-backed firms generated lower growth and employment than their purely government-backed peers. Both schemes showed meagre innovation activity. The conclusion is that because of the conflict of private and economic policy objectives in hybrid financing, the exposure of hybrid risk capital to moral hazard is higher than that of pure public financing. Private interests in hybrid funds can only improve investment efficiency if they are structured along the lines of market-based independent financial intermediation and the contracts imitate the ones existing amongst limited and general partners in private schemes.

Research limitations/implications – The research covers the data of Hungarian government-backed firms by tracking the full range of 86 investments made in the purely government scheme and 340 firms that received funding in the hybrid scheme. The research focuses on two government initiatives, and the results are influenced by the specific regulation of the programs; therefore, the results cannot be generalized for all government agendas; they are indicative in the designs of the agendas.

Originality/value – There is a limited number of empirical studies investigating the impact of VC in developing markets, especially in the Central and Eastern Europe region. This firm-level research on the impact of public VC can help improve the effectiveness of development policies. By analysing the entirety of investments of a VC program that is near to its completion, the authors provide new insight into the efficiency and prospects of GVC schemes in the region.

Keywords Venture capital, Innovation, Entrepreneurial ecosystem, Entrepreneurial finance, Government backed venture capital funds, Hybrid venture capital, Public policy, Firm

Paper type Research paper

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Introduction

In recent years the venture capital (VC) market of Central and Eastern Europe (CEE) has undergone significant development in investment activity. Although the private equity market of the region still lags behind the average of the European market, there is rapid growth in the region regarding fundraising and investment activity in the seed and early-stage VC segment. This growth has mainly been led by a few countries such as Poland, the Czech Republic, Hungary and Estonia ([Invest Europe, 2021](#)). On the other hand, the increased activity in the region – and within that – the Hungarian VC market is not driven by the increased interest of private investors, as most of the fundraising is connected to government agencies. Public resources are available to a wide range of businesses in the region, but at the same time, market considerations are less prevalent ([Karsai, 2022](#)). Therefore, in the past few years, we could observe an artificial development led by government support rather than an organic development led by the evolution of the entrepreneurial system.

While the market activity of CEE countries has become substantial, we do not have much information about the efficiency of these developing markets. The data available from developing markets is still limited. While we have data about fundraising and investment activity in developing regions, we still have little knowledge about the impact of VC investments on firms' performance, exit activity and innovation. Early studies in the field confirmed that VC plays an important role in the development of the region, but CEE countries were heterogeneous in this field ([Klonowski, 2006](#)). The case of the CEE region's VC market is special in two ways; the government-backed artificial growth of fundraising and investments has created an active market, but on the other hand, in the absence of available data, we do not know how fairly this increased activity reflects the actual development of the market.

Research on entrepreneurial activity showed that specific links contributing to the efficient entrepreneurial system are still missing or underdeveloped in the region relative to the USA and western ecosystem. [Szulczewska-Remi and Nowak-Mizgalska \(2021\)](#) showed though the example of Poland and the Czech Republic that the institutional framework alleviating the commercialization of innovative ideas is not adequate to support the business utilization of scientific results. [Dvouletý \(2017\)](#) showed, based on Czech evidence, that entrepreneurship policy supporting high-growth enterprises has a positive impact on employment and economic growth. [Klonowski and Golebiowska-Tataj \(2010\)](#) showed that in the CEE region, access to finance is one of the major obstacles of the development of high-tech firms. Based on the evidence of transitional economies like Bosnia and Herzegovina and Macedonia, [Hisrich et al. \(2016\)](#) showed that for the development of the VC industry, the advancement of the legal and business environment is crucial. According to [Sipola \(2022\)](#) VC industry, in its development stage, creates blueprints for the market and is influenced by policy goals; the VC method might differ from the exit and growth-oriented traditional private VC method.

In our research, we investigate the impact of government-backed VC (GVC) on invested firms in the case of the Hungarian VC market, where the VC market is in its infancy and relies heavily on government support. The participation of the government has led to a vibrant VC market in Hungary over the past decade; in terms of the number of investments, Hungary has seen the highest investment activity in the CEE region in the past few years, exceeding the CEE and the European average ([Invest Europe, 2021](#)), whereas the Global Entrepreneurship Index score of Hungary, which describes the development of the entrepreneurial environment, is relatively low ([Szerb et al., 2018](#)). In terms of entrepreneurial finance, Hungary exceeded the regional average ([GEM, 2022](#)). Thanks to government

support, the activity of the Hungarian VC market is notably higher than in those countries where the entrepreneurial environment is similarly developed. Artificial government-backed fundraising has created an exuberance of capital in an entrepreneurial environment where the supply of VC was previously scarce. The economic policy goal underpinning the government interventions is to spur economic growth, innovation and employment by supporting a key element of the entrepreneurial environment.

Even in developed countries where the VC market was not substantial, governments participated in the creation of VC markets (Becsky-Nagy and Fazekas, 2015; Da Rin *et al.*, 2006; Karsai, 2018; Leleux and Surlemont, 2003; Lerner, 2009; Murray *et al.*, 2012). Although there are numerous examples of well-designed and successful government agendas, there are also many programs that fail to achieve the desired results (Lerner and Tåg, 2013). Based on theoretical and empirical evidence, it is obvious that in the long run, GVC cannot replace its private backed peer, but at the same time, in the case of infant VC markets, the government is able to contribute to the development of the market as a catalyst.

In this article, we focus on the supply-side theories of efficient GVC design from the point of view of a developing entrepreneurial ecosystem. Owen and Mason (2019) consider the setting up of hybrid funds managed by market investors to be a cornerstone of ideal public-backed VC schemes. On the other hand, hybrid schemes are more exposed to agency problems, which can reduce their effectiveness (Fazekas and Becsky-Nagy, 2021). We address the question of whether a hybrid government-backed scheme is more efficient compared to pure government VC funding via Hungarian evidence.

The goal of this research is to support the theoretical design of GVC agendas in the case of infant industries by providing empirical evidence about their impact based on Hungarian evidence. Using a hand-collected database that covers the Hungarian GVC investments' firm-level data from 2010 to 2016, we analyse the use of government funding and its impact on invested firms' growth and innovation, as the major characteristics of startups' vitality is their capability for growth (Alvarez-Salazar, 2021). The range of firms we analysed fully covered the population of firms that received public funding in that period. At the same time, hybrid investments have crowded in market investors, so pure market-based VC activity has been negligible. Financial data of investee companies have been tracked from 2010 until 2020. By identifying and observing every firm that received funding within the framework of the agendas in the given period, we created a unique database suitable for analysing the different forms of GVC in a comprehensive way. In our research, we focused on the different forms of the effect of GVC's in the developing market of Hungary.

In the first section, we introduce the literature, focusing on GVC's impact on invested firms with special regards to the different schemes of government participation. In the second section, we describe briefly the Hungarian VC market and the government agendas which have been present over the past decade. In the third section, we present the database and models of the research, and in the fourth section, we introduce the results. In the final section, we make our concluding remarks in the context of developing markets with regards to the efficient design of GVC agendas based on the case study of the Hungarian market.

Literature review

Over the past few decades, the research focusing on the impact of VC on invested firms has become more extensive as various databases have been established. The results of these research papers do not share a common opinion on VC's impact on invested firms, which is not surprising if we take into consideration the special aspects of VC markets. VC market is embedded into startup ecosystems, and its efficiency is influenced by this special segment of the entrepreneurial system.

As the VC market is not homogeneous, the region-specific analyses lead to diverse results regarding the performance of VC investments and their impact on invested firms. [Lerner and Tåg \(2013\)](#) presented how institutional factors influence the development of VC markets. Also, the quality of VC depends on the knowledge accumulated in the industry, which is hugely influenced by the stage of the industry's development. In infant industries, the non-financial services provided by the investors are not as sophisticated as in well-developed industries. In conclusion, there is no global market for VC; every region or country has its own characteristics depending on the features of its startup ecosystem. Therefore, the features and the impact of government-backed agendas can be analysed in the context of the given country or region's startup ecosystem. The main questions regarding the performance of VC-backed firms target its effects on survival, innovation and growth. The following section synthesizes the findings in the literature in connection to these questions.

The highly cited article by [Kortum and Lerner \(2000\)](#) stated the positive effect of VC on innovation in the USA. On the other hand, research in the field does not show such unambiguous results. [Hellmann and Puri \(2000\)](#) and [Bertoni and Tykova \(2012\)](#) strengthen the notion that VC is able to spur innovation, whereas [Engel and Keilbach \(2007\)](#) and [Peneder \(2010\)](#) do not. [Hellmann and Puri \(2000\)](#) found that firms in Silicon Valley had a higher probability of obtaining VC if they were innovators prior to receiving investments. This result also suggests that VC financed the process of delivering the products to market rather than initial R&D activities. [Bertoni and Tykova \(2012\)](#) found, based on international evidence, that VC had a positive effect on innovation. However, they also found that this result is connected to private venture capital (PVC), as government-backed investments did not have such an effect. [Engel and Keilbach \(2007\)](#) found when examining German enterprises that VC made no difference in innovation performance. [Peneder \(2010\)](#) had somewhat mixed results investigating Austrian investments; according to their results, the cooperation of VC and a firm does not lead to superior innovation performance. However, their results resemble the findings of [Hellmann and Puri \(2000\)](#) in the sense that innovative firms had a higher probability of receiving funding.

The literature seems unambiguous in terms of VC's effect on firm growth. All research in the field had a consensus that VC-backed firms achieved higher growth in terms of revenues ([Chemmanur et al., 2011](#); [Engel and Keilbach, 2007](#); [Lerner, 1999](#); [Nightingale et al., 2009](#); [Peneder, 2010](#); [Puri and Zarutskie, 2012](#)). The firms' growth measured by the number of employees also suggests that VC has a positive influence ([Lerner, 1999](#); [Nightingale et al., 2009](#); [Peneder, 2010](#)). While VC-backed firms in the USA market were superior to their non-VC-backed peers in terms of innovation, international evidence showed mix results. In terms of growth, besides the USA market, European country-specific case studies and research done on an international scope also strengthened the positive effect of VC. The results seem to be robust also in terms of industry specification. This result is consistent with the presumption that VC primarily seeks high growth potential. The growth of profitability, on the other hand, shows a very different picture. The studies examining the profitability of invested companies do not show a significant difference compared to their non-VC-backed peers. [Puri and Zarutskie \(2012\)](#) confirmed that despite high growth in revenues, VC-backed companies do not generate higher profits. [Nightingale et al. \(2009\)](#) found a pattern in the course of profitability over time; these companies have a "U" shape in their profits that is consistent with the pattern of R&D projects. We should mention that these studies examined the markets of the UK and the USA, which are considered to be the most developed, so relatively underdeveloped and emerging markets might show different results.

Results relating to the effects of VC on the survival of invested firms are not consistent (Jáki and Molnár, 2021). Similarly to innovation, the findings differ by geographic scope. Puri and Zarutskie (2012) found by examining the US market that in the early periods of investments, VC is able to improve the survival rate of invested companies compared to non-VC-backed firms, but in the second half of the investment, the chances for bankruptcy are equalized. However, studies focusing on the European market show different results. In the Belgian (Manigart *et al.*, 2002) and French markets (Pommet, 2017), such improvement was not apparent.

By using the total factor productivity method, Chemmanur *et al.* (2011) and Croce *et al.* (2013) examined the effect of VC on efficiency and productivity. Both studies confirmed that the cooperation of investor and firm creates added value, but Croce *et al.* (2013) found that the selection of European VCs does not, whereas Chemmanur *et al.* (2011) also reported added value in the case of the VC selection in the USA.

The most scrutinized area of VC research is the US market. Most of the studies confirmed the positive impact of VC on invested firms. The literature focusing on a comparative analysis of the performance of VC-backed firms supports VC's positive impact on growth (Chemmanur *et al.*, 2011; Puri and Zarutskie, 2012) and innovation (Kortum and Lerner, 2000; Hellmann and Puri, 2000). In European case studies, the research had mixed results. Engel and Keilbach (2007), based on German, and Peneder (2010), based on Austrian evidence, found a positive effect of VC on invested firms' growth, but Manigart *et al.* (2002) and Alperovych *et al.* (2015) did not find evidence for the positive impact of VC on the survival and efficiency of the invested firms in the Belgian market. The non-US evidence does not support the role of VC in spurring innovation (Engel and Keilbach, 2007; Peneder, 2010).

International empirical evidence strengthens the notion that PVC is superior to GVC in spurring innovation and commercial successes. Grilli and Murtinu (2014) analysed the differences between government and PVC-backed firms based on the VC and Angel Investment activity in Europe (VICO) database. Their result suggests that as single investors, GVC did not improve the invested firm's performance, although they did create value in syndicated investments with PVC. By analysing the investments of seven European countries, Bertoni and Tykova (2012) also found that PVC and syndication increased innovation performance; government investments alone did not. Government funding had a positive effect if it supplemented the lead PVC investor. Using the VICO database with a questionnaire, Luukkonen *et al.* (2013) showed that GVC creates less value for invested firms and has fewer services aimed at non-financial value creation. Also, based on the VICO database, Cumming *et al.* (2017) found that PVC investments have better exit prospects than GVCs, with mixed investments having a statistically not significant positive impact. Brander *et al.* (2015) also found that government funds supplement rather than substitute PVCs. Syndicated PVC and government investments perform the best, whereas sole government investors fall behind PVCs. Baldock and Mason (2015) also emphasizes the complementary role of GVC and show that government funding can stimulate economic growth.

Country-specific studies led to similar results. By analysing the survival of GVC and non-VC-funded Belgian firms, Manigart *et al.* (2002) found that, in general, VC-backed firms had a lower survival rate, especially if they were funded by GVC. Furthermore, GVC-backed firms had lower productivity than PVC investments (Alperovych *et al.*, 2015). Standaert and Manigart (2018) found that, based on Belgian evidence, GVCs were less efficient in selecting investment targets compared to their private peers. Cumming and Johan (2010) investigated the differences of duration and exit between PVC and GVC based on Canadian and US

evidence. Their results suggest that the proportion of IPO was lower for GVCs; these firms exited earlier, which shows lower added value. Based on German evidence, [Becker and Hellmann \(2005\)](#) found that the first German VC fund supported by the government failed, mainly because the institutional environment was not prepared for such investments, the supply lacked the necessary expertise and the entrepreneurial system did not create enough firms that met the requirements of professional VC investors. After the evolution of the entrepreneurial system and the promotion of hybrid VC funds, [Engel and Keilbach \(2007\)](#) found that VC was able to enhance the growth of invested firms in comparison to non-VC-backed firms and supported their commercial successes. [Owen and Mason \(2019\)](#) points out the specific characteristics of programmes aimed at developing VC markets in small and peripheral countries, highlighting that initial demand-side stimuli and ecosystem development can be effective with a simultaneous supply-side intervention.

There are a limited number of research papers that distinguish between purely GVC and hybrid GVC (HGVC). In GVC, the capital is provided by the state, and government-backed agencies are responsible for the management of the capital. HGVC incorporates the private and public sectors; private venture capitalists manage the capital that was provided at least partially by the public sector with specific guidelines and regulations regarding the use of capital. The underlying principle of setting up HGVC instead of GVC is to use the special expertise of private participants and to give ground for the appearance of private interests.

The empirical evidence – although the number of studies is limited – seems to strengthen the notion that HGVC is a step forward compared to GVC. By analysing an international sample, [Brander *et al.* \(2015\)](#) showed that the probability of a successful exit is higher for HGVC investments than for GVC investments. Furthermore, the appearance of hybrid funds increased the amount of PVC, which shows that HGVC had a crowd-in rather than a crowd-out effect. Based on UK evidence, [Nightingale *et al.* \(2009\)](#) found that HGVC had a slightly positive impact on employment and labour efficiency. Their conclusion was that the regulation of HGVC limited the efficiency of investments. [Standaert and Manigart \(2018\)](#) found that the partnership of GVC and PVC achieved higher employment than a single private or government-backed investor. [Cumming and Johan's \(2016\)](#) results are unique within the literature, as they found, after comparing Australian PVC and the Innovation Investment Fund, that the government-backed investor proved to be more efficient in spurring innovation, employment and market capitalization. Based on Chinese evidence, [Suchard *et al.* \(2021\)](#) found that GVC is beneficial for firms if the government investor does not take full control of the investment process.

The Central and Eastern European private equity statistics show that the region's market is well below the European average in terms of fundraising and investments. The major source of funding is government, which provided around 35%–40% of the capital in the 2017–2020 period, mostly focusing on funding early-stage investments ([Invest Europe, 2021](#)). Poland, Estonia and the Czech Republic are the most active in terms of the total private equity market, but in the segment of early-stage VC investments, Hungary is dominant in terms of invested firms. The increased investment activity is the result of the artificially engineered supply rather than a symptom of organic development. The empirical evidence relating to the region's VC market is sparse; there are no studies that systematically measure the impact of VC, mainly because data is hardly available. [Karsai \(2018\)](#) analysed government-backed agendas in the region and found that the major problems are the costs and distortions of increased agency problems, short timeframes, small fund sizes and counterproductive administrative measures. By examining the company-level data of the Hungarian market, we are aiming to fill this gap in this research field. Therefore, in the next section, we introduce the basic characteristics of the Hungarian VC market.

Hungarian government-backed venture capital agendas

Private equity appeared in Hungary early in the 90s after the transition from the socialist economic system. The industry was dominated by buyouts, and activity in the area of traditional VC investments was scarce. The number of investments and the supply of capital was low, and the fundamentals of a developing industry did not evolve. Without adequate market economy experience, the VC ecosystem could not support a vibrant market (Szerb *et al.*, 2007). The supply of VC was concentrated in a few domestic investors. International investors interested in the region made capital available in a more significant volume, but only a very limited number of Hungarian enterprises were able to meet their requirements, so the entrepreneurial environment did not spin off enough potential investment targets (Karsai, 2006; Karsai, 2015). There were numerous government-backed attempts to spur the Hungarian VC market, mainly through supply-side actions. Government agencies tried to act in the absence of private investors, but they failed to achieve real development in the industry. The approach of direct government involvement changed when, in the 2007–2013 EU programming period, funds became available in the form of VC within the framework of Joint European Resources for Micro to Medium Enterprises (JEREMIE). JEREMIE VC funds changed the landscape of the Hungarian market. Nyikos *et al.* (2021) showed that the development of the Hungarian entrepreneurial system is strongly affected by EU funding, which had a positive impact on the economy. Table 1 presents the fundamental features of the Hungarian VC market.

With the appearance of EU and Hungarian government funding, the HGVCs started their operation in an entrepreneurial ecosystem where VC funding did not have a strong foundation, and the VC industry had the features of an infant industry. The industry received a significant stimulus as EU and government funding created an exuberance of capital in a market where the number of investors was limited and the investment activity was low. In this way, the market had to undergo rapid and artificial growth instead of organic development. Furthermore, besides HGVCs, purely GVC funding also started its operation, which increased the supply of capital even more. In the given period, there was no considerable private VC activity, as the incentive schemes of the HGVC agenda crowded in private investors; therefore, the crowded-out effect could not be observed.

In the framework of the JEREMIE agenda, 28 funds were created in a hybrid scheme. The capital of HGVCs were provided to the tune of 70% by EU and government funds. The remaining capital had to be acquired from private investors. The funds were managed by private investors who assumed responsibility for using the capital in accordance with the economic policy goals; namely, they had to provide funding for young and innovative firms. The use of capital was regulated by industry, investment size, revenues and the age of the potential investment. With this regulation, government agencies tried to force private participants to meet the economic policy goals, but at the same time, the regulation limited the flexibility of the investors.

| Feature | Prior JEREMIE funds | After JEREMIE funds appeared |
|--|--|---|
| Supply of VC | Scarce capital | Oversupply of capital |
| Activity | Low activity | High volume of investments |
| Background of limited partners | Mostly international, regional investors | Domestic investors (hybrid and government-backed investors) |
| Investment focus | Mature firms (buyouts) | Young firms (traditional VC) |
| relationship of general and limited partners | Independent financial intermediation | Captive funds (LPs and GPs are not independent) |

Source: Author's own compilation

Table 1.
The main features of the Hungarian venture capital market prior to and after the appearance of JEREMIE venture capital funds

With government-backed capital, private investors could enjoy the benefits of economies of scale and a higher level of diversification. An asymmetric profit distribution scheme preferring private investors and mitigating their potential losses was built into the hybrid program. The HGVC scheme incentivized private participants who previously were not present in the industry, and in this way, they attracted private investors. At the same time, many actors appeared in the market who did not have significant experience in VC investments; therefore, the expertise associated with private VC investors was not present.

Besides hybrid investments, GVC investments have been made since 2012 through the Széchenyi Capital Fund (SCF) with the goal of providing capital for businesses with significant growth potential. Like HGVCs, the GVC fund provided seed, early-stage and growth investments for young firms. The preferred exit track of the purely government-backed SCF is the managerial buyout; in many cases, the entrepreneurs were even obliged to buy back the shares of the GVC. With these commitments, the GVC investments created similar incentives for entrepreneurs to debt-like funding. By its own admission, GVC emphasizes the selection of invested firms, and follow-on active involvement in the strategic decisions of the firms is not considerable. In this way, GVC is more focused on the funding of firms rather than imitating the “smart money” feature of private VC.

Data and methodology

Hypotheses

The empirical research focuses on the growth of the invested firms in revenues, assets and employment and their profitability in connection to their funding background. Preliminary empirical analysis of the efficiency of Hungarian VC investments tested the efficiency of the programs when the investments were still active. Early results suggested that HGVCs were not able to improve the performance of invested firms (Fazekas and Becsky-Nagy, 2018). Based on the literature and the preliminary analysis of Hungarian investments (Fazekas and Becsky-Nagy, 2018), we tested the VC's impact on the growth of invested firms. In this regards, we formulated four hypotheses in connection to the growth of the firms measured in revenues, employment, income and asset value. They are the following:

- H1.* HGVC-backed firms generate higher growth in revenues than their GVC-backed peers.
- H2.* HGVC-backed firms generate higher growth in employment than their GVC-backed peers.
- H3.* HGVC-backed firms generate higher growth in profits than their GVC-backed peers.
- H4.* HGVC-backed firms generate higher growth in assets than their GVC-backed peers.

When we formulated the hypotheses, we assumed that HGVC will outperform the purely GVC investments based on literature findings and the positive impact of private participations. On the other hand, the rejection of the hypothesis would suggest that the disadvantages of the extensive moral hazards of conflicting interests had a more significant impact on investments.

Based on the specific features of the Hungarian investments, we investigated one further hypothesis:

- H5.* The higher the proportion of ownership acquired by venture capitalists, the less the firms' growth in terms of revenue and the number of employees.

H5 says that the ownership acquired by investors has an inverse relationship with the firms' growth. This suggests that a high stake acquired by venture capitalists signals the poor quality of the invested firm. In this case, firms are willing to give up a significant part of their firm because they do not see real business potential in it. On the other hand, venture capitalists are only willing to fund poor-quality firms if they are rewarded with higher stakes. If this hypothesis stands, then the coefficient of the variable must be negative. This hypothesis builds on the signalling theory (Busenitz *et al.*, 2005; Spence, 1973; Stiglitz, 1985, 2002).

Data collection

The basis of empirical research is a unique database containing information about the Hungarian GVC investments in the 2010–2016 period. Using the Hungarian Company Register, we identified each firm that received funding via JEREMIE funds. The empirical research includes those Hungarian-based enterprises that have received funding from hybrid funds since 2010 within the framework of JEREMIE. The research covers 340 companies. Apart from GVC-backed investments, these enterprises almost entirely cover the Hungarian VC market in the given period. Within the framework of JEREMIE, 28 funds were created and have started their operation (Equinox Consulting, 2016; Illés and Lovas, 2018).

Invested firms were identified via data provided by investors and collected from the Hungarian Company Registration Office. In the Hungarian Company Registration Office (www.e-cegjegyzek.hu/?szemelykereses), we listed the firms that received funding within the framework of JEREMIE. We have updated the list of firms annually when the annual financial statements were published. The firms included in the database were those which had a JEREMIE fund among the owners. In this way, the whole population of invested firms is covered by the research.

Besides hybrid investments, GVC investments have been made since 2012 by the SCF. The analysis covers 86 GVC-backed firms. They were identified based on information published by the Széchenyi VC Fund Management. The financial data of enterprises was collected from the financial reports of invested firms; the panel database covers the economic years from 2010 to 2020.

Model specification

As only a specific group of enterprises has the potential to obtain VC, its performance cannot be measured based on SMEs. We must control for the specific characteristics of young and innovative firms. Research must tackle two major issues in this field: selection bias and access to data. Early studies focused on enterprises that went through IPO (Brau *et al.*, 2004; Coakley *et al.*, 2007; Megginson and Weiss, 1991). As mainly successful investments result in IPOs, these studies are exposed to positive selection bias regarding the performance of invested firms; therefore, their conclusions cannot be generalized for VC.

To overcome the problem of selection bias, many studies used some type of pairing method in the comparison of VC-backed firms with their non-VC-backed peers. Various criteria were used in these studies; activity (Hellmann and Puri, 2000; Lerner, 1999; Megginson and Weiss, 1991), financial and non-financial indicators (Alperovych *et al.*, 2015; Brau *et al.*, 2004; Nightingale *et al.*, 2009; Manigart *et al.*, 2002; Puri and Zarutskie, 2012) and propensity score matching (Bertoni and Tykova, 2012; Chemmanur *et al.*, 2011; Croce *et al.*, 2013; Grilli and Murtinu, 2014; Engel and Keilbach, 2007; Peneder, 2010). These latter studies that took into consideration the specific nature of VC and carried out their investigation on a more extensive sample were able to make more general conclusions.

A specific area of research is the comparison of invested firms with different investor backgrounds (Alperovych *et al.*, 2015; Bertoni and Tykova, 2012; Brander *et al.*, 2015; Cumming and Johan, 2010; Grilli and Murtinu, 2014; Luukkonen *et al.*, 2013). These studies aim at the comparison of PVC with GVC and, in most cases, do not intend to tackle the problem of selection biases; they attribute the efficiency of selection to the type of investor. In our current research, we followed the latter logic; by comparing GVC and HGVC investments, we do not separate the impact of selection and post-investment value added.

The research questions were tested via random effect panel regression models. The models are specified based on Evans (1987), who created his model to measure firms' growth. This form is widely used in the field of VC research (Grilli and Murtinu, 2014). The original model of Evans (1987) was modified to fit the specifics of the database and research hypotheses. The growth of the firms is measured by the revenue and the effect on employment is measured by the number of employees. The dependent variable is the logarithm of these variables. Growth is measured by the differences in the logarithms of revenues ("GrowthlnSale") and employees ("GrowthlnEmployee") between "*t*" and "*t*-1" time periods. The models were specified in the equations below:

$$\begin{aligned} GrowthlnSale_{i,t} = & \beta_0 + \beta_1 HGVC_i + \beta_2 ownership_{i,t} + \beta_3 lnAssets_{i,t} + \beta_4 lnAge_{i,t} \\ & + \beta_5 FinAssIntensity_{i,t} + \beta_6 IntangibleIntensity_{i,t} + \beta_7 lnCapital_{i,t} \\ & + \beta_8 lnSale_{i,t-1} + Industry_i + Time_i + u_{i,t} + \varepsilon_{i,t} \end{aligned}$$

$$\begin{aligned} GrowthlnEmployee_{i,t} = & \beta_0 + \beta_1 HGVC_i + \beta_2 ownership_{i,t} + \beta_3 lnAssets_{i,t} + \beta_4 lnAge_{i,t} \\ & + \beta_5 FinAssIntensity_{i,t} + \beta_6 IntangibleIntensity_{i,t} + \beta_7 lnCapital_{i,t} \\ & + \beta_8 lnEmployee_{i,t-1} + Industry_i + Time_i + u_{i,t} + \varepsilon_{i,t} \end{aligned}$$

$$\begin{aligned} Income_{i,t} = & \beta_0 + \beta_1 HGVC_i + \beta_2 ownership_{i,t} + \beta_3 lnAssets_{i,t} + \beta_4 lnAge_{i,t} \\ & + \beta_5 FinAssIntensity_{i,t} + \beta_6 IntangibleIntensity_{i,t} + \beta_7 lnCapital_{i,t} \\ & + \beta_8 Income_{i,t-1} + Industry_i + Time_i + u_{i,t} + \varepsilon_{i,t} \end{aligned}$$

$$\begin{aligned} growthlnAssets_{i,t} = & \beta_0 + \beta_1 HGVC_i + \beta_2 ownership_{i,t} + \beta_3 lnAssets_{i,t-1} + \beta_4 lnAge_{i,t} \\ & + \beta_5 FinAssIntensity_{i,t} + \beta_6 IntangibleIntensity_{i,t} + \beta_7 lnCapital_{i,t} \\ & + Industry_i + Time_i + u_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Regarding the research questions, the most important independent variable is "HGVC", which is a dummy that takes value 1 if the firm is funded by a hybrid fund and 0 if it is financed by GVC. If the variable is significant, then the different forms of GVC have different effects on invested firms. If the coefficient is positive, then HGVC-backed firms outperformed their GVC-backed peers, whereas a negative coefficient indicates the better performance of GVC.

In the models, "Industry" dummies control for the differences caused by the different activities. Firms are categorized according to their main field of activity in line with the

Hungarian industry classification. The effect of the investment year is controlled by “Time” dummies that express the year of investment. In the model, further control variables were built in, such as the logarithm of total assets (“lnAssets”), the age of the firm (“lnAge”) and the size of investment (“lnCapital”). Controlling for the age and size of firms is important to handle the possible differences that derive from the regulation of government-backed agendas.

The activity of firms is controlled with other variables as well. The variables are the intensity of intangible assets (“IntangiblesIntensity”) and financial assets (“FinancialAssetIntensity”). These variables are the ratios of intangibles or financial assets and fixed assets. The intensity of financial assets controls for the outsourcing of activities to subsidiary companies. If the firms follow this practice, then the ratio will have a high value. The dominance of intangibles amongst fixed assets might indicate that the firm is prior to market entry. After market entry, the high value of the variable might indicate the knowledge-intensive nature of the activity.

In modelling the growth of revenues and employment, it is reasonable to assume that these variables are dependent on their lagged values. This is especially true in the case of revenues as a proportion of invested firms that are prior to market entry or which have a short sales history, while other firms have a more substantial record in this field. For this purpose, the one-period lag of the revenue’s logarithm (“lnSale_{t-1}”) is built into the model, whereas in the model focusing on the growth of employment, the one-period lag of the number of employee’s logarithm (“lnEmployee_{t-1}”) is presented.

Results

The data used in this study was hand collected from Hungarian companies that received funding from HGVCs and GVCs in the 2010–2016 period, and the panel data covers their financial data for the years 2010–2020. Table 2 presents the descriptive statistics of the dependent variables in the models described in the previous chapter.

The revenues of the firm indicate how successful the firms are in delivering its products or services to the market. The majority of HGVC-backed firms are not able to generate significant revenues; only firms in the top quartile can achieve real growth. Low revenues do not necessarily show problems with market entry, as it could be the symptom of unfinished R&D activity, but this explanation is contradicted by the low innovative performance of the invested firms. Also, most firms are not able to appear successfully on the market even several years after the VC investment. While the average sales increase in time, the limit of the top quartile reaches its highest value in the sixth year of investment, then starts to decrease as the best firms exited at this point. In GVC, investments revenues are higher, even in the first year of investments, indicating that GVC selected businesses with more proven business models for its portfolio. In both groups, there is a high standard deviation relative to the average sales, which can be explained by the heterogeneity of the invested firms.

The number of employees shows a similar pattern to the revenues. On average, GVC-backed firms achieved higher employment than their HGVC-backed peers. The growth in average employees shows a downturn after the sixth year of investment, indicating that at this point, venture capitalists exited the best firms. The number of employees also shows a high coefficient of variance; therefore, the diversity of the firms is present in employment as well as in revenue.

The difference between the two groups is most apparent in terms of profits. The majority of GVC-backed firms are able to create income, whereas HGVC-backed investments are not able to reach the break-even point. The low quartile of HGVC-backed firms’ income reaches its lowest point in the sixth year, indicating that at this point, investors are not only selling their stocks in their best investments but also exiting their failed ones. The coefficient of variance is especially high in the case of income.

Table 2.
Descriptive statistics of the invested firms' sales, number of employees, income and total assets by investment length (1–11 years) and investor type (HGVC or GVC)

| Investment years | HGVC backed firms | | | | | GVC backed firms | | | | | | |
|-------------------------|-------------------|-------|-------|------------------------------|--------|------------------------------|-------|-------|---------|------------------------------|--------|------------------------------|
| | Count | Mean | SD | 25 th per-centile | Median | 75 th per-centile | Count | Mean | SD | 25 th per-centile | Median | 75 th per-centile |
| <i>Sales</i> | | | | | | | | | | | | |
| 1 | 335 | 31.3 | 91.4 | 0 | 0.1 | 11.2 | 80 | 197.0 | 384.4 | 2.0 | 30.6 | 210.7 |
| 2 | 324 | 65.1 | 156.2 | 0 | 3.6 | 60.8 | 80 | 357.6 | 1,205.2 | 21.0 | 61.8 | 245.8 |
| 3 | 292 | 94.9 | 203.0 | 0 | 8.8 | 90.8 | 72 | 341.1 | 898.3 | 18.2 | 76.6 | 312.3 |
| 4 | 248 | 126.9 | 263.4 | 0 | 17.2 | 116.8 | 57 | 435.9 | 1,143.5 | 30.0 | 106.1 | 263.4 |
| 5 | 200 | 182.9 | 429.2 | 0.3 | 17.8 | 173.6 | 47 | 295.6 | 609.2 | 27.8 | 93.8 | 228.3 |
| 6 | 131 | 207.4 | 473.1 | 0 | 14.5 | 184.9 | 34 | 315.5 | 570.7 | 18.6 | 123.5 | 290.3 |
| 7 | 79 | 202.5 | 436.3 | 0 | 7.8 | 171.1 | 14 | 332.7 | 783.0 | 18.2 | 145.9 | 264.1 |
| 8 | 36 | 231.5 | 485.5 | 0 | 0.1 | 160.3 | 6 | 184.5 | 183.1 | 21.7 | 154.3 | 297.1 |
| 9 | 23 | 280.2 | 665.2 | 0 | 0 | 146.5 | 2 | 287.1 | 83.2 | — | — | — |
| 10 | 9 | 384.6 | 878.3 | 0 | 10.8 | 30.2 | | | | | | |
| 11 | 5 | 9.3 | 15.8 | 0 | 0 | 10.2 | | | | | | |
| <i>No. of Employees</i> | | | | | | | | | | | | |
| 1 | 326 | 2.8 | 5.2 | 0 | 1 | 3 | 80 | 13.8 | 26.5 | 2 | 5 | 15.5 |
| 2 | 322 | 5.7 | 13.0 | 1 | 2 | 7 | 80 | 15.0 | 25.9 | 3 | 6 | 15 |
| 3 | 292 | 6.5 | 15.4 | 0 | 2 | 8 | 72 | 16.5 | 36.6 | 3 | 6.5 | 13.5 |
| 4 | 248 | 6.9 | 13.6 | 0 | 2 | 8 | 57 | 19.1 | 51.5 | 3 | 7 | 13 |
| 5 | 200 | 7.7 | 15.8 | 0 | 2 | 9 | 47 | 11.5 | 21.6 | 2 | 4 | 10 |
| 6 | 132 | 7.9 | 15.0 | 0 | 1.5 | 9 | 34 | 10.4 | 14.8 | 3 | 6 | 11 |
| 7 | 79 | 6.7 | 12.4 | 0 | 1 | 8 | 14 | 8.5 | 9.4 | 2 | 4 | 13 |
| 8 | 36 | 6.9 | 13.5 | 0 | 0 | 5 | 6 | 10.8 | 12.6 | 2 | 4 | 27 |
| 9 | 22 | 7.1 | 15.8 | 0 | 0 | 3 | 2 | 24 | 5.7 | — | — | — |
| 10 | 10 | 9.6 | 19.49 | 0 | 0 | 1 | | | | | | |
| 11 | 5 | 0.2 | 0.4 | 0 | 0 | 0 | | | | | | |
| <i>Income</i> | | | | | | | | | | | | |
| 1 | 333 | −23.1 | 50.7 | −27.9 | −7.2 | −0.8 | 80 | 10.5 | 99.3 | −13.7 | 0.8 | 27.1 |
| 2 | 324 | −43.8 | 84.6 | −56.8 | −15.1 | −2.3 | 80 | 24.6 | 159.1 | −23.5 | 1.1 | 38.7 |
| 3 | 293 | −46.4 | 121.2 | −71.5 | −13.8 | −0.6 | 72 | 0.1 | 103.2 | −23.8 | 0.2 | 15.1 |
| 4 | 248 | −14.8 | 350.6 | −66.1 | −14.7 | −0.5 | 57 | 21.5 | 104.9 | −15.6 | 1.5 | 16.5 |
| 5 | 200 | −42.0 | 109.4 | −83.8 | −11.3 | −0.5 | 47 | 9.1 | 58.9 | −14.6 | 5.2 | 20.2 |
| 6 | 132 | −59.7 | 177.7 | −78.3 | −12.9 | −0.4 | 34 | 8.0 | 38.6 | −5.3 | 4.5 | 19.1 |

(continued)

(continued)

Table 2.

| Investment years | HGVC backed firms | | | | | | GVC backed firms | | | | | |
|------------------|-------------------|--------|--------|------------------------------|--------|------------------------------|------------------|-------|--------|------------------------------|--------|------------------------------|
| | Count | Mean | SD | 25 th per-centile | Median | 75 th per-centile | Count | Mean | SD | 25 th per-centile | Median | 75 th per-centile |
| 7 | 80 | -37.9 | 135.0 | -47.0 | -6.6 | 1.7 | 14 | 5.2 | 22.2 | -11.0 | 2.1 | 20.8 |
| 8 | 36 | -44.3 | 126.0 | -58.2 | -6.8 | 1.3 | 6 | 6.4 | 12.7 | -5.2 | 4.1 | 14.3 |
| 9 | 23 | -3.8 | 106.1 | -13.0 | -3.0 | 3.8 | 2 | -11.5 | 54 | - | - | - |
| 10 | 9 | -117.7 | 407.4 | -17.6 | -6.7 | 45.6 | | | | | | |
| 11 | 5 | -48.8 | 102.9 | -17.3 | -5.7 | -3.0 | | | | | | |
| Total assets | | | | | | | | | | | | |
| 1 | 334 | 251.8 | 288.7 | 43.6 | 131.5 | 415.5 | 80 | 318.0 | 402.2 | 93.0 | 223.7 | 394.5 |
| 2 | 324 | 328.4 | 398.3 | 41.1 | 183.6 | 479.8 | 80 | 501.6 | 1108.4 | 112.8 | 264.1 | 398.0 |
| 3 | 293 | 399.3 | 608.7 | 51.7 | 233.0 | 527.4 | 72 | 442.3 | 625.6 | 81.9 | 263.9 | 501.4 |
| 4 | 248 | 484.9 | 804.7 | 67.0 | 270.7 | 574.7 | 57 | 528.0 | 807.0 | 134.3 | 281.4 | 440.1 |
| 5 | 200 | 609.9 | 1518.8 | 92.2 | 291.5 | 719.5 | 47 | 440.2 | 666.7 | 102.2 | 243.0 | 451.8 |
| 6 | 132 | 496.4 | 631.7 | 94.9 | 315.0 | 713.6 | 34 | 423.7 | 619.8 | 92.8 | 238.9 | 482.6 |
| 7 | 80 | 439.3 | 481.4 | 90.6 | 292.7 | 600.0 | 14 | 322.5 | 359.4 | 44.3 | 312.2 | 426.4 |
| 8 | 36 | 526.3 | 464.5 | 178.5 | 430.4 | 833.7 | 6 | 239.1 | 171.8 | 40.4 | 272.8 | 347.6 |
| 9 | 23 | 634.8 | 706.9 | 163.7 | 450.4 | 869.0 | | | | | | |
| 10 | 9 | 735.1 | 518.7 | 295.4 | 631.1 | 902.7 | 2 | 358.4 | 161.1 | - | - | - |
| 11 | 5 | 556.7 | 431.2 | 216.0 | 502.5 | 880.2 | | | | | | |

Note: Values are in million Hungarian Forint (HUF) except for number of employees
Source: Author's own compilation

Note: Values are in million Hungarian Forint (HUF) except for number of employees
Source: Author's own compilation

[Table 3](#) describes the results of the random effect regression models, showing describing the growth of invested firms measured by their revenues, employees, income and total assets.

The key independent variable in our models is the HGVC dummy variable that is significant in all four models, in three cases at the 1% significance level and at the 5% significance level for the number of employees. The coefficient of the HGVC variable is negative in all four models; therefore, we must reject our hypotheses. The results suggest that the appearance of hybrid VC investors negatively affects the growth prospects of the invested firms compared to the purely government-backed venture capitalists' investments. The growth in sales, employment, profitability and asset value was less for hybrid-backed firms.

The ownership variable featuring the stakes of venture capitalists was significant in the models. Models describing the growth of revenues, employment and assets presented the ownership variable with a negative coefficient, which suggests that the high ownership stakes acquired by investors led to poorer performance. Although the models led to different results in three specifications, the hypothesis related to the relationship between ownership acquired by venture capitalists and the performance of invested firms was strengthened. This result is relevant for capital structure and signalling theories.

The "lnassets" variable was significant in all specifications with positive coefficients, suggesting that larger firms generated higher growth. The age of firms was also a significant independent variable in three specifications and had a negative coefficient. This suggests that older firms were less capable of showing dynamic growth. As [Nightingale et al. \(2009\)](#) found a "U" shaped connection between profitability and investment length, we tested the model by building in the square of the number of years since the initial investment. However, this independent variable was insignificant in all model specifications, and based on the Akaike information criterion, the models without this variable were better. In the next section, we present the major reasons that led to the poor performance of HGVC in the Hungarian market.

Discussion

The hypotheses of this study were formulated assuming that hybrid funding presents a superior funding form that is able to overcome the numerous drawbacks of pure government funding, but the Hungarian evidence supports the contrary conclusion; GVCs proved to be a more successful tool in spurring firms' performance. This result contradicts the general assumption that government VC should be built on hybrid schemes. These results shed new light on the underlying principles of GVC schemes in developing and mostly peripheral economies.

Of course, the conclusion that we can draw is not that GVCs enjoy general supremacy over HGVC schemes in funding firms. Our research was carried out based on specific agendas with given regulations. Our results cannot be generalized to hybrid and GVC schemes as a whole, but given the specifics of the agendas and the Hungarian market, we can draw indicative conclusions regarding the characteristics that determine the success of given government-backed programs.

Demand and supply deficiencies

Firstly, the supply of VC did not match the demand; the sudden exuberance of capital exceeded the capital absorption capabilities of the Hungarian young and innovative firms. The demand side of the infant industry was not ready to obtain the increased capital. This conclusion is in line with [\(Owen and Mason, 2019\)](#), who stated that in peripheral economies, the supply-side intervention must be simultaneous with a demand-side stimulus. At the

| Dependent variables | Generalized Least Squares | | |
|-----------------------------------|---------------------------|---------------------|---------------------|
| | GrowthInSale | GrowthInEmployment | GrowthInIncome |
| <i>Investor-related variables</i> | | | |
| HGVC | -14.54** [0.2397] | -0.1367** [0.0653] | -32794*** [11989] |
| Ownership | -0.8984** [0.3963] | -0.3865*** [0.1072] | 41,683*** [17879] |
| Syndicated | 0.2234 [0.3019] | 0.0242 [0.0843] | -39859*** [15052] |
| InvestmentYear | Yes | Yes | Yes |
| <i>Firm-related variables</i> | | | |
| Ln(assets) | 0.6205*** [0.0804] | 0.1233*** [0.0230] | 18,130** [7632] |
| Ln(capital) | -0.1740 [0.1124] | 0.0086 [0.0266] | -40451 *** [9749] |
| Ln(age) | -0.7721 *** [0.1626] | -0.2214*** [0.0355] | -2086 [7175] |
| IntangiblesIntensity | -0.1997 [0.2663] | -0.0851 [0.0618] | 12,890 [13805] |
| FinancialAssetsIntensity | -1.1829*** [0.3682] | -0.4079*** [0.0774] | 25,704** [10304] |
| Ln(Sale _{t-1}) | -0.3233*** [0.0216] | - | - |
| Ln(Employment _{t-1}) | - | -0.2856*** [0.0265] | - |
| Income _{t-1} | - | - | -0.7359*** [0.0817] |
| Ln(assets _{t-1}) | Yes | Yes | Yes |
| Industry | Yes | Yes | Yes |
| Constant | 0.5821 [1.1238] | -0.3689 [0.2635] | 30,7705*** [48771] |
| <i>Summary statistics</i> | | | |
| Number of observations | 1,669 | 1,669 | 1,669 |
| Number of groups | 406 | 406 | 406 |
| Average observation per group | 4.1 | 4.1 | 4.1 |
| Wald Chi ² Test | 0.0000 | 0.0000 | 0.0000 |
| R ² overall | 0.1917 | 0.1038 | 0.2090 |
| within | 0.3627 | 0.3628 | 0.3297 |
| between | 0.1369 | 0.0249 | 0.0217 |

Notes: ***, **, * and * denote significance at 0.1, 1, 5 and 10%, respectively; the table presents the coefficients and their robust standard errors in brackets
Source: Author's own compilation

Spurring
entrepreneurship
with public
venture capital

Table 3.
Random effect
regression models
investigating the
growth of revenues,
number of
employees, income
and total assets of
Hungarian hybrid
and purely
government-backed
venture capital
investments in
2010–2016

same time, neither on the supply side were VC firms ready to manage these funds, as they lacked the expertise of private fund managers. Reliance on financial capital without proper human and social capital does not improve the prospects of enterprises (Linder *et al.*, 2019). There were numerous new entrants on the market that did not have a relevant track record in the field of VC investments. As a result, the previously small circle of venture capitalists expanded, and the concentration of industry knowledge was diluted. We can conclude that the supply and demand side of the market must be built up simultaneously and gradually. Smaller and focused agendas could be more successful in reaching their goals, especially in infant industries, where the fundamentals of VC agendas are not necessarily guaranteed by the existing market institutions. The numerous newly founded HGVC funds showed great heterogeneity in the non-financial value added to invested firms. The dispersion of industry knowledge resulted in many funds failing to imitate the services provided by well-established VC investors, whereas the centralized operation of the GVC proved to be more efficient.

Conflicting private and government policy goals and higher exposure to moral hazards

The second problem of the hybrid scheme comes from its conceptual framework. The foundation of PVC is given by the special expertise of investors and the private interests of the participants that GVC cannot imitate. HGVC was created partially to remedy these shortcomings by involving private investors. The appearance of private investors leads to a conflict of interest between private and public participants, as the motives of private participants are not necessarily consistent with the fundamental economic policy goals of government funding. The assumption of the model is that if the entrepreneurial ecosystem were able to generate viable investment targets, then private participants would be willing to participate in their funding even without government interventions. If the industry is in need of government support, then funding those firms that are targeted by government agendas is not consistent with the interests of private participants. The function of the incentives built into the HGVC is to bridge the gap of the expected and perceived return that private investors associate with the targeted firms. If the incentive scheme, investment policy and transparency of agendas are not regulated properly, in the short run, the inconsistency of HGVCs might lead to an even higher misallocation of capital than GVCs (Fazekas and Becsky-Nagy, 2021). In hybrid schemes, the problem of the double principle-agent relationship described by Sahlman (1990) is further aggravated by inconsistencies amongst private and public participants that lead to higher exposure to moral hazards.

Captive venture capital funds lack the characteristics of efficient contracts of independent financial intermediation

In most cases, VC funds were set up in captive form rather than in the form of independent financial intermediation. The double principle-agent relationship that evolves in VC funding and the moral hazard issues deriving from this problem are well documented (Sahlman, 1990). The methods formulated in PVC schemes to manage the risks of this relationship make a significant contribution to the efficiency of the private funding model. In the captive form, fund managers and limited partners are not separated; therefore, these control mechanisms do not appear. The lack of these risk-mitigating methods can decrease the efficiency of investments, especially if the private investors of hybrid schemes can use the economic benefits of the incentives built into the programs. HGVC schemes, therefore, should promote the form of independent financial intermediation, and this way, incentivizes private participants to imitate the contracts and risk management methods that

are prevalent in private VC schemes. [Karsai \(2018\)](#) also points out that problems of principle-agent relationships have far-reaching negative consequences in the CEE region.

The use of incentives is an inevitable part of hybrid schemes as in their absence, private investors would not participate in these agendas, but at the same time, their extensive use enhances the already substantial moral hazards of GVC investments. In this way, incentives become the source of market distortions. In Hungarian HGVCs, private participants benefited from asymmetric profit distribution with leverage; only 30% of the capital was provided by private investors and the profits of government funds above the pre-determined benchmark returns were channelled to private investors while their losses were mitigated, and they were partially taken on by governments. While this asymmetric profit distribution scheme incentivized private participants, it also led to increased moral hazards and the relatively poor performance of hybrid schemes, as private investors were able to realize profits even without real commercial successes. In this aspect, we can conclude that the limited use of incentives could contribute to the more efficient use of public funding.

Focus on less developed regions

Our final note regarding the efficiency of hybrid schemes resonates with the findings of [Nightingale et al. \(2009\)](#), who found that too strict restrictions connected to the use of capital could be counterproductive measures, especially territorial restrictions and the limited size of investments. The differences in investment size are widely discussed in the literature, but we must emphasize the problem of territorial restrictions. In many cases, government agendas see VC as a funding tool that could mend the funding problems of SMEs in less developed regions; therefore, they limit investments in more developed entrepreneurial areas. By its nature, VC is concentrated in the most advanced entrepreneurial ecosystem; therefore, excluding these areas from funding programs significantly hinders the efficient use of funds and, at the same time, does not meet the demand of less developed areas.

Signalling of ownership structure

Regarding the ownership structure of invested firms, it is surprising that HGVCs became the majority stakeholders in their investments. *H5* was formulated reflecting this feature. In the presence of information asymmetries, the actions of economic actors indirectly signal those features of firms that cannot be observed directly. In the case of equity financing, according to the signalling theory, the higher the ownership stakes the entrepreneurs are willing to hand over to investors, the lower the business potential they see in their firms. Also, as minority stakeholders, the founders of the firm lose motivation to put more effort into developing their firms. Information provided by the capital structure of firms has an important role in signalling business potential when information asymmetries are present. As *H5* was accepted, the theory in connection to the signalling of capital structure was supported; capital structure provides information about the quality of the invested firms in VC funding. On the other hand, the variable has a positive coefficient in the model describing the profit of the firm; therefore, the results in this sense are not unambiguous.

Conclusions

Hungarian evidence of GVC shows that HGVC investments underperformed relative to GVC. On the other hand, the generalization of these results would be a serious mistake. Thesis 1 describes the inconsistency of hybrid VC's conceptual framework; its extent and negative effect depend on the specific regulation of agendas. The empirical research based on Hungarian data examined two specific realizations of the funding schemes; therefore, it highlights the shortcomings of the agendas' design and regulation rather than the general

dominance of GVC over HGVC. In our opinion, HGVC might have a positive contribution to make to the development of an industry in its early stages if the agendas are designed in line with the following points.

Designing and implementing GVC programmes is on the agenda on domestic and international levels, as well. To create successful agendas in the future it is inevitable to build on the evidence and experience gained by previous initiatives. In this way, the regulation might fit better to market needs. Finally, we would like to summarize those recommendations that might contribute to the more efficient design of future agendas.

International and Hungarian evidence strengthens the notion that the enterprises targeted by VC have limited capital absorption capabilities. Prior to the increased level of government participation, there was only scarce activity on the VC market, and the number of potential investment targets could not be estimated properly. On the other hand, as a result of the oversupply of capital, we have a clearer picture of the potential size of the market. On the Hungarian market, there were a high number of firms seeking VC, but the number of those firms that were able to use the capital efficiently fell below the level that was required by the increased capital. Therefore, in the future, the implementation of agendas that are smaller in scale and more concentrated would be preferable. In this way, the investors would have more possibilities for the selection of invested firms, which is the essential element in VC's value creation.

The conceptual framework of hybrid VC funding revealed inconsistencies in the funding model. The conflict of economic policy goals and private interests increases moral hazards, and therefore, the possible market distortions caused by government interventions. The regulation must focus on these issues. In our opinion, the propagation of the scheme involving independent private fund managers would be a step forward compared to the current practice in which captive funds are dominant amongst HGVCs. In the selection of fund managers, those VC firms should be prioritized that are able to obtain private funding from an independent third party. In this way, control mechanisms and risk management techniques could evolve, which make a great contribution to the efficiency of the PVC model.

To make targeted firms appealing, it is inevitable to build incentives into HGVCs. On the other hand, the extended use of these incentives might lead to market distortions. In the past, Hungarian HGVC agendas used a variety of incentives. The high level of incentives is parallel to the increased capital managed within the framework of the agenda; the high amount of capital can be secured only with an extensive incentive scheme. In our opinion – in agreement with the first recommendation – programs managing less capital suited for the demand of VC could be more fruitful. In a parallel way, the level of incentives could be decreased because there would be higher competition among VC firms for the right to manage public funds.

As a final remark, we must emphasize that measuring the efficiency of GVC agendas on the basis of the performance of invested firms focuses only on the short-term impact of these agendas. There is a consensus in the literature that on the long run, government funding must withdraw and give room to private participants, but on the short run, as a catalyst, GVCs might have to make a positive contribution to the development of the market. In the case of every government-backed program that focuses on infant VC markets, the final goal is to spur the development of the industry to reach the level where private participants are able and willing to sustain the market. There is an industry learning curve that is accelerated by the accumulated knowledge that is created by the high volume of investments, and the increased supply of capital has a pull impact on other elements of the entrepreneurial ecosystem. The market imperfections present in these markets, especially the problem of adverse selection, could be lessened by the active involvement of the

government. In this sense, the inclusion of private participants in hybrid schemes holds more promise regarding the long-term self-sustaining prospects of the industry, even if on the short run, this leads to poorer performance.

Finally, we should emphasize that our results cannot be generalized for all GVC and HGVC schemes. We analysed two simultaneous programs; therefore, the regulation of these programs strongly influences the results. With different incentives, regulation and scale, the programs might have different outcomes. Therefore, the conclusions must be interpreted together with the background of the programs. Also, in a more developed entrepreneurial ecosystem, the different schemes might operate with different efficiency; in a more developed environment, the private interest might have more added value. In further research analysing the regulatory and institutional environment of government interventions is required to understand the impact of GVC programs in the case of the regional entrepreneurial development policies.

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