The Dance Between Government and Private Investors: Public Entrepreneurial Finance around the Globe

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Abstract

This paper examines the interaction between governments and private capital investors when financing early-stage ventures. We model when funding will be provided exclusively by private investors, government funding, or a mixture of sources, and rationalize the widespread use of co-investment requirements. Using hand-collected data on 755 programs worldwide, we document that the magnitude of government funding of new ventures rivals that of private venture capital. Co-investments are more likely when targeting earlier-stage ventures, when governments are more effective, and the local VC market is more developed. The findings highlight the importance of synergies between public and private entrepreneurial finance markets.

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1. Introduction

The financing of early-stage ventures enables the creation and development of entrepreneurial firms, thereby contributing to innovation and economic growth (Solow 1957). Venture capital investors typically provide such capital, but face limits in their ability to advance technological change. For example, they often focus on a narrow band of technologies, face intense cyclicality in capital availability, and (for all but a subset of elite firms) encounter fundraising challenges (Lerner and Nanda 2020). Government investments have long been prescribed by economists as a solution to market failures, particularly where investments have substantial social benefits and significant externalities. Innovative spillovers from new businesses (e.g., Acs and Audretsch 1988), as well as the increasing returns associated with the formation of entrepreneurial clusters (Glaeser, Kerr, and Kerr 2015), suggest that this is an area where externalities are substantial and public investments appropriate.

This argument, however, depends on governments having the skills to identify market failures, and on the implementation of these programs not being distorted by the pursuit of private benefits by government officials (Shleifer and Vishny 1998). Investing in high-growth businesses and monitoring their progress require significant expertise (see, for instance, Gompers and Lerner 1999; Kaplan and Stromberg 2003). Moreover, the selection and oversight of such firms often is made by private investors using soft information (Kaplan and Stromberg 2004; Bernstein, Giroud, and Townsend 2016). Decision-making based on such imperfect information may be difficult for government officials to duplicate (e.g., Stein 2002).

In this paper we seek to achieve two goals. First, we aim to understand the magnitude of governments' involvement around the globe in the financing of early-stage ventures. Most of the earlier literature has mostly focused on the design of a single program or in a single nation to evaluate its consequences, typically using well-identified approaches (Bronzini and Iachini 2014; Howell 2017; Kisseleva 2020; Le and Jaffe 2017; Myers and Lanahan 2022; Pless 2020; Santoleri et al. 2020; and many others). However, the highly focused nature of this approach sheds limited light on the scale and importance of governments' involvement in early-stage financing markets around the globe. In this paper, we attempt to answer this question by collecting a comprehensive, detailed data on the universe of government funding programs of entrepreneurial ventures around the globe. This effort

allows us to shed light, for the first time, on the magnitude and importance of government funding efforts in early-stage financing.

Our second goal is to explore the structure of these government funding programs to better understand the interplay of public and private entrepreneurial finance: the extent in which governments collaborate with private capital markets when deploying capital to early-stage ventures. Governments' shortcomings in deploying capital to early-stage ventures may be overcome, at least partially, through the formation of partnerships between public and private investors. Economists have prescribed these joint efforts as a way to address similar problems in a wide variety of settings (e.g., Bolton, Samama, and Stiglitz 2012). To encourage entrepreneurial finance, the government should be willing to contribute capital with an eye to maximizing externalities that may not be internalized by private capital providers but are an important driver of economic growth (Griliches 1992; Bloom, Schankerman, and Van Reenen 2013). Private investors, as the literature cited above suggests, may have greater expertise in selecting and funding entrepreneurs in general. These considerations suggest that under some circumstances, governments' collaborations with private capital investors may yield substantial benefits. The existing literature, as mentioned above, typically analyzes a single program or a single nation. To explore the extent to which such collaborations arise systematically requires the reliance on a comprehensive and detailed information on government funding programs around the globe.

We assemble novel, comprehensive, and detailed data on the universe of government funding programs of entrepreneurial ventures world-wide to explore the aggregate importance of these efforts, and the circumstances under which co-investments in entrepreneurial companies arise between public and private investors. We show that government funding programs have become prevalent around the globe. Between 2010 and 2019, national governments' entrepreneurial finance programs around the world have on average a cumulative annual budget of $156 billion, as opposed to an average of $153 billion of global disbursements of traditional venture funds.[2]

[2] These estimates are based on our sample, as described below. If we exclude the 42% of public entrepreneurial finance programs that are debt-oriented, the total average expenditure still exceeds $90 billion annually. See Appendix 1 for a discussion of the methodology behind these comparisons.

Many of the government funding programs rely on private sector involvement. For example, in 35% of the programs, private investors are included on the investment committees. The most popular form of reliance on private investors is through the matching funds requirements, in which government funding is conditional on the ability of firms to also raise capital from the private sector. Such requirements exist in 43% of the government programs. Yet, despite the prevalence of government efforts in early-stage funding, and the importance of public-private collaborations, the structure of these public entrepreneurial finance efforts has attracted relatively little attention in financial economics.

To motivate our empirical analysis, we present a simple conceptual framework in Section 2. We build on a key theoretical contribution on public entrepreneurial finance, Lach, Neeman, and Schankerman (2021), who study government loans for R&D startups. We extend their work by focusing on the interaction of public and private sector investments in early-stage ventures, while simplifying some aspects of their model to focus on the key dynamics in our setting.

Our simple framework depicts the dynamics between three sets of players. First, entrepreneurs propose to undertake risky but potentially high return projects, which also have positive externalities. These entrepreneurs often cannot finance the projects themselves, so they turn to venture capital (VC) investors. These financiers provide capital and also enhance the probability of success of a project, an effect increasing with the venture capitalist's abilities and decreasing in the difficulty of obtaining the right match between the entrepreneur and venture investor. Finally, the government is distinguished by being the only party to weigh the social externalities generated by the company. The government may thus be interested in funding projects that are rejected by the venture capitalists. It seeks to maximize social welfare without financing projects that would receive support from private markets anyway.

The government can either fund projects on its own (in return for an equity stake) or split the investment with VC investors. The government can induce private investor participation in riskier but high-externality projects by offering a co-investment scheme with subsidized equity. The government may be inclined to do so because the venture investors can improve project success. Under these assumptions, we obtain several results:

- First, there is a strict gradation of projects. The highest quality ones, based on the projected financial returns, are funded by private investors alone; the next best are funded jointly; and the lowest are exclusively financed by government or are not funded at all.
- Second, as the effectiveness of private investors increases, co-investment funding becomes *more* likely relative to government-only funding programs. Conversely, as the search costs for VC funding increases, co-investment funding becomes *less* likely relative to government-only funding programs.
- Finally, as government officials extract more private benefits from funding, government-only programs become more likely relative to co-investments.

To test these ideas and explore when collaboration between governments and private capital providers is likely to emerge, we hand-collected novel data set on nationwide entrepreneurial finance policies around the world active between 1995 and 2019 (755 programs in 66 countries). As we discuss in depth in Section 3, we focus on national-level programs financing domestic entrepreneurial firms or the intermediaries that fund them. We build as comprehensive a dataset as possible of the universe of these programs and their features to explore the relationship between public entrepreneurial finance initiatives and local private capital markets.

After presenting some key stylized facts in Section 4, we create an index of private sector involvement in each program, focusing on three commonly encountered ways in which government programs are structured. We then turn in Section 5 to examining the hypothesis that as governments obtain more private benefits from funding, government-only programs become more likely relative to co-investments. This claim suggests private sector involvement will be greater in programs of higher quality governments. We find that, consistent with the theoretical suggestion, the involvement of the private sector is greater in governments that rank higher on rule-of-law and government effectiveness scores.

We similarly look across programs to examine if, as the effectiveness of private investors increases, co-investment funding becomes more likely relative to government-only funding. We operationalize this notion by examining programs that focus on early-stage investments. We anticipate these settings, where governance problems are likely to be more substantial (Gompers 1995), will be ones where the contributions of private investors will be greatest. Again, the results are consistent with the hypothesized effect.

We then examine the proposition that as the cost of search for VC funding increases, co-investment funding becomes less likely relative to government-only funding programs. This hypothesis suggests that private sector involvement in government programs will be greater in settings with larger local private venture capital activity, as it will be easier to find a venture investor with the skills that match well to the entrepreneur. To examine this, we look at the country-year level, regressing the extent of public programs with private sector involvement on lagged private venture activity. The predicted positive relationship holds using various measures, including when looking at the country-year-industry level.

We also examine whether these results hold across different types of programs in Section 6. We anticipate that, if the involvement of the private sector in public initiatives is costly, governments will be more likely to include such provisions when they matter the most. We anticipate that programs where governments are making equity investments, as opposed to grants or loans, would be one such setting, as there may be the greatest uncertainty about repayment. Consistent with this suggestion, we see the relationships summarized above—especially those between the involvement of the private sector on the one hand and the presence of private benefits for government officials and the extent of information problems on the other—are driven by programs involving equity financing.

The framework suggests that inception of public financing (whether public-private co-investment or government-only) will expand the set of companies funded and the volume of innovation in the nation. To explore the hypothesized effect on innovation, we explore in Section 7 four different metrics based on U.S. patent filings, which (as we discuss below) are well suited for this assessment. These include the total number of patent applications from residents of a given country, the number of high-quality innovations as measured by citations, the number of patents in basic technology classes, and the number of patents filed by new patenting entities.

Across all innovation measures, we find similar patterns: a meaningful and statistically significant improvement in innovation following the initiation of government funding programs.[3] Important for interpreting these results, we find no statistically significant pre-existing trends in the years leading to the government funding programs.

[3] This result is broadly consistent with Brander, Du, and Hellmann (2015), who show that investments with public and private capital perform better than either source alone.

In Section 8, we explore an alternative explanation for the prevalence of matching requirements. The trend-chasing hypothesis suggests that governments pursue investments perceived to have promising attractive private returns, rather than those that boost social welfare.[4] We argue that this hypothesis is inconsistent with the evidence presented here.

This paper is related to the recent resurgence of interest in industrial policy more generally. While for many years public interventions to promote nascent industries were viewed with suspicion, the question today, as Stiglitz, Lin, and Monga (2014) assert, "is not whether any government should use industrial policy but rather how to use industrial policy in the best way." This paper seeks to understand the rationales for one particular set of industrial policy interventions, the financing of early-stage ventures.

2. Conceptual Framework

Why might we see co-investments between public and private venture capital investors? How might such collaborations interact with the prospects of the projects and the potential impact of private investors? In this section (and Appendix 2), we present a simple conceptual framework to explore these dynamics, building on the work of Lach, Neeman, and Schankerman (2021), who study the optimal design of government loans for R&D startups using mechanism design methods in a partial equilibrium framework. We extend their work by focusing specifically on the interaction of public and private sector, and the conditions under which such co-investments will arise. We also simplify some aspects of their model to focus on the key dynamics in our setting.

In this framework, risk-neutral and financially constrained entrepreneurs generate risky projects that may have socially desirable externalities. While private investors care only about financial returns, governments consider the externalities such projects generate. At the same time, private investors not only finance firms, but can also enhance a startup's probability of success by providing monitoring, advisory, and networking services, therefore

[4] For instance, public programs are sometimes assessed based on "success stories" (accounts of companies that succeed commercially, regardless of the marginal contribution of public funds) or rely on proceeds from successfully exited investments for additional investment capital. Both these considerations may pressure public managers to invest in the companies or sectors with the greatest financial prospects.

increasing the probability of success. We assume that governments are unable to duplicate these value-creating services.

Public entrepreneurial finance programs encompass various kinds of financing instruments for early-stage ventures, categorized broadly into equity, debt, and grant policies. Equity and grant account for 80 percent of these programs in our sample. Our conceptual framework focuses on funding programs in which a government-led entity acquires an equity stake in a startup, and could possibly offer private investors to the opportunity to co-invest at a subsidized rate. Indeed, we document empirically below that 48% of equity programs require that government funds must be provided alongside capital from a private investor.

This finding raises the question of when public-private co-investment arises. In our framework, we focus on a contractual arrangement in which the government provides capital in return for an equity stake in the project. In the case of co-investment, the government and the investors provide matching funds, and split the equity ownership. We describe the assumptions and broad implications of the model below.

2.1 Model Setup and Assumptions

Entrepreneurs generate risky projects with a probability of success p, private returns $R > 1$, and externality σ. We assume for simplicity that project characteristics are all common knowledge. The cost of the project is normalized to 1, while entrepreneurs' internal funds are $b < 1$. Therefore, they need to raise $1 - b$ from external sources.

Venture capital investors can provide capital for an equity stake in the project. We also assume, in line with the evidence in the literature, that private sector investors are able to add value to the project, and therefore increase its likelihood of success (Babina et al. 2020; Bernstein, Giroud, and Townsend 2016; Bernstein et al. 2021; Kortum and Lerner 2000). We denote the increase in the success probability by $\beta = \frac{1}{\gamma} + \delta$, where $\gamma > 0$ represents search costs of matching with venture capital investors, and δ measures VC effectiveness, where $\delta > 1 - \frac{1}{\gamma}$. Put another way, the value-added service of the venture capitalist increases in the match quality between the investor and the entrepreneur, which is inversely related to the cost of search γ, and also increases in the capability of the venture investor to improve projects, denoted by δ. We assume that $\beta \leq \frac{1}{p}$, such that the success likelihood of a project, βp,

cannot be greater than 1. Moreover, venture capitalists do not internalize the externality of the project σ, but instead focus on private returns only.

Venture capitalists will not invest in a project with a negative expected return, that is, the only projects that can be funded by the private sector alone are those that satisfy $p\beta R \geq 1$ or $p \geq \frac{1}{\beta R}$. Hence, some riskier projects may not be funded in the absence of government intervention, even if they may have significant positive externalities. Moreover, we assume that investors require that they break even on their investment in order to support a project.

The government, on the other hand, does internalize externalities of the project, denoted by σ. These externalities might include, for instance, the positive effects of an entrepreneurial business on subsequent ventures, which will benefit from the presence of investors, lawyers and other intermediaries, and workers familiar with practices in entrepreneurial ventures. Therefore, a project characterized by a pair of (p, σ) generates total social returns of $p(R + \sigma)$. The government's objective is to maximize social welfare, which also incorporates externalities.

We also allow cases in which government officials extract private benefits from such funding programs, denoted by PB. Here we envision that companies can be pressured to engage in a variety of activities that benefit the program administrators, from hiring relatives to pursuing "pet projects" of politicians that may improve the visibility of their actions. In this case, government officials will overestimate the true benefit from funding the project, assuming the total return to be $p(R + \sigma + PB)$. We also examine a scenario where governments can only obtain private benefits from investments without private sector collaboration.[5] An illustration of this case is provided in Figure A-1.

The government can either fund the projects on its own in return for an equity investment, or split the required amount of investment, $1 - b$, with private sector investors. We assume that in the case of co-investments, the private sector will need to provide matching funds, in line with the empirical evidence described below. We

[5] For instance, government officials may be unable to force firms to pursue unproductive actions when private investors are involved or may be reluctant to do so in these contexts, as these steps may deter future private investment.

assume that the capital provided will be split equally between the government and the investors, even if the equity is divided differently. Specifically, let α_J^{VC} and α_J^G denote the VC and government equity shares in the case of co-investment, while each party contributes half the needed capital, that is $\frac{1}{2}(1-b)$. In such case, the return to the private investors is $\alpha_J^{VC} p\beta R - \frac{1}{2}(1-b)$.

2.2 Model Implications

The form of financing available for the entrepreneur depends on the nature of her project, that is, its likelihood to succeed p, and the externalities it generates σ. Projects that are highly likely to succeed will be funded only by venture capital investors, as private returns are sufficiently high, and the government would rather not deploy its own funds due to its shadow pricing. Alternatively, an exclusively private investment may be more attractive to entrepreneurs for whom government involvement is more of a tax than a benefit.

We denote p^{**} as the boundary condition under which if $p > p^{**}$ the venture capitalist will invest alone. Note that p^{**} is independent of the externalities associated with the project, since these are not internalized by the private investor. This is illustrated in Panel A of Figure 1, where we provide a numerical illustration of the model across the project space characterized by (p, σ). However, as we illustrate in Appendix 2, p^{**}, the boundary condition, is in fact decreasing with R and β. Private investors are more likely to fund projects when they are more attractive, and when they are more capable of adding value to the projects.

When projects are riskier, that is, when $p < p^{**}$, then the venture capitalist is unwilling to invest alone. However, the government can still incentivize private investor participation, by offering a scheme of matched funds. In this case, the venture investor will contribute only a portion of the funds but will get a disproportionally high equity compensation. The government would be interested in doing so because the venture capitalist is able to improve the success rate of the project to βp, where $\beta > 1$, and therefore improve the likelihood of the realization of the project externalities σ.

The project externality σ allows governments to take a smaller equity stake and thus provide a larger equity stake to the venture investor to induce her participation in the project. In the extreme case, the government provides half the funding, $\frac{1}{2}(1-b)$, while allowing the venture capitalist to gain the entire equity compensation from their

joint investment. The government would be willing to do so when the externalities from the project are meaningful enough. This case is equivalent to a grant, where government investment requires no ownership stake in return.

However, if the project is particularly risky, then even this extreme incentive will not be sufficient to induce co-investment of the venture capitalist. The government will instead invest alone, as long as externalities are sufficiently high. Denote p^* as the riskiest project where the venture investor would be willing to invest with the government. In other words, co-investment will occur only within the range $p^* \leq p \leq p^{**}$. Figure 1 illustrates this boundary condition. Note that when externalities are low, the government is less willing to provide discounted equity for the venture investor, and therefore, joint investment will happen only for safer projects (that is, p^* is decreasing with σ).

When projects are particularly risky, that is, when $p < p^*$, then the government is unable to induce VC investment, and therefore unable to benefit from private investors' value-added activities. The government may still be willing to invest in such risky projects only if their externalities, σ, are sufficiently high, as illustrated in Figure 1. If externalities are not high enough, the government will also not fund these projects. Denote $p^{\wedge}$ the boundary condition for which projects with $p < p^{\wedge}$ remain unfunded. It is useful to note in Figure 1 that $p^{\wedge}$ is declining with σ: that is, the higher the externalities associated with the project, the more willing the government is to fund riskier projects alone.

The discussion above can be summarized as follows, illustrating the ranking of project funding:

Result 1. For a given space of projects characterized by (p, σ), projects will be funded in the following order:

(1) Highest quality projects are funded by the private sector only, that is, when $p > p^{**}$. Moreover, p^{**} is independent of project externalities σ.

(2) When $p^* \leq p \leq p^{**}$, projects are co-funded by the government and the private sector. Moreover, p^* is weakly decreasing with project externalities σ.

(3) When $p^{\wedge} \leq p \leq p^*$, only the government funds the projects. $p^{\wedge}$ is decreasing with project externalities σ. If $p < p^{\wedge}$, projects remain unfunded.

Proof. See Appendix 2.

Note that the figure also demonstrates that the presence of public entrepreneurial finance programs should be associated with more innovation and entrepreneurial activity in that country, particularly of the high-σ type, as the existence of such government programs expands the set of projects funded. We explore this empirically below, where we measure such innovation using basic and high impact patents originating from that nation.

How does the likelihood of co-investment change when the effectiveness of the venture capital investor increases? We illustrate this case in Panel B of Figure 1, where all parameters remain unchanged, with the exception of the increase in β. This change leads to two effects. First, the VC investor is more likely to fund projects alone, as more projects are becoming attractive: that is, p^{**} is declining with β. Second, relative to government-only funding scheme, joint investments become more attractive.

To study this relationship in greater detail, in Figure 2 we describe how the boundary conditions change as a function of VC effectiveness δ and VC search costs γ. In Panel A of Figure 2, it is apparent that both p^{**} and p^{*} are declining with δ. That is, once private investors are able to add more value, more projects are likely to be funded by VC investors, either alone or jointly with the government. Moreover, as expected, $\hat{p}$ is unaffected, since the boundary of government-only projects is not correlated with the ability of private investors to add value. But as illustrated in the figure, if private investors become sufficiently effective, co-investments and VC-only funding may entirely crowd out government-only funding programs.

Panel B of Figure 2 shows the opposite occurs when search costs are raised and match quality between investors and entrepreneurs is worse: VC investors fund fewer projects alone as the lower bound for the private-funding region, p^{**}, increases. Moreover, as match frictions increase, the government becomes less likely to collaborate with the private sector, as illustrated by the increase of p^{*}.

This can be summarized in the following result:

Result 2.

1. As the effectiveness of private investors δ increases, co-investment funding becomes weakly more likely relative to government-only funding programs.

2. As the cost of search γ for VC funding increases, co-investment funding becomes weakly less likely relative to government-only funding programs.

Proof. See Appendix 2.

Note that this result generates two predictions that can be tested empirically. First, it suggests that in countries with more developed venture capital ecosystems and hence lower VC search costs, governments may be more inclined to co-invest with local investors, rather than invest alone. The second implication of this result is that since venture capital investors can add more value to portfolio companies earlier in their life cycle, we expect to see that governments are more inclined to co-invest with private investors in earlier-stage projects. We explore these hypotheses in the empirical analysis below.

Finally, we explore how changes in government private benefits affect project funding. If the government generates private benefits from funding companies, the government may overestimate the benefit from funding these projects above and beyond the financial gains and social externalities.

In Panel A of Figure 3, we replicate Panel A of Figure 1, but instead increase the private benefits extracted by the government, PB. Naturally, this increases the region in which projects are funded only by the government, as the government is now willing to invest in even riskier projects. Moreover, when governments gain more private benefits, the joint financing region also expands towards low externality projects that previously would not have received government support. These projects are relatively limited, as they must still have moderate success probabilities in order to bring about VC participation. In Panel B of Figure 3, we draw the derived boundaries with respect to government private benefits. The figure shows clearly that an increase in private benefits increases the portion of projects with government-only funding relative to joint investments, which leads us to the following result:

Result 3. As governments obtain more private benefits from funding, the set of funded projects expands towards lower quality and lower externality projects, and government-only programs become more likely relative to co-investments.

Proof. See Appendix 2.

In the empirical analysis, we explore how joint investments of public and private sector are correlated with government quality. We assume that higher quality governments extract fewer private benefits through their funding programs.

3. Creating the Data Set

In this section, we describe the process through which we create the data on public entrepreneurial programs. To do so, we use 190 different sources published between 1998 and 2020. These documents are prepared by international bodies (especially the Organisation for Economic Cooperation and Development), national governments, and academics. They summarize relevant policies on a national, regional, or international basis, often providing information on their design. Table A-1 in the Appendix summarizes the sources used; Appendix 3 provides more details on the criteria used for the selection process.

3.1. Defining the included programs

To construct the data, we first attempt to identify the universe of all public entrepreneurial finance programs. A guiding principle is to focus on national programs that involved the provision of capital to entrepreneurs, either directly by the government, or indirectly through venture capitalists, angel funds, and banks.

These seemingly straightforward criteria, however, had a number of nuances. In Appendix 3, we provide examples of included and excluded policies. The key principles that motivate our decisions are as follows:

- Domestic focus: We drop policies focused specifically on other markets and not on the country in which they are initiated. For instance, we delete the programs of a number of wealthy nations that are aimed towards promoting entrepreneurship in emerging economies.
- Financial orientation: We wish to focus on programs that involve the financing of entrepreneurs. Thus, we keep policies supporting innovation centers so long as the innovation center itself offers financing of entrepreneurial firms, but not if the emphasis is solely on training, mentoring, or similar activities. Similarly, we keep policies that involved special economic zones, so long as the program involves the financing of entrepreneurial firms.

- Nation-level policies: Because we focus our analysis on the national level, we drop programs run by international bodies such as the European Union. We keep policies that are joint efforts between a national government and an international body, as long as the participation of the international body is only for funding purposes and the policy itself is run by a national government. We also drop policies organized by states, provinces, and municipalities. Our decision to do so is driven not by a lack of interest in or significance of these programs, but because of the difficulty in getting systematic data on these efforts.
- Appropriate program level: Governments are inconsistent about how programs are defined. These situations are quite idiosyncratic and can be complex. In general, we adjust the definition of what constitutes a program in one of three cases. Below are these three commonly encountered situations, and how and why we modify the definition of the programs:
    - In some cases, there are "umbrella" policies that encompass a number of clearly distinct programs with different types of financing provided and/or firms targeted. In many cases, the branding of the umbrella programs changes over time, even as the underlying programs remains constant: for instance, a new administration might announce an initiative, which essentially is a repackaging of already-existing programs. In these cases, we split the umbrella policies up into their clearly defined subprograms.
    - In some cases, policies are announced as separate programs, even though they have the same structure. For instance, in some cases, a government launches three separate financing programs with identical features, which target three different industries. In these cases, we classify these as a single program and aggregate the budget information. While such a reclassification reduces the number of reported programs, it does not affect most of the analyses using weighted totals.
    - In policies where there is a clear primary financing type but some additional capital provided (e.g., an equity financing program with a small loan component appended), we code the policy according to the primary financing type.

Sometimes programs change design or scale over time. We address these shifts as follows. If the program design changes radically, we create a second entry with a note that it is a restructured version of the original program. If there are only minor modifications, we use the characteristics as of the end of 2019.

3.2. Identifying and coding the programs

We now describe the process by which we identify and code the programs. To do this, we first create as comprehensive a list of programs to research as possible.

One concern with the coding is that terminated policies are difficult to observe; they are less likely to be included on current government websites and other directories. We seek to avoid such truncation bias by identifying programs using contemporaneous sources to as great an extent as possible.

In particular, we use 190 sources on public entrepreneurial finance programs published between 1998 and 2020. Many of these directories list websites for these programs, which are either still active or available through the Internet Archive (www.archive.org).[6] The information that we obtain from these websites cause us to revise the program list in some cases. For instance, we discover that some of the listed programs are duplicates of other programs, umbrella designations that encompassed multiple programs, or other problematic cases. In some cases, we also discover additional programs, which are either not in the published sources or conflated with another program. Table A-2 describes how we created the final sample of 755 programs.

We gather information on the features of these programs from multiple sources. Many of the reports summarizing the programs have information on the key aspects of these features. In addition, many existing (and terminated) programs have extensive information online on program design, in current or archived sites. Appendix 4 provides definitions of the coded policy-level variables.

Of the measures that we code, the treatment of annual budgets is particularly challenging. We seek to capture the annual budget flow of the program in U.S. dollars. We use, wherever possible, the amount actually

[6] The archived (and current) Internet information is quite extensive. We are able to find relevant information online for 93% of the programs active in the sample period established before 2000, 89% of the programs established between 2000 and 2009, and 90% of those established in 2010 and after.

disbursed, not the original appropriation or budget request. In some cases, the flow varies from year to year. The quality of the budget information is generally higher in later years, so we use the average of the most recent three years of the program, if possible. If available budget information is a cumulative amount over a longer period, we take the annual average. Using the recent flows is imperfect for two reasons: in some cases, programs increase in size over time, so this approach may overstate program size. (Though, as noted above, we seek to address substantial breaks in program design by treating these as two separate programs.) In other cases, equity and debt programs have an evergreen feature, where capital returned from original investments is "recycled" in new deals. In these cases, the budget amounts may understate the economic importance of mature programs.

3.3. Characterizing the countries

We characterize the countries using measures that are similar to those in Bernstein, Dev, and Lerner (2020). We first use a number of explanatory variables that characterize the countries in general. We obtain annual data on population (in millions) and GDP (in billions of 2010 U.S. dollars) from the Economist Intelligence Unit database. In some cases, these data are missing, so we supplement this source with data from the *CIA Factbook*, United Nations databases, and government websites of the respective countries. Appendix 5 provides definitions of the country-level variables, including a number of measures used exclusively in Table 1, such as initial public offering activity.

In our analysis, we also explore how entrepreneurial finance is associated with the quality of government. To assess government quality, we use two measures compiled by the World Bank's Worldwide Governance Indicators project: their measures of the effectiveness of government and the rule of law. These aggregate indicators combine the views of corporate, individual citizen, and expert survey respondents in developed and developing countries, and are based on over 30 individual data sources that a variety of survey institutes, think tanks, non-governmental organizations, international organizations, and private sector firms produce. The data series date back to 1996. Since these series are initially produced biannually, when data are missing in a given year, we use the information in the immediately subsequent year.

In addition, we use Economist Intelligence Unit's (EIU) overall business environment rating. The business rating measures the quality or attractiveness of the business environment. The overall score is derived as an

unweighted average of ten component category scores and the ratings run from 1 to 10, 1 being low and 10 being high[7].

We also gather three metrics that measure entrepreneurial and innovative activity. First, we gather country-level venture capital investment data from two sources.

The initial source of information is various national and regional associations. These organizations routinely gather data on venture capital investments that should be of high quality due to their close ties to members. Unfortunately, these data have two substantial limitations. First, in much of the world, these associations are quite new and only recently began tracking venture investments. Second, not all groups use the same methodologies.

Consequentially, we also use Refinitiv VentureXpert data (other databases have limited global coverage, especially in the 1990s). The data include 342,832 transactions with an average of 2.16 investors per deal. We remove transactions with missing total investment values, or transactions classified as Buyout, Fund of Funds, Generalist Private Equity, Mezzanine, Other Investor (Non-Private Equity), Other Private Equity, and Real Estate. Our final deal count is 204,446 transactions. We sum the venture capital investment by country and year. Of 6,150 country-year observations between 1990 and 2019, 4,150 have no data from either source, in which case we assume there are no venture capital investments. table A-3 summarizes the methodology.

Finally, we gather information about U.S. patenting activity from Clarivate's Derwent Innovation and the USPTO's PatentsView databases. U.S. patents have several advantages when evaluating these programs. First, the use of USPTO awards assures that patents across nations are more directly comparable, thereby facilitating cross-national analyses. Some nations, for instance, have very narrow patent filings, which may inflate award counts. Second, the standards for U.S. patent filings are unaffected by policy changes in the home country (except in the U.S., where a substantial literature suggests that patent policy is shaped by many considerations largely exogenous to entrepreneurship promotion). While it might be objected that many national patents are not filed in the U.S., we expect that more important awards would be filed in the U.S., as otherwise the inventions will not be protected in

[7] The business rating examines ten separate criteria or categories, covering the political environment, the macroeconomic environment, market opportunities, policy towards free enterprise and competition, policy towards foreign investment, foreign trade and exchange controls, taxes, financing, the labor market, and infrastructure.

this important market. Finally, unlike initial public offerings, which can take place years or even more than a decade after a company's innovations attract the attention of venture groups, the lag between innovation and patent filing is generally quite short, a question we return to in Section 7.

We extract from these patent databases the name and nationality of each inventor, the primary patent class, the application date, the identity of the assignee(s), and the number of citations (through September 29, 2020) for each patent. Following Moretti (2021), we assign patents to countries proportionately to the number of investors from each particular nation. Appendix 6 provides more details about the construction of the patent database.

Using these data, we create four patent-based measures. The first includes the overall number of U.S. patents applied in a given year and country. The second is the number of "top patents", which are patents at the top 10% of citations, relative to other awards in that application year and patent class. The third measure is the number of patents in basic technology classes. Following the approach of Akcigit et al. (2020), we define basic patent classes as the patent classes that are in the top 10% in citations to academic journals per patent, relative to other CPC classes in the same year. Finally, we count the volume of patenting by new patenting entities in a given country-year, based on the assignees who are new to the patent database.

4. Stylized Facts about Government Funding Programs of Entrepreneurial Ventures

We thus assemble a hand-collected dataset of government funding programs of entrepreneurial ventures around the world. Given the novelty of the data, and the limited information available in the literature about the extent and structure of these programs, in this section, we describe several stylized facts.

Stylized Fact 1: Government funding programs have become increasingly more prevalent, and today are common around the globe.

As Table 1 shows, our data cover 755 government funding programs in 66 countries around the world active between 1995 and 2019. On average, governments spend $1.85 billion per year (conditional on having at least one

policy). Moreover, a given country has 11.4 such policies, and the average funding program lasts 11 years. (This calculation includes the age of non-terminated programs as of 2019.)

The tendency to rely on such government funding programs is geographically dispersed, and not just a phenomenon confined to developed countries. For example, Figure 4 illustrates the total number of policies around the world. Countries that have a significant number of different programs include Canada, Germany, and the Netherlands, but also Turkey and a number of Eastern European nations. Figure 5 presents the annual budget of these programs, and Figure 6 spending relative to GDP. While Figure 5 illustrates a strong correlation with the size of the nations (such as in the case of Brazil, China, Russia, and the U.S), Figure 6 reveals that a few smaller nations spend significantly on such entrepreneurial funding programs. Canada, China, France, Germany, and Indonesia are in the highest category in both Figures 5 and 6.[8] Finally, Figure 7 explores the stability of these programs, in terms of their length. Overall, it is evident that the use of such programs is widespread.

It is also interesting to note the importance of these government programs increasing over time. Figure 8 illustrates the annual aggregate budgets allocated for government funding programs of entrepreneurial ventures. The figure illustrates the steady and significant increase in global government spending over time, from roughly $50 billion in 1995 to more than $170 billion in 2019.

Stylized Fact 2: The aggregate budget of government funding programs is comparable to the global venture capital market.

It is interesting to compare these programs to the global venture capital market. As Figure 8 illustrates, over the last decade, the average cumulative annual budget of such government funding programs around the world is $156 billion. In contrast, global annual disbursements of traditional venture funds around the world are on average

[8] The reader may be surprised by the inclusion of Algeria among the top nations. Algeria's ranking is driven by the programs for young entrepreneurs run by the Agence Nationale de Soutien à l'Emploi des Jeunes (ANSEJ), which is characterized by BTI as "a massive public investment" (https://www.bti-project.org/en/reports/country-report-DZA-2020.html). For more details on the program, see https://www.imf.org/external/pubs/ft/scr/2014/cr14161.pdf.

$153 billion, as tabulated by CrunchBase's *Global VC Reports*.[9] This illustrates the remarkable dominance of governments as a key provider of capital to early-stage ventures.

Stylized Fact 3: Governments rely on a host of different financial instruments.

Panel A of Table 2 illustrates the different types of financial instruments that governments employ. The most prevalent type of government instrument is grants, accounting for 43.8% of all programs, as column 1 notes. The second most popular financing form is equity funding, accounting for 18.2%. But governments utilize a host of other types of financial instruments, ranging from credit guarantees and loans to innovation vouchers to tax credits. It is interesting to note that when accounting for the size of the programs, as illustrated in column 2, tax credits and government loans are more significant, partially because they are used by later-stage and larger companies.

Stylized Fact 4: Government funding programs often involve private capital markets.

Government funding programs often rely on private capital investors. Panel B of Table 2 shows that the involvement comes in various forms. Column 1 illustrates that the involvement of private investors in the investment committee occurs in 35% of the government funding programs. In 7% of programs, governments allocate capital via intermediaries (subject to various rules, such as restrictions on the industry and the geography of the financed firms). However, the most popular form of reliance on private investors is through matching requirements, in which government funding is conditional on the ability of firms to raise matching capital from the private sector (providing a signal for the validation of the project). Such requirements exist in 43% of the government programs.

Stylized Fact 5: Government funding programs often target specific industries and company stages.

[9] https://news.crunchbase.com/news/the-q4-eoy-2019-global-vc-report-a-strong-end-to-a-good-but-not-fantastic-year/ and earlier years. An estimate by another venture data services, PitchBook, of average annual venture investment globally over the same period is $148 billion (https://nvca.org/recommends/111997-2/).

Panels C and D of Table 2 highlight the industries and company stages that the programs target. In our coding, we allow programs to target multiple categories. In terms of the number of programs, programs focusing on the life sciences and technology firms are the most common, as well as those targeting early-stage firms. We also tabulate categories that are excluded from coverage in these government programs in Panel D. Here, agricultural, financial services, and sin industries are the most frequent industries to be excluded.

5. The Interaction of Private and Public Activity

With the conceptual framework in Section 2 in mind, we turn to the empirical analysis to explore when government co-investments with private sector investors are more likely to occur. It is important to highlight that to test these ideas, we need to rely on cross-country analyses. Of course, one downside of such approach is the lack of a clean identification strategy. However, alternative approaches cannot shed light on the circumstances in which governments and private capital markets collaborate when deploying capital to early-stage ventures due to their focus on specific countries and programs. In that regard, we view our approach to be complementary to the existing literature.

The framework suggests that when governments derive fewer private benefits from funding programs, the likelihood of government collaboration with private investors should be higher. Table 3 explores this hypothesis. The unit of observation in each regression is each public entrepreneurial finance program *p* introduced between 1995 and 2019. The dependent variable, $PrivateSector_p$, equals one if the public program has any component of private capital investors' involvement outlined above.

In the table, we use the effectiveness of governance and the rule of law scores in the year of the policy introduction as the key independent variables. We also include country-year controls, population and per capita GDP, as well as country fixed effects:

$$PrivateSector_p = \beta_1 \times GovtEff_{c,t-1} + \delta \times X_{c,t} + \alpha_c + \varepsilon_{c,t} \qquad (1)$$

Table 3 shows that nations with better public governance at the time of policy introduction, whether measured through the effectiveness of government or the rule of law score, are more likely to involve the private sector.

Specifically, in column (1), we find that an increase of one standard deviation in government effectiveness boosts the likelihood of a program incorporating private investors by 18%, an effect statistically significant at the 1% level. Introducing fixed effects for the year of program initiation in column (2), we find this effect increases to 21%. In column (3), we explore the score pertaining to the rule of law. We find that a one standard deviation increase in the score pertaining to rule of law increases private investor involvement by 23%. The effect remains similar when introducing year fixed effects.[10]

We explore the robustness of the results regarding the impact of government quality using an alternative measure, the EIU business environment rating in Panel A of Table A-5. We find that the positive relationship remains consistent, with a boost in private sector involvement by 14% with one standard deviation increase in the EIU score.

The conceptual framework also suggests that when venture capitalists are able to contribute more value to their supported companies, the likelihood that a government program incorporated private capital investors should be greater. We argue that this condition is more likely to be the case when government programs target early-stage ventures. Indeed, in column (1) of Table 4, we find that targeting early-stage firms increases the likelihood of collaborating with the private sector by 8%, a coefficient statistically significant at the 5% confidence level. The effect almost doubles to 14% in column (2) when we add year fixed effects.[11]

We also anticipate that the ability of venture capital investors to add value is higher when the match between investors and early-stage ventures is better. The conceptual framework suggests that when such matching is of higher quality, governments are more inclined to collaborate with private capital investors. In our empirical setting, we proxy for search costs using the size of the local venture capital market.

Table 5 explores this hypothesis by exploiting the panel nature of the data to examine how changes in venture capital activity, within country, correlate with the decision to initiate government programs over time and

[10] In Table A-4 we repeat the analysis by weighting programs by their budget. We find that while the magnitude of the effect increased, the statistical significance diminishes. As we illustrate below, most of the variation is driven by government programs targeting early-stage ventures.

[11] We lose this effect when we weight the program by the size of the budget in Table A-6. This change reflects the fact that the programs with early-stage focuses have smaller budgets on average. Specifically, programs with an early-stage focus on average have budgets about half the size of those without an early-stage focus.

whether these new programs require a collaboration with private capital investors. Specifically, the dependent variable, $PrivateSector_{c,t}$, is the number of active policies in each country-year between 1995 and 2019 with private sector involvement:

$$PrivateSector_{c,t} = \alpha_c + \alpha_t + \beta \times Log(Lagged\ PrivateVC_{c,t-1}) + \delta \times X_{c,t} + \varepsilon_{c,t} \quad (2)$$

In column (1) of Table 5, we find that even when controlling for nation fixed effects, an increase in venture capital funding leads to a higher likelihood of private sector involvement in government funding programs. Specifically, the coefficient in column (1) equals 0.306, and is statistically significant at the 1% level. A one standard deviation increase in lagged VC investments leads to an 86% increase in the number of policies with private sector involvement. When we include year fixed effects in column (2), the results remain statistically significant at the 1% level, but the magnitude somewhat decreases to 70%.[12] Overall, the results illustrate the strong association between local venture capital activity and the initiation of programs that require collaboration with private local investors.

Interestingly, governments' tendency to collaborate with local investors does not only vary with the availability of venture capital within a country over time, but also within a country across industries. To demonstrate this, we focus on the eight industries most frequently mentioned in the descriptions of government programs. We identify annual venture investments in these country-industry-year triples based on four-digit Standard Industrial Classification codes. Table 2 highlights that the most targeted industries are high technology, healthcare, and sustainability, with the addition of a few large programs targeting agriculture-related businesses.

We report in Table 6 analyses in the spirit of those in Table 5. Because the observations are at the country-industry-year level, we include country, industry, and year fixed effects. Specifically, we use as a dependent variable $TargetedIndustry_{i,c,t}$, which denotes as one cases where an industry *i* in country *c* is specifically targeted in a given period *t* by a government program and the program includes a collaboration with private investors. We estimate the following regression at the industry-country-year level:

$$TargetedIndustry_{i,c,t} = \alpha_i + \alpha_c + \alpha_t + \beta \times PrivateVC_{i,c,t-1} + \delta \times X_{c,t} + \varepsilon_{i,c,t} \quad (3)$$

[12] Similar results arise also when weighting programs by their budget, as illustrated in Table A-7.

In column (1), we find that lagged venture capital activity in the respective industry has strong explanatory power for the existence of government programs that target an industry in collaboration with local investors, even after controlling for country fixed effects. Specifically, the coefficient equals 0.036 and is statistically significant at the 1% level, suggesting that an increase in VC investments in an industry in the prior year is associated with a significant increase in the likelihood of a joint program that targets that industry. In column (2), we find that the results hold even when we include industry fixed effects, and in column (3), we further include year fixed effects. The coefficients remain remarkably stable, and statistically significant at the 1% level. These results support the view of the complementarity between public entrepreneurial finance programs and private capital market activity.

6. Decomposing the Results

Next, we seek to understand which subsets of programs drive the results seen above. In Tables 7 and 8, we present simple decompositions of the coefficients that we present in Tables 3 through 5.

First, we decompose the coefficients by the type of engagement in the program of the private investors. As Panel B of Table 2 illustrates, private investors engage with these programs in three different manners: through matching funding requirements, government direct funding of intermediaries, and participation on investment committees. Second, we decompose the analyses by the security type the public sector uses. We divide the programs into three classes: those involving equity investment, those involving loans, mezzanine, and other debt-related instruments, and programs focusing on grants. The use of these financial instruments is summarized in Panel A of Table 2.

These analyses repeat the analyses seen in the earlier tables, with Panel A corresponding in both cases to Table 3, Panel B to Table 4, and Panel C to Table 5. We present in each case an estimation akin to the second regression in the earlier table (and in the case of Panel A, to the fourth regression in Table 3 as well). In Panels A and B of Table 7, the dependent variable is an interaction of whether the program has private sector involvement (defined as above) and the type of engagement in the program of the private investors (a program that has private sector involved in the form of a matching fund). When a program has more than one type of engagement, we assign

it randomly to one of the types of engagements. In Panels A and B of Table 8, the dependent variable is an interaction of whether the program has private sector involvement and the type of the program (e.g., an equity program with private sector involvement). In Panel C of Tables 7 and 8, where the analysis is at the country-year level, the dependent variable is the count of policies satisfying both criteria.

These specifications have an adding-up property: we can see which types of programs drive the effects observed in earlier tables. To illustrate the point, the coefficient on government effectiveness in the second regression of Table 3 is 0.149. This coefficient is equal to the sum of columns 1, 3, and 5 in Panel A of Table 7 (0.135-0.032+0.046).[13]

The results in Table 7 are striking: the coefficients are driven in large part by the matching fund requirements. We find that the coefficients of the government effectiveness measure in column (1) and the rule of law score in column (2) are highly statistically significant at 1% level. These coefficients represent 91% and 80%, respectively, of the total coefficient in Table 3. In contrast, we find no statistically significant relationship between government quality and the tendency to engage private investors through financial intermediaries, as noted in columns (3) and (4). Finally, we find that higher quality governments are more likely to introduce collaborations with private capital markets by adding investors to the investment committees, as illustrated in columns (5) and (6), but the overall impact of the coefficient is modest.

Similar results hold in Panel B of Table 7, when we study how private investors participate in government funding programs when targeting early-stage ventures. In column (1), we find that having an early-stage focus increases the probability of having a matching fund requirement, accounting for 93% of the coefficient reported in Table 4. We find no statistically significant effect on funding financial intermediaries in columns (2) and (3).

[13] This adding-up approach also works in Table 8 because each program is classified as primarily involving one security. In Table 7, programs may engage the private sector in more than one way (as opposed to Tables 3 through 5, where the dependent variable is a binary one). We adjust the dependent variables in Table 7 in the cases where it engages the private sector in more than one way by randomly assigning each program to one of the categories. Table A-9 is similar to Table 7 in the text, but when a program is engaged with the private sector in more than one way, we assign it on a pro-rated basis (e.g., if the program falls into two categories, each has a dependent variable of one-half). In Table A-10, in multiple cases, we assign a dependent variable of one to each category. (In this case, the adding-up property of Tables 7, 8, and A-9 does not hold),

In Panel C of Table 7, we examine the relationship between local VC investments and the three components of private sector involvement. We find statistically significant effects of the volume of VC investment for two of the three components. Similar to the results of Panels A and B, we find the matching fund requirement accounts for the vast majority (82%) of the coefficient reported in Table 5. Using the EIU business environment rating as an alternative measure of government quality in Panel B of Table A-5, we find that the results remain consistent and significant. Higher quality governments are more likely to introduce matching fund requirements, and this accounts for over 100% of the effect reported in Panel A of Table A-5.

Turning to Table 8, we might anticipate that if involvement of the private sector in public initiatives is costly, governments would be more likely to include such provisions when they matter the most. This is most likely to be the case when governments are making equity investments, as opposed to grants or loans. In the former setting, there may be the greatest uncertainty about repayment, and the most expertise required for monitoring and governance.

In Panel A of Table 8, we find the relationship between higher-quality governments and structuring programs in collaboration with the private sector is stronger in programs that involve equity financing. Specifically, columns (1) and (2) illustrate that both government effectiveness and rule of law scores are positively associated with an equity-based program, when the coefficient accounts for 58% of the coefficient reported in Table 3. The effect for grants is similar in magnitude, but statistically insignificant, and that for debt much weaker in absolute magnitude (and negative in sign). We run a robustness analysis in Panel C of Table A-5, using the EIU business environment rating measure again. We find a similar result: a positive and significant relationship between quality of government and the presence of programs involving equity financing (over 50% of coefficient reported in Panel A of Table A-5)[14].

We see similar patterns when examining the effect of early-stage focus in Panel B of Table 8. An early-stage focus is associated with an increase in the likelihood of public-private collaboration for equity-financing programs. These observations account for over 100% of the effect Table 4 reports.

[14] In Panel C of Table A-5, we find a significant positive effect for programs with grants and significant negative effect for debt programs.

In Panel C of Table 8, we once again examine how the local venture capital market is associated with the structure of the government program. We find that an increase in local VC activity is associated with an increase in private sector collaboration in all three classes of programs, with the bulk of the effect being driven by grant (55% of the coefficient in Table 5) and equity-based (27%) programs.

Overall, these decomposition results illustrate that the key findings in the paper, as reported in Tables 3 to 5, are driven by programs that require matching funds from private investors and those making equity investments.

7. Innovation and Government Funding Programs

The conceptual framework in Section 2 predicts that the presence of public entrepreneurial finance programs should be associated with more innovation and entrepreneurial activity. Government funding should expand the set of projects funded, particularly those with high externalities. This section explores this hypothesis empirically. Of course, any analysis that attempts to establish the causal consequences of these programs should be approached with caution, due to two issues. Before turning to the analysis, we discuss these concerns and how we address them.

The first of these issues is that we employ a staggered difference-in-difference analysis. Moreover, as shown in Table 1, countries that undertake a single entrepreneurial finance policy typically initiate multiple subsequent ones. Due to critiques such as Athey and Imbens (2018), it is widely understood that this setting can lead to biased estimates of average treatment effects unless precautions are taken. Our baseline analysis examines the first public entrepreneurial finance policy introductions of treated nations during the sample period. We show below that the results are robust to accounting for subsequent introductions.

Second, it is likely that decisions to initiate these programs are non-random. The same underlying considerations that lead to a boost in innovation may also trigger individual nations to start public entrepreneurial finance programs. To address this possibility, we plot the effects dynamically in Figure 9. The lack of pre-existing trends provides us with some comfort with respect to the causal interpretation of the results in this section. We also note that, as discussed above, we examine U.S. patent applications, whose review standards should not be influenced by policy changes in the nation initiating the entrepreneurial finance program. Finally, we may expect a time lag

between the passage of the programs and any effects that arise on patenting activity. Indeed, the slow and gradual effect we observe seems to further alleviate to some degree these concerns.

Our baseline analysis relies on the following specification:

$$Innovation_{c,t} = \alpha_c + \alpha_t + \beta \times POST_{c,t} + \gamma \times X_{c,t} + \varepsilon_{c,t} \qquad (4)$$

where $Innovation_{c,t}$ are the logarithms of (one plus) the four measures of the U.S. patent filings in a given country-year discussed in Section 2.3. $POST_{c,t}$ is a dummy variable denoting that the observation year is after that in which the country initiates its first program. The specification includes country and year fixed effects, as well as controls for population, per capita GDP, and lagged venture capital activity. We cluster standard errors at the country level. We include 30 country-year observations for each country (1990-2019, conditional on data availability) using all countries in the sample. The 139 countries that are never treated serve as controls.

The results of this specification are presented in Table 9. In column (1), the dependent variable is the log number of patent applications. The coefficient of the *POST* variable equals 0.344 and is statistically significant at the 1% level. The coefficient suggests a 41% (=*exp*(0.344)) increase in patenting activity following the introduction of the first government funding program.

However, the number of patents may not necessarily reflect the volume of high-quality innovations. Therefore, in column (2), we focus on the number of "top patents," that is, those in the top 10% of citations of all those with the same application year and technology class. Following the initiation of government funding programs, the number of top patents filed increases significantly by 32%. It is also interesting to note that government programs induce patenting activity in more basic technologies, as noted in column (3), which may reflect more fundamental discoveries. Moreover, column (4) illustrates that government funding programs are associated with increases in the likelihood of patenting by new patenting entities by 24%.

The results demonstrate that government funding programs are associated with subsequent increases in innovation. As noted above, a natural concern about the interpretation of the results is that government funding programs and the increases in local innovation activity arise due to unobserved factors. To explore whether this is the case, we plot the innovation dynamics in the five years before and after the initiation of initial government entrepreneurial finance programs. Specifically, we estimate the following specification at the country-year level:

$$Innovation_{it} = \alpha_c + \alpha_t + \delta \cdot 1\{t \leq Year_{init} - 5\} + \sum_{j=-4}^{j=4} \beta_j 1\{t = Year_{init} + j\}$$

$$+ \theta \cdot 1\{t \geq Year_{init} + 5\} + \gamma X_{ct} + \epsilon_{ct} \quad (5)$$

which includes indicator variables for the years surrounding program initiation. Again, the specification includes country and year fixed effects, as well as the same set of country-specific controls as described above. Standard errors are clustered at the country level. The omitted baseline is the year prior to policy initiation, which is normalized to zero. We thus identify effects from the differences between treated countries and never-treated countries, as well as differential timing of introduction of such programs within the treated countries.

Figure 9 illustrates the coefficients on the time dummies for the years surrounding the program initiations with 95% confidence intervals. In Panel A, we see a gradual increase in the number of patent applications following the initiation of a government funding program. The effect becomes statistically significant in the third year after the funding program's initiation. We find similar patterns when we focus on the number of top patent applications (Panel B), the number of patents in basic research (Panel C), and the number of applications by new patenting entities (Panel D). It is important to note that in all figures, we do not find any evidence for the existence of statistically significant pre-trends, which helps alleviate concerns about pre-trends and reverse causality.

It might be thought that we would see an immediate reaction in patent filings to a program initiation. Hall, Griliches, and Hausman (1986) highlight the short lag between R&D spending and patent filings. It should be noted, however, that foreign entities have one year after filing in their home country to file applications directly in the U.S. They may be able to delay their U.S. filings by up to 30 months after the original filing by exploiting features of the Patent Cooperation Treaty, as https://www.wipo.int/pct/en/faqs/faqs.html describes. Thus, even if the public programs have an immediate effect on innovation, there may be a delayed response when measured by U.S. patent filings.

Finally, we explore whether the baseline results are robust to alternative approaches. In the first of these, we use both first policy introductions as well as subsequent initiations, so long as there is no policy introduction in the five years prior. This adds 16 additional initiations to the original 65. We continue to have 30 country-year

observations for each country and use all 204 countries in the sample. The relevant lead/lag indicators are reset to 1 for the second initiation, as well as for the first.[15] The second alternative approach uses first policy introductions and subsequent initiations with no introduction in the five years prior, with the addition of a new independent observation for each additional program. Again, this adds 16 additional initiations to the original 65. Using this approach, 60 country-year observations, rather than 30, are included for a country with two initiations that meet these criteria. The 139 of the never-treated countries continue to serve as controls. As shown in Tables A-11 and A-12, both methods generate similar and consistent results.

Taken together, the results are consistent with the theoretical framework that suggests that public entrepreneurial funding can expand the set of implemented projects, particularly those with high externalities and of a more basic nature.

8. An Alternative Mechanism – Trend Chasing

Thus far, we explore how public entrepreneurial finance interacts with private capital markets, using a simple framework to generate a set of predictions of when the government may set up funding programs in collaboration with the private sector. We corroborate these predictions empirically.

In this section, we consider an alternative potential mechanism that may have driven some of the patterns seen here: trend-chasing. One possible interpretation is that government officials seek to maximize private returns, and as such, simply create government funding programs that follow similar patterns to those of private investors. That is, both sets of actors are pursuing investments perceived as promising attractive private returns, rather than the government seeking to maximize social welfare through collaboration with the private sector.

Such a scenario may be a consequence of the criteria by which many public firms are evaluated or structured. For instance, Wallsten (2000) suggests that in its first decades, the Small Business Innovation Research (SBIR) program in the U.S. was largely evaluated through compilations of "success stories": accounts of companies

[15] Note that this method will not include the >=+5 indicator from the first initiation for observations beginning five years before the initiation of the second policy.

that receive public funding and then achieve success in the product and/or financial markets. As he notes, such evaluations are problematic as they lead program managers to focus on "measurable private returns and anecdotes, largely ignoring the difficult-to-estimate expected returns and spillovers." Such an evaluation scheme may lead program administrators to target sectors that are contemporaneously the focus of intense investor interest. Thus, the efforts by government officials to involve the private sector could be seen as a bid to boost the financial returns to the public funds.

However, this interpretation of the results is inconsistent with several findings documented above. First, government programs frequently rely on private capital markets through capital matching requirements, where private capital groups are often allowed to invest in more preferential terms than the public funds (The grant programs are an extreme example here.) The frequency of these provisions suggests that public funding is doing more than "chasing" financial returns and following "hot" sectors.

The second contradictory finding relates to the settings in which the use of matching requirements is most prevalent. If trend-chasing is a manifestation of the "gaming" of evaluation criteria or program design, such behavior might be especially common in settings where government effectiveness is *lower*. Instead, as seen above, more effective governments are more likely to employ provisions that rely on collaborating with private capital investors.

9. Conclusion

This paper examines the interactions between governments and private capital investors in the context of public entrepreneurial finance, which collectively represents a source of financing rivaling independent venture funds. A simple framework highlights where collaboration between governments and private investors is most likely. Looking empirically at programs world-wide, we find that, consistent with the conceptual framework, collaboration with private sector is greater where the rankings of government effectiveness are higher, when the programs target earlier-stage companies, and when the local private venture market is more developed. These government funding programs also increase local innovation.

The analysis suggests questions for future research. Foremost among these is the need for a better understanding of the mechanisms in these programs and their implications. While the contracts between venture capitalists and entrepreneurs have been extensively scrutinized, these programs have a wide variety of provisions that lend themselves to theoretical and empirical economic analysis. Examples include the differing sharing rules in the equity programs (e.g., the capping of the return to the public sector or the provision of downside protection to private investors) and the extent that governments attempt to use these programs to achieve multiple goals. For instance, the SBIR program simultaneously attempts to promote technological innovation, to use small businesses to meet Federal R&D needs, and to encourage diversity.

Despite the proliferation and size of public programs to promote entrepreneurial finance, many questions remain about their design and implementation. It is our hope that this analysis will encourage work on the open questions identified above, as well as related questions.

References

Anat R. Admati, and Paul Pfleiderer, "Robust financial contracting and the role of venture capitalists," *Journal of Finance* 49 (1994): 371-402.

Ufuk Akcigit, Sina T. Ates, Josh Lerner, Richard R. Townsend, and Yulia Zhestkova, "Fencing off Silicon Valley: Cross-border venture capital and technology spillovers," Working Paper no. 27828, National Bureau of Economic Research (2020).

Kenneth Arrow, "Economic welfare and the allocation of resources for invention," In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, Princeton, Princeton University Press for National Bureau of Economic Research, 1962, pp. 609-626.

Susan Athey and Guido W. Imbens, "Design-based analysis in difference-in-differences settings with staggered adoption," Working paper no. 24693, National Bureau of Economic Research (2018).

Tania Babina, Alex Xi He, Sabrina T. Howell, Elisabeth Ruth Perlman, and Joseph Staudt, "The color of money: Federal vs. industry funding of university research," Working paper no. 28160, National Bureau of Economic Research (2020).

Shai Bernstein, Xavier Giroud, and Richard R. Townsend, "The impact of venture capital monitoring," *Journal of Finance* 71 (2016): 1591-1622

Shai Bernstein, Abhishek Dev, and Josh Lerner, "The creation and evolution of entrepreneurial public markets," *Journal of Financial Economics* 136 (2020): 307-329.

Shai Bernstein, Kunal Mehta, Richard R. Townsend, and Ting Xu. "Reputation spillovers in venture capital: Evidence from a randomized field experiment," Working Paper no. 27907, National Bureau of Economic Research (2021).

Nicholas Bloom, Mark Schankerman, and John Van Reenen, "Identifying technology spillovers and product market rivalry," *Econometrica* 81 (2013): 1347-1393.

Patrick Bolton, Frederic Samama, and Joseph E. Stiglitz, editors, *Sovereign Wealth Funds and Long-Term Investing*, New York, Columbia University Press, 2012.

James A. Brander, Qianqian Du, and Thomas Hellmann, "The effects of government-sponsored venture capital: international evidence," *Review of Finance* 19 (2015): 571–618,

Raffaello Bronzini and Eleonora Iachini, "Are incentives for R&D effective? Evidence from a regression discontinuity approach," *American Economic Journal: Economic Policy* 6 (2014) 100-134.

Paul A. Gompers, "Optimal investment, monitoring, and the staging of venture capital," *Journal of Finance* 50 (1995): 1461-1489.

Paul A. Gompers, and Josh Lerner, 1999. *The Venture Capital Cycle*, Cambridge, MIT Press, 1999.

Zvi Griliches, "The search for R&D spillovers," *Scandinavian Journal of Economics* 94 (1992): S29–47.

Bronwyn H. Hall, Zvi Griliches, and Jerry Hausman, "Patents and R&D: Is there a lag?," *International Economic Review* 27 (1986): 265-283.

Sabrina T. Howell, “Financing innovation: Evidence from R&D grants,” *American Economic Review* 107 (2017): 1136–1164.

Steven N. Kaplan and Per Stromberg, “Financial contracting theory meets the real world: An empirical analysis of venture capital contracts," *Review of Economic Studies* 70 (2003): 281-315.

Steven N. Kaplan and Per Stromberg, “Characteristics, contracts, and actions: Evidence from venture capitalist analyses,” *Journal of Finance* 59 (2004): 2177-2210.

Katja Kisseleva, “Public funding and entrepreneurial firm growth: Which channel works best?,” Unpublished working paper, ESMT Berlin (2020).

Samuel Kortum, and Josh Lerner, “Assessing the contribution of venture capital to innovation,” *RAND Journal of Economics* 31 (2000): 674-692.

Saul Lach, Zvika Neeman, and Mark Schankerman. “Government financing of R&D: A mechanism design approach,” *American Economic Journal: Microeconomics* 13 (2021): 238-72

Trinh Le and Adam B. Jaffe, “The impact of R&D subsidy on innovation: Evidence from New Zealand firms,” *Economics of Innovation and New Technology* 26 (2017): 429-452.

Alexander Ljungqvist, “IPO underpricing: A survey,” In *Handbook of Corporate Finance: Empirical Corporate Finance*, B. Espen Eckbo, editor, New York: North-Holland, 2007, volume 1, pp. 375-422.

Enrico Moretti, “The effect of high-tech clusters on the productivity of top inventors,” *American Economic Review* 111 (2021): 3328-75.

Kyle Myers and Lauren Lanahan, “Estimating spillovers from publicly funded R&D: Evidence from the U.S. Department of Energy,” *American Economic Review*, forthcoming (2022).

Richard Nelson, “The simple economics of basic scientific research”, J*ournal of Political Economy* 67 (1959): 297-306.

Jacquelyn Pless, “Are 'complementary policies' substitutes? Evidence from R&D subsidies in the UK,” Unpublished working paper (2020).

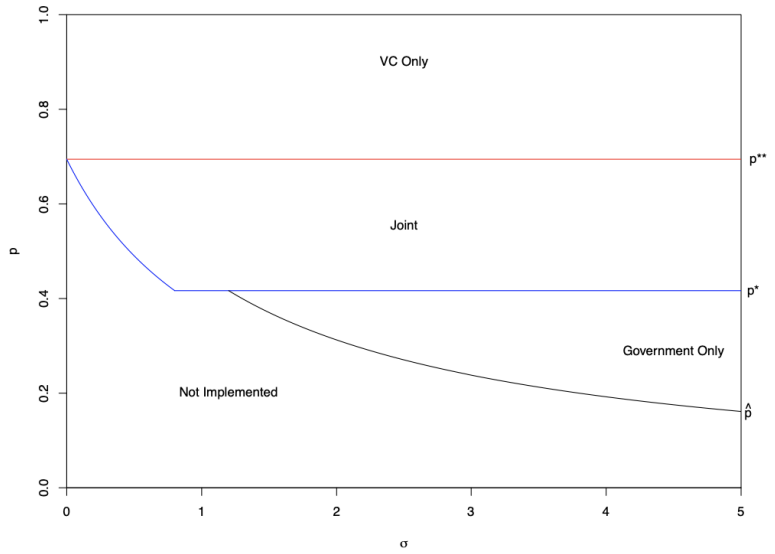
Pietro Santoleri, Andrea Mina, Alberto Di Minin, and Irene Martelli, “The causal effects of R&D grants: Evidence from a regression discontinuity,” LEM Papers Series 2020/18, Laboratory of Economics and Management, Sant'Anna School of Advanced Studies, Pisa, Italy (2020).

Jeremy C. Stein, “Information production and capital allocation: Decentralized versus hierarchical firms,” *Journal of Finance* 57 (2002): 1891-1921.

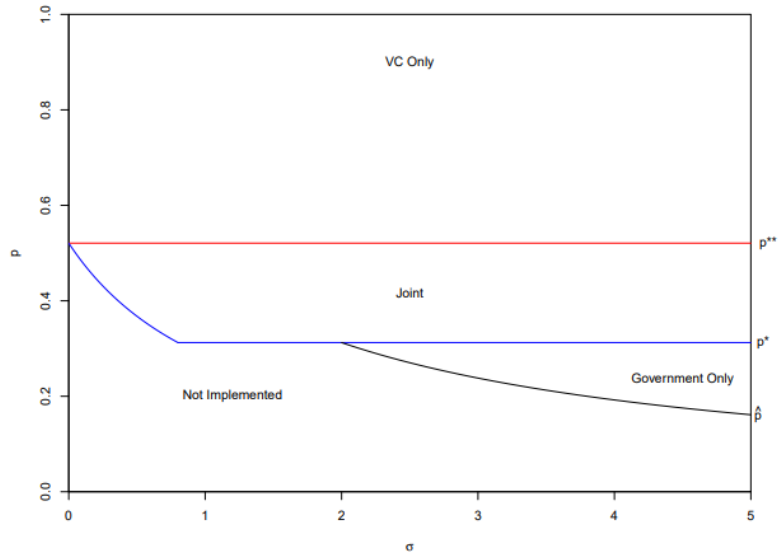
Joseph E. Stiglitz, Justin Y. Lin, and Celestin Monga, “Introduction: The rejuvenation of industrial policy,” In *The Industrial Policy Revolution*, Joseph E. Stiglitz and Justin Y. Lin, editors, London, Palgrave Macmillan, 2014, volume I, pp. 1-15.

Scott J. Wallsten, “The effects of government-industry R&D programs on private R&D: The case of the Small Business Innovation Research program,” *RAND Journal of Economics* 31 (2000): 82-100.

Figure 1. Boundary conditions for VC-only, joint, and government-only financing in terms of project social externality.



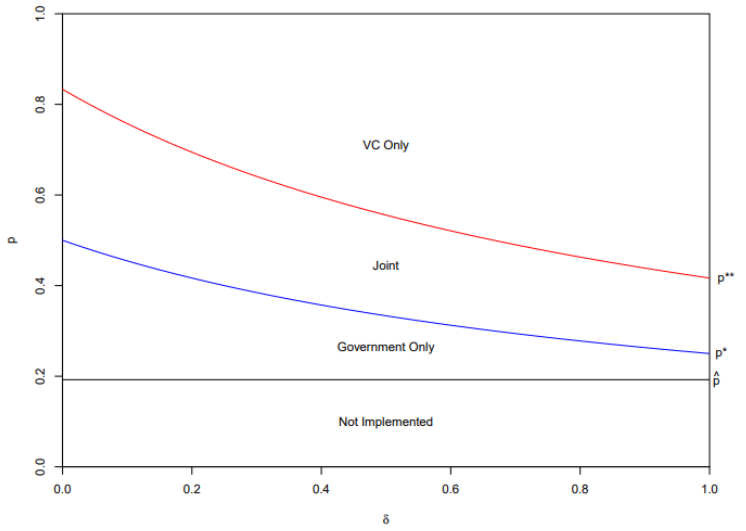
Panel A: Boundary conditions in (σ, p) space.



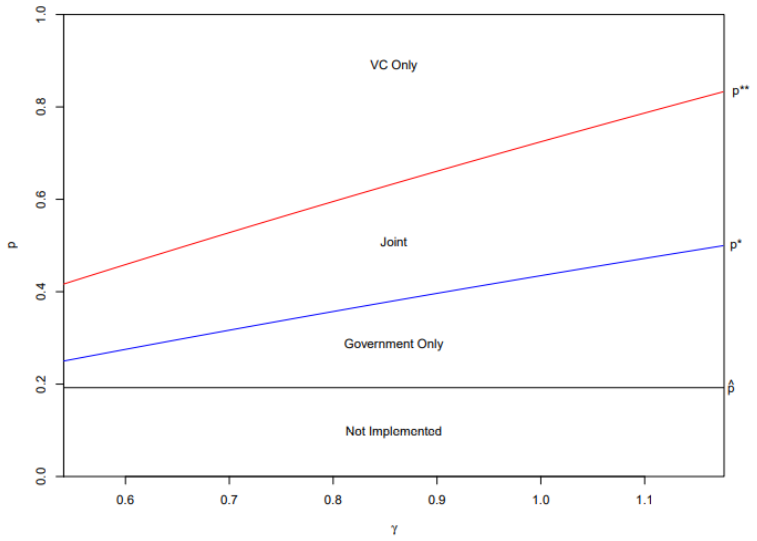
Panel B: Boundary conditions in (σ, p) space, with increased beta.

Notes: This figure provides a numerical illustration of the conceptual framework of Section 2 across the project space characterized by (σ, p), where σ is the project externality and p is the success probability. Panel A assumes parameter values of β=1.2 (increase in success probability from VC), R=1.2 (private returns), b=0.4 (internal funds of entrepreneur), and PB=0 (government private benefits). The figure shows that the highest quality projects (p>p**) are funded by venture capitalists alone, projects with $p^* \leq p \leq p^{**}$ and sufficiently high externalities are co-funded by the government and the private sector, and projects with $p < p^*$ are funded by the government alone. Projects with $p < \hat{p}$ remain unsupported. Panel B uses the same parameter values as Panel A but increases β to 1.6. This increase makes joint investments more attractive relative to government-only funding schemes.

Figure 2. Boundary conditions for VC-only, joint, and government-only financing in terms of features of VC market.



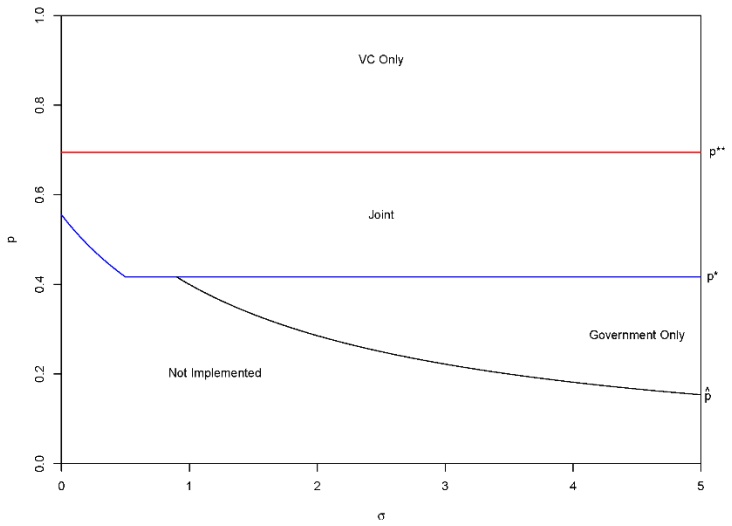
Panel A: Boundary conditions in (δ, p) space.



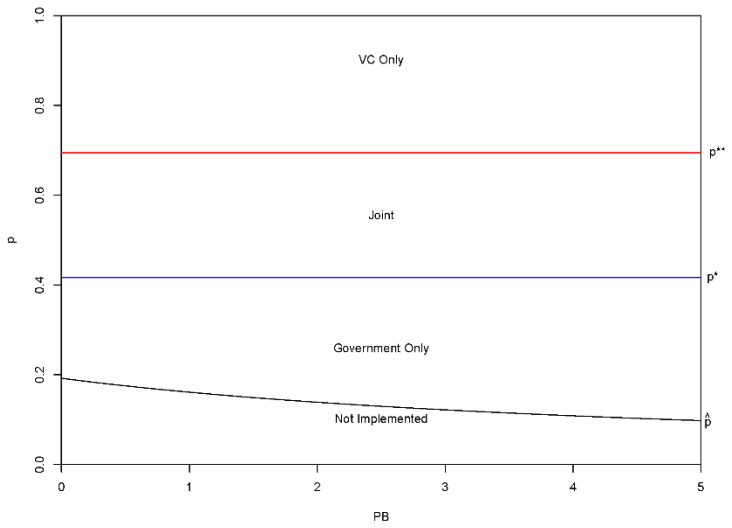
Panel B: Boundary conditions in (γ, p) space.

Notes: Panels A and B provide a numerical illustration of the model across the project space characterized by (δ, p) and (γ, p), respectively, where δ is VC effectiveness, γ is VC search costs, and p is the project success probability. Both panels assume parameter values of σ=4 (social externality), R=1.2 (private returns), b=0.4 (internal funds of entrepreneur), and PB=0 (government private benefits). Panel A assumes γ=1 (VC search costs), while Panel B assumes δ=0.15 (VC effectiveness). Panel A demonstrates that as the effectiveness of private investors δ increases, co-investment funding becomes weakly more likely relative to government-only funding programs. Panel B demonstrates that as the cost of search γ for VC funding increases, co-investment funding becomes weakly less likely relative to government-only funding programs.

Figure 3. Boundary conditions for VC-only, joint, and government-only financing in terms of government private benefit.



Panel A: Boundary conditions in (σ, p) space, with increased PB.



Panel B: Boundary conditions in (PB, p) space.

Notes: Panel A provides a numerical illustration of the model across the project space characterized by (σ, p), where σ is the project externality and p is the success probability. Panel A assumes parameter values of β=1.2 (increase in success probability from VC), R=1.2 (private returns), b=0.4 (internal funds of entrepreneur), and PB=0.3 (government private benefits). Panel B provides an illustration of the model across the project space characterized by (PB, p), where PB is the government private benefit. Panel B assumes parameter values of β=1.2 (increase in success probability from VC), R=1.2 (private returns), b=0.4 (internal funds of entrepreneur), and σ=4 (social externality). The figures show that government-only investment increases with private benefit extraction.

Figure 4. The count of distinct entrepreneurial finance policies active between 1995 and 2019 inclusive by nation.

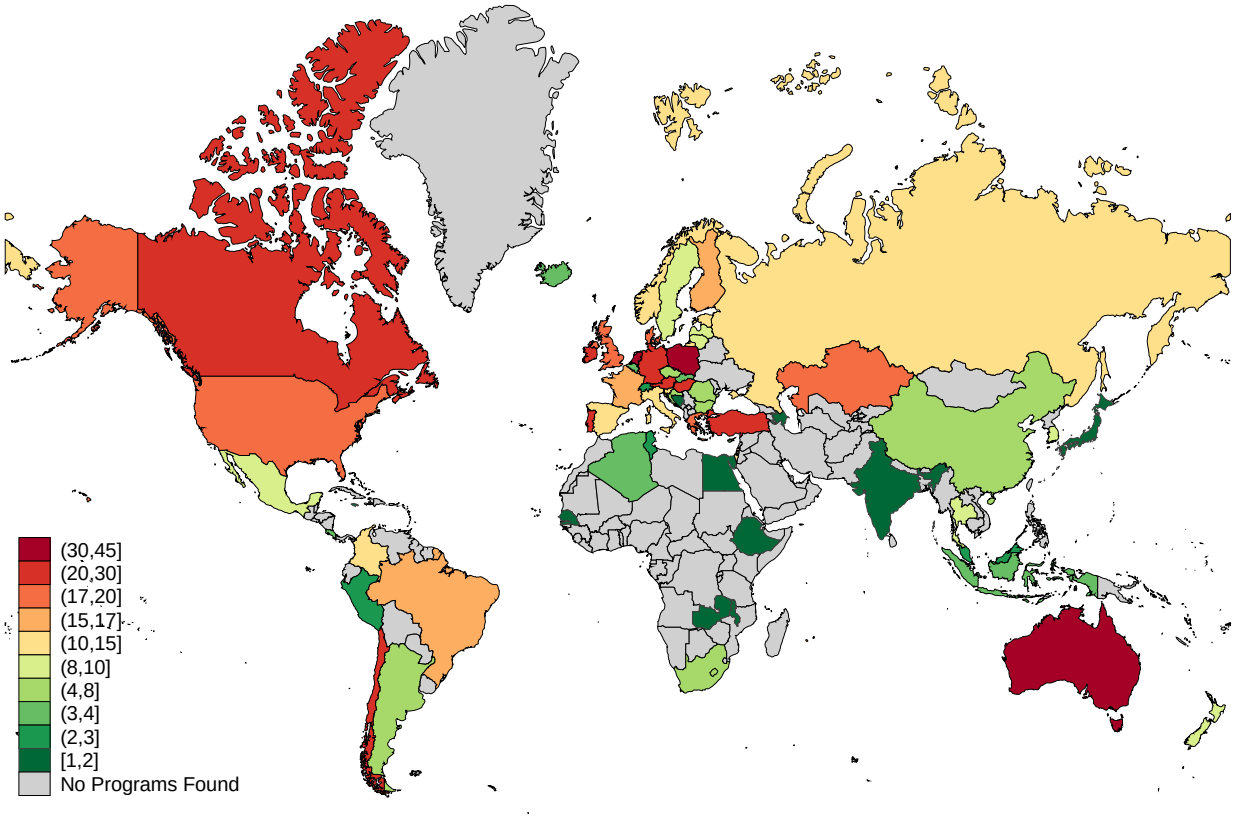


Figure 5. Average of annual budget (in billions of U.S. dollars) of entrepreneurial finance policies active between 1995 and 2019 inclusive by nation.

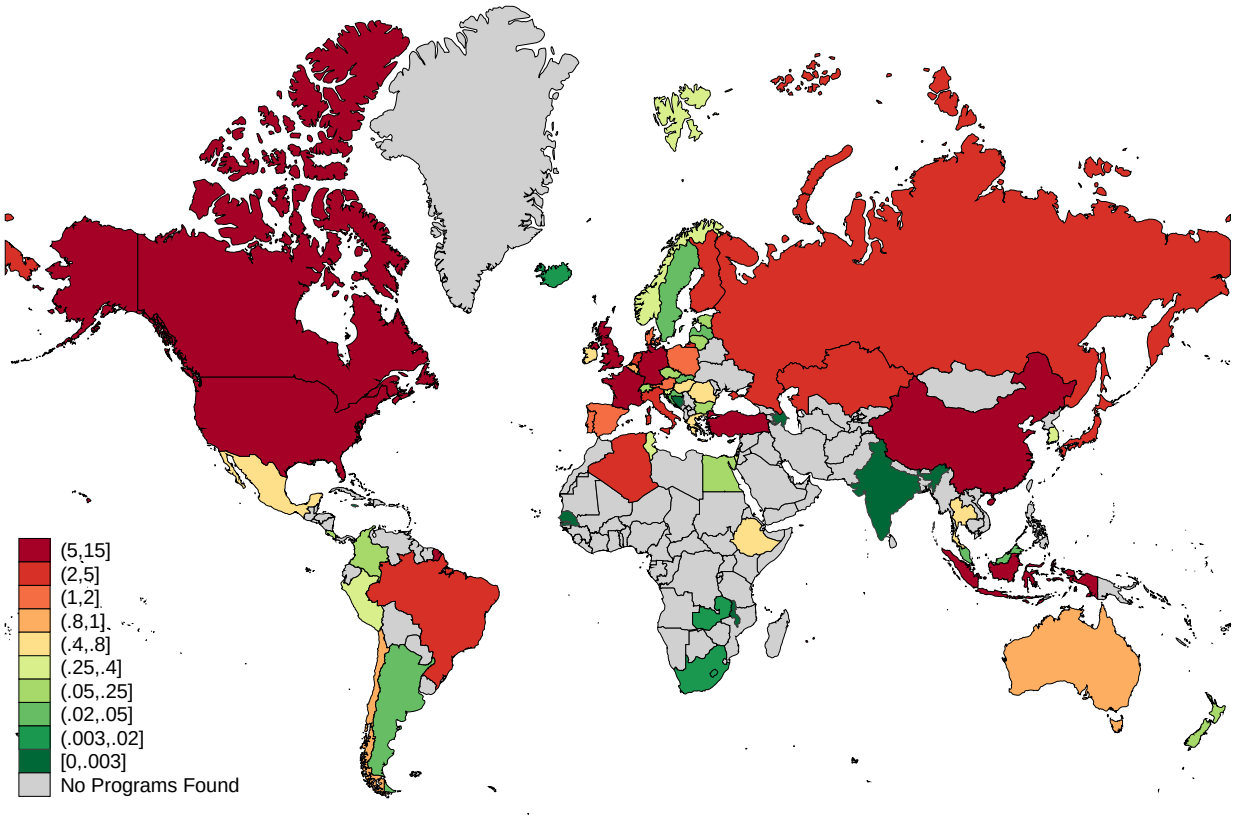


Figure 6. Average of annual budget/GDP (in percent) of entrepreneurial finance policies active between 1995 and 2019 inclusive by nation.

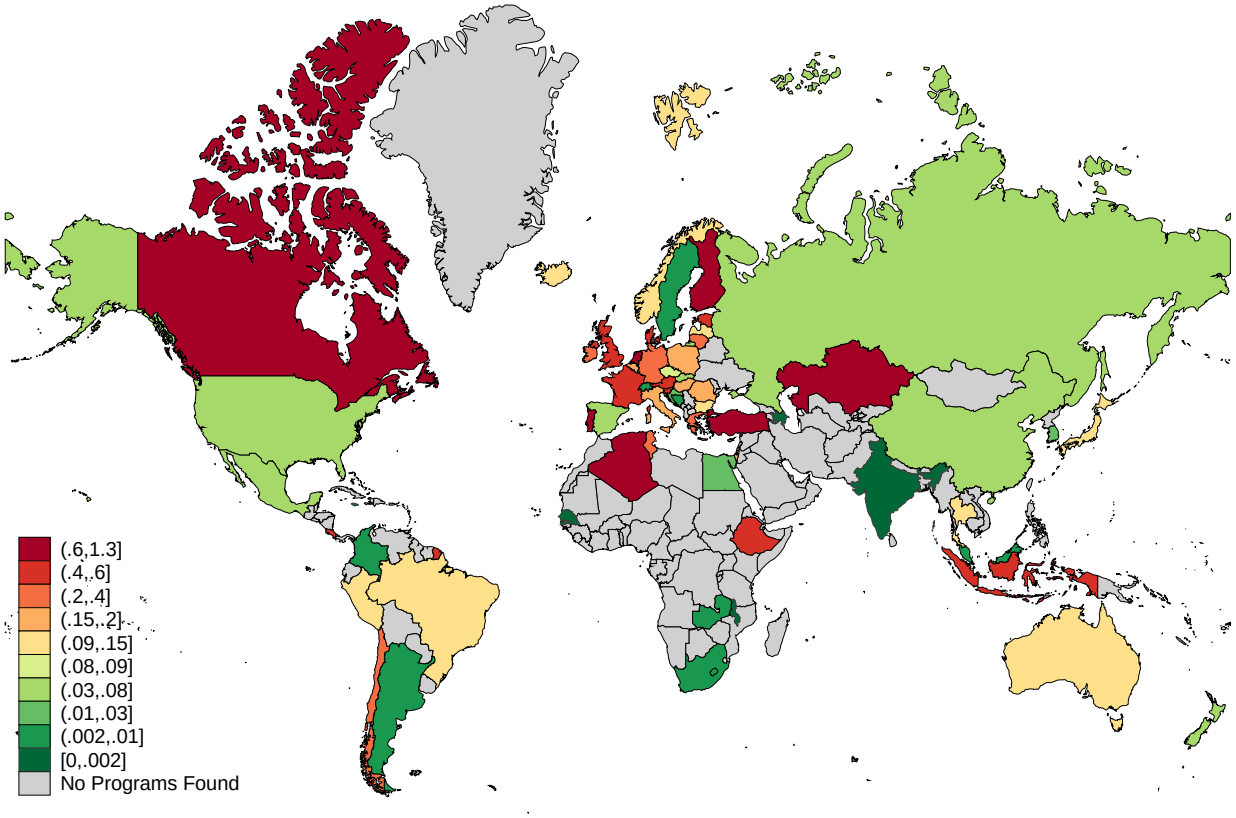


Figure 7. Average length (in years) of entrepreneurial finance policies active between 1995 and 2019 inclusive by nation.

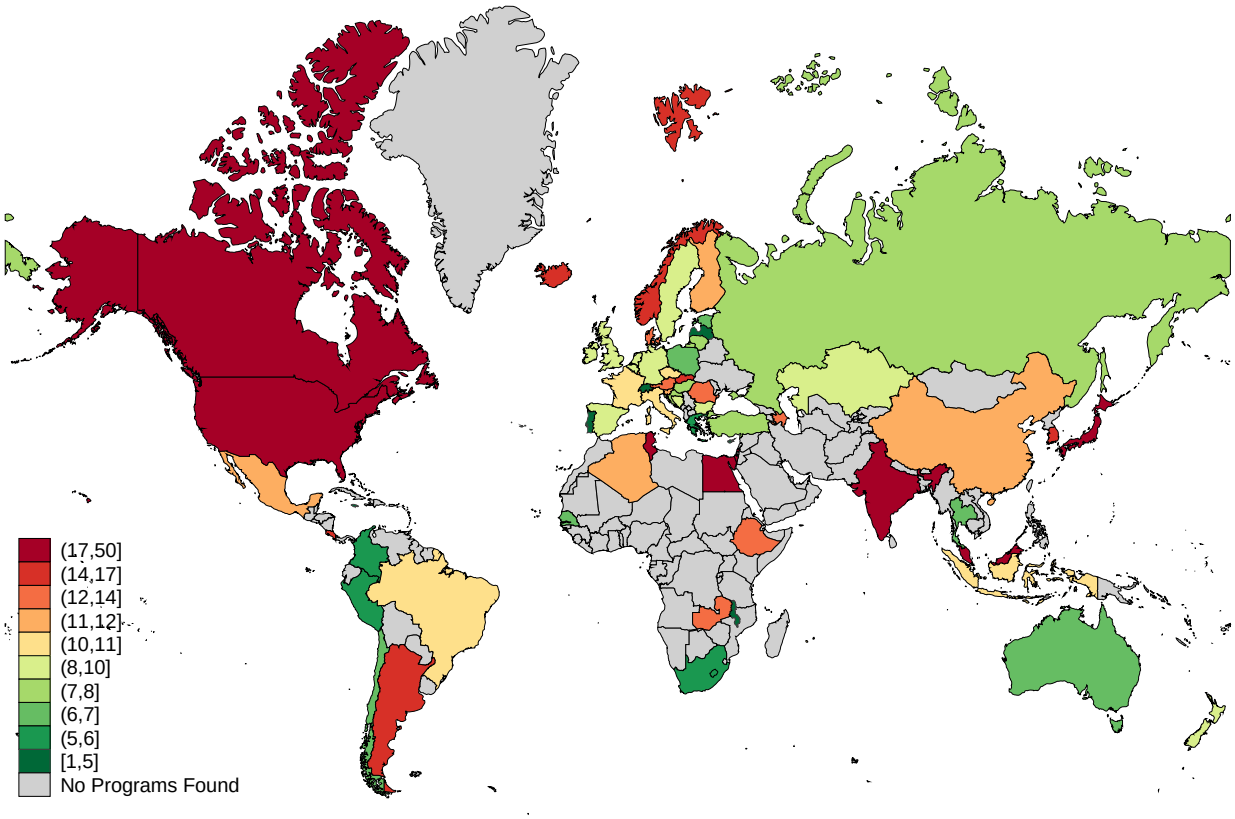


Figure 8. The figure indicates the aggregate spending on all active programs by year between 1995 to 2019.

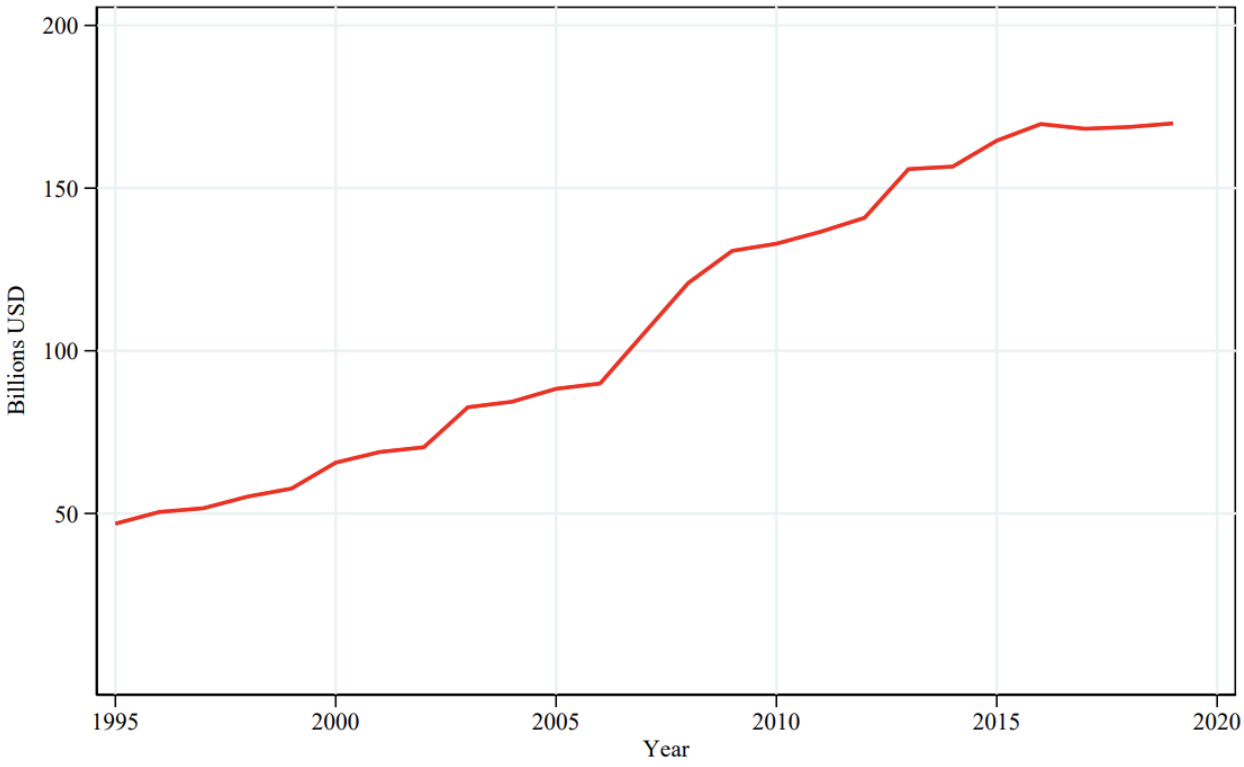
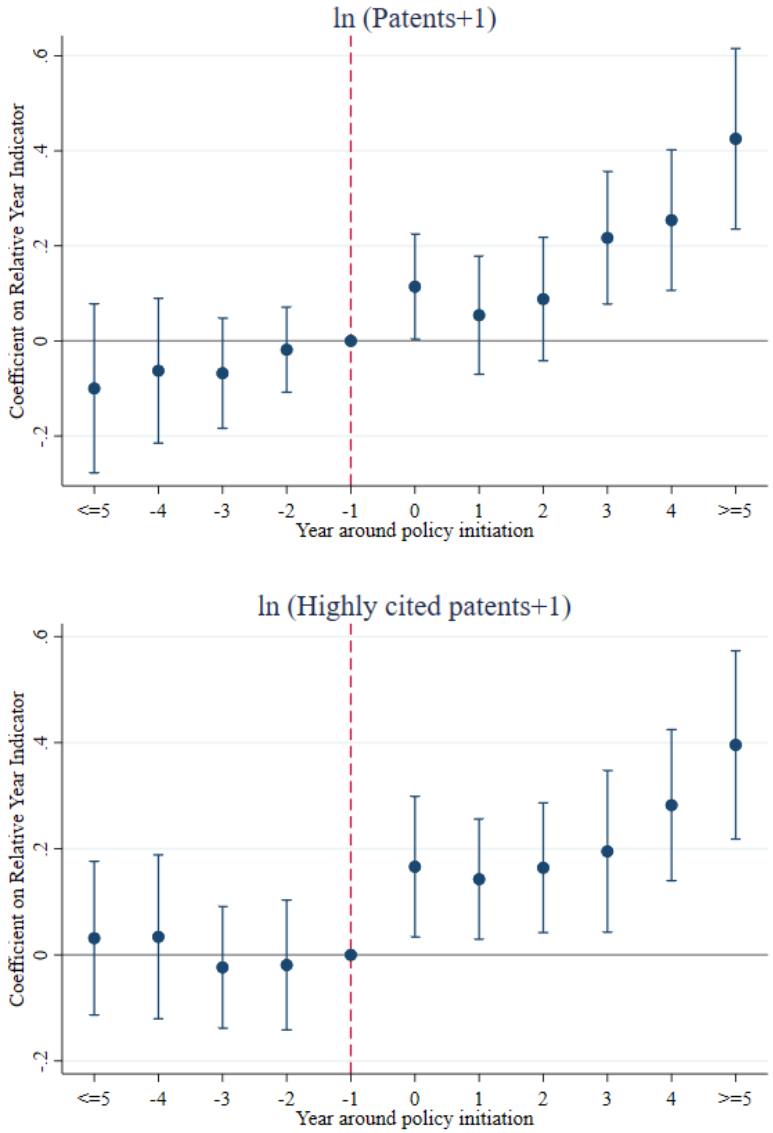
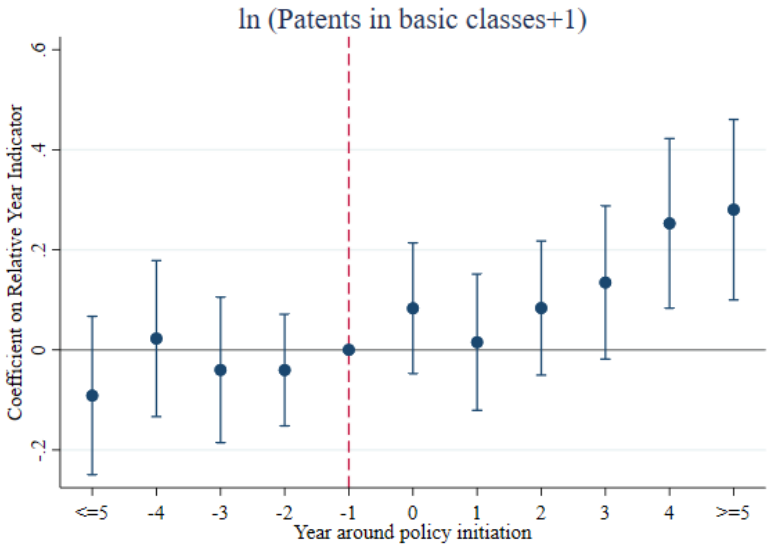


Figure 9. New venture policy introduction and innovation outcomes. The figure shows the coefficients on the relative year indicators from the following specification:

$$Y_{it} = \alpha_i + \alpha_t + \delta \cdot 1\{t \leq Year_{init} - 5\} + \sum_{j=-4}^{j=4} \beta_j 1\{t = Year_{init} + j\} + \theta \cdot 1\{t \geq Year_{init} + 5\} + \gamma X_{it} + \epsilon_{it}$$

which includes country and year fixed effects as well as country-year specific controls, specifically ln(Population), ln(Per capita GDP), and ln(Lagged venture capital activity). The construction of the patent outcome variables is described in the Section 2.3 of the text. All patent variables are log transformed. $Year_{init}$ is the year of the first introduction of an entrepreneurial finance program observed in the sample period of 1990-2019 by country *i*. The vertical line is positioned at the year prior to program initiation. Standard errors are clustered at the country level. 95% confidence intervals are shown.




ln (Patents in basic classes+1)
Coefficient on Relative Year Indicator
-.2
0
.2
.4
.6
<=5
-4
-3
-2
-1
0
1
2
3
4
>=5
Year around policy initiation

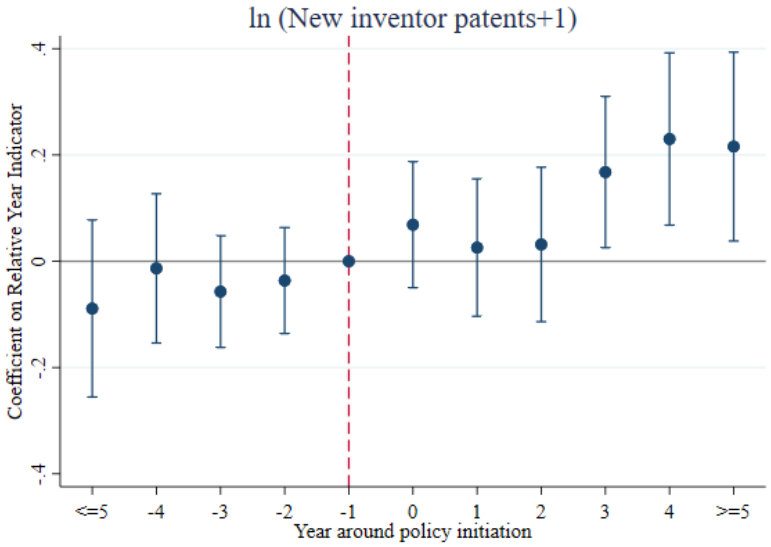

ln (New inventor patents+1)
Coefficient on Relative Year Indicator
-.4
-.2
0
.2
.4
<=5
-4
-3
-2
-1
0
1
2
3
4
>=5
Year around policy initiation

Table 1. Distribution of the budget and number of government entrepreneurial finance policies active between 1995 and 2019. Observations are at the country-year level. The table presents the sum of distinct policies active in this period, the count of years in which individual programs are active, and the annual national budgets, as well as measures of the distribution of these variables (total program as a share of GDP and policy age through time of termination or (in the case of still-active programs) in 2019). Distribution measures are computed only for the 66 nations with at least one active policy between 1995 and 2019.

	Sum	N	Mean	P10	Median	P90
Total Policy Count	755	66	11.4	1	9	23
Total Policy-Years	7,368	66	111.6	17	83.5	234
Average of Annual Budget (USD Billions)	122.10	66	1.85	0.002	0.34	8.54
Average of Annual Budget/GDP (%)		66	0.227	0.001	0.106	0.662
Average length of policies (years)		66	11.2	5	10.08	18

Table 2. Characteristics of programs initiated, 1995-2019.

	Share of	
	Program counts	Budget-weighted programs
Panel A: Program type		
Debt		
Credit Guarantee	5.12%	11.59%
Loan	10.23%	22.90%
Mezzanine	1.75%	7.98%
Equity		
Business Angel	5.41%	1.89%
Equity	18.27%	6.87%
Grant		
Grant	43.86%	16.02%
Innovation voucher	5.85%	0.39%
Tax Credits	9.50%	32.37%
Panel B: Private sector involvement		
Role on Investment Committee	34.69%	21.22%
Funding Intermediaries	7.02%	12.58%
Matching Fund Requirement	43.63%	26.91%
Panel C: Industry Targeting		
Included industries		
Healthcare	10.67%	8.00%
Technologies	15.94%	11.89%
Industrials	8.19%	5.28%
Sustainability	9.21%	7.31%
Sin	0.15%	0.01%
Agriculture	5.99%	11.04%
Extractive	1.90%	0.33%
Financial	0.58%	0.31%
Excluded industries		
Healthcare	10.38%	7.37%
Technologies	7.02%	3.87%
Industrials	12.72%	7.40%
Sustainability	11.99%	8.04%
Sin	17.69%	11.13%
Agriculture	19.15%	9.54%
Extractive	16.96%	11.03%
Financial	18.57%	11.77%

Panel D: Stage and Alternative Objectives		
Stage focus		
Early-Stage/Seed	81.87%	92.84%
Venture	47.60%	71.96%
Growth	20.76%	40.40%
Additional stated objectives		
Diversity	0.90%	0.06%
Meeting government needs	0.20%	0.08%
Other goals	1.51%	0.52%

Table 3. The determinants of private sector participation in public entrepreneurial finance programs. The observations are public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. The dependent variable is policy that has any private sector involvement: i.e., that has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The independent variables include measure of the effectiveness of government and the rule of law in the year of the policy introduction, the natural logarithm of population and per capita GDP, and country and program initiation year fixed effects.

	(1)	(2)	(3)	(4)
Government effectiveness	0.128***	0.149***		
	(0.044)	(0.054)		
Rule of law score			0.135***	0.156***
			(0.037)	(0.047)
ln (Population in prior year)	-0.015	-0.008	-0.010	-0.002
	(0.022)	(0.020)	(0.022)	(0.021)
ln (GDP in prior year)	0.037	0.007	0.012	-0.024
	(0.044)	(0.059)	(0.042)	(0.059)
Constant	0.290*	0.538*	0.360**	0.609**
	(0.152)	(0.270)	(0.150)	(0.272)
Adjusted R^2	0.052	0.054	0.060	0.063
Std. beta	18.524	21.509	23.000	26.597
Country FE	YES	YES	YES	YES
Program Initiation Year FE		YES		YES
Observations	637	637	637	637

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4. The determinants of private sector participation in public entrepreneurial finance programs. The observations are public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. The dependent variable is policy that has any private sector involvement: i.e., that has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries The independent variables include whether the program has an early-stage focus, the natural logarithm of population and per capita GDP, and country and program initiation year fixed effects.

	(1)	(2)
Early-stage focus	0.080**	0.086**
	(0.034)	(0.034)
ln (Population in prior year)	-0.026	-0.020
	(0.021)	(0.020)
ln (GDP in prior year)	0.104***	0.129***
	(0.031)	(0.038)
Constant	0.192	0.035
	(0.146)	(0.254)
Adjusted R^2	0.036	0.039
Std. beta	7.978	13.848
Country FE	YES	YES
Program Initiation Year FE		YES
Observations	684	684

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Panel analysis of the determinants of private sector participation in public entrepreneurial finance programs. Observations are annual ones of each country in the sample between 1995 and 2019. The dependent variable is number of policies active in that year in a given nation that any private sector involvement: i.e., that has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The independent variables include the natural logarithm of (one plus) lagged venture capital investment, the natural logarithm of population and per capita GDP, and country and year fixed effects.

	(1)	(2)
ln (VC investments in prior year)	0.306***	0.250***
	(0.0652)	(0.0568)
ln (Population)	-0.0298	-1.765**
	(0.244)	(0.779)
ln (Per capita GDP)	0.528***	-0.158*
	(0.168)	(0.0865)
Constant	-0.630*	2.633***
	(0.372)	(0.978)
Adjusted R^2	0.634	0.672
Std. beta	86.47	70.63
Country FE	YES	YES
Year FE		YES
Observations	5112	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6. Panel analyses of industry-targeted new venture policies that have private sector participation. Observations are annual observations of each country-industry pair in the sample between 1995 and 2019. The dependent variable is whether a policy that has a private sector involvement targeting that industry is active in that nation and year: i.e., that has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The independent variables include the natural logarithm of venture capital investment in the country and industry in the year prior to the observation, the natural logarithm of population and per capita GDP, and country, year, and industry fixed effects.

	(1)	(2)	(3)
ln (VC investments in prior year in industry-nation)	0.036***	0.035***	0.033***
	(0.009)	(0.009)	(0.009)
ln (Population)	0.009	0.009	-0.074**
	(0.010)	(0.010)	(0.032)
ln (Per capita GDP)	0.022***	0.023***	-0.010**
	(0.008)	(0.008)	(0.005)
Constant	-0.040**	-0.018	0.135***
	(0.018)	(0.020)	(0.043)
Adjusted R^2	0.208	0.220	0.232
Std. beta	134.379	128.845	123.566
Country FE	YES	YES	YES
Industry FE		YES	YES
Year FE			YES
Observations	40896	40896	40896

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7. A decomposition analysis of the determinants of private sector participation in public entrepreneurial finance programs. Panel A explores the quality of the government, Panel B examines programs with an early-stage focus and Panel C looks at volume of VC activity. The panels have similar structures to Table 3, 4 and 5 respectively. In Panels A and B, the observations are of public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. In Panel C, the observations are annual ones of each country in the sample between 1995 and 2019. The dependent variables are whether the policy has a matching fund requirement, financed financial intermediaries, or involved the private sector in the investment decision-making process (or the count of such policies, in Panel C). The independent variables include measure of the effectiveness of government and the rule of law in the year of the policy introduction in Panel A, whether the program has early-stage focus in Panel B, and the natural logarithm of (one plus) lagged venture capital investment in Panel C. Additional independent variables for the natural logarithm of population and per capita GDP, as well as country and year fixed effects, are included in all the three panels. When a program is assigned to more than one dependent variable, we assign it randomly to one of these.

Panel A. Quality of the government.

	(1) Matching Fund	(2) Matching Fund	(3) Fin. Intermediary	(4) Fin. Intermediary	(5) Invt. Decision-making	(6) Invt. Decision-making
Government effectiveness	0.135***		-0.032		0.046**	
	(0.051)		(0.026)		(0.020)	
Rule of law score		0.125***		-0.016		0.046**
		(0.043)		(0.018)		(0.018)
ln (Population in prior year)	-0.014	-0.009	-0.011	-0.011	0.017	0.018
	(0.019)	(0.020)	(0.007)	(0.007)	(0.011)	(0.011)
ln (GDP in prior year)	-0.009	-0.018	0.006	-0.008	0.010	0.002
	(0.056)	(0.054)	(0.037)	(0.032)	(0.016)	(0.015)
Constant	0.374	0.409	0.315	0.333	-0.151*	-0.133*
	(0.253)	(0.266)	(0.218)	(0.223)	(0.080)	(0.076)
Adjusted R^2	0.043	0.046	0.031	0.028	0.025	0.029
Std. beta	24.455	26.825	-42.597	-24.898	76.569	91.312
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	637	637	637	637	637	637

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel B. Programs with an early-stage focus.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
Early-stage focus	0.080**	-0.021	0.028
	(0.039)	(0.018)	(0.017)
ln (Population in prior year)	-0.019	-0.015**	0.014
	(0.018)	(0.007)	(0.010)
ln (GDP in prior year)	0.125***	-0.041*	0.046**
	(0.034)	(0.022)	(0.019)
Constant	-0.202	0.410**	-0.172**
	(0.175)	(0.172)	(0.070)
Adjusted R^2	0.046	0.058	0.016
Std. beta	10.026	-17.921	32.466
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	684	684	684

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel C. Volume of VC activity.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
ln (VC investments in prior year)	0.204***	0.0125	0.0337**
	(0.0452)	(0.00989)	(0.0141)
ln (Population)	-1.286**	-0.287*	-0.192*
	(0.566)	(0.150)	(0.105)
ln (Per capita GDP)	-0.124*	0.00184	-0.0352*
	(0.0653)	(0.0165)	(0.0199)
Constant	1.868***	0.451**	0.314**
	(0.710)	(0.184)	(0.139)
Adjusted R^2	0.621	0.828	0.529
Std. beta	86.37	14.45	147.3
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	5112	5112	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8. A decomposition analysis of the determinants of private sector participation in public entrepreneurial finance programs. Panel A explores the quality of the government, Panel B examines programs with an early-stage focus, and Panel C looks at the volume of VC activity. The panels have similar structure to Table 3, 4 and 5 respectively. In Panel A and B, the observations are public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. In Panel C, the observations are annual ones of each country in the sample between 1995 and 2019. The regressions look separately at equity, grant, or debt policies. The dependent variables are whether the policy has private sector involvement: i.e., that has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries (or the count of such policies, in Panel C). The independent variables include measures of the effectiveness of government and the rule of law in the year of the policy introduction in Panel A, whether the program has an early-stage focus in Panel B, and the natural logarithm of (one plus) lagged venture capital investment in Panel C. Additional independent variables for the natural logarithm of population and per capita GDP, as well as country and year fixed effects, are included in all the three panels.

Panel A. Quality of the government.

	(1) Equity	(2) Equity	(3) Grant	(4) Grant	(5) Debt	(6) Debt
Government effectiveness	0.086***		0.088		-0.024	
	(0.025)		(0.055)		(0.030)	
Rule of law score		0.086***		0.074		-0.004
		(0.022)		(0.046)		(0.022)
ln (Population in prior year)	0.000	0.004	-0.006	-0.004	-0.002	-0.001
	(0.011)	(0.011)	(0.019)	(0.020)	(0.009)	(0.009)
ln (GDP in prior year)	-0.020	-0.033	-0.033	-0.031	0.061	0.040
	(0.033)	(0.033)	(0.056)	(0.054)	(0.038)	(0.034)
Constant	0.184	0.218	-0.007	0.002	0.361	0.389
	(0.251)	(0.254)	(0.170)	(0.166)	(0.241)	(0.246)
Adjusted R^2	0.032	0.037	0.044	0.045	0.041	0.039
Std. beta	50.548	59.841	22.072	22.111	-19.407	-3.957
Country FE	YES	YES	YES	YES	YES	YES
Program Initiation Year FE	YES	YES	YES	YES	YES	YES
Observations	637	637	637	637	637	637

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel B. Programs with an early-stage focus.

	(1) Equity	(2) Grant	(3) Debt
Early-stage focus	0.203***	-0.122**	0.004
	(0.027)	(0.047)	(0.020)
ln (Population in prior year)	-0.001	-0.013	-0.007
	(0.010)	(0.018)	(0.009)
ln (GDP in prior year)	0.045**	0.075**	0.009
	(0.021)	(0.037)	(0.025)
Constant	-0.222***	0.017	0.240
	(0.081)	(0.181)	(0.191)
Adjusted R^2	0.121	0.058	0.044
Std. beta	83.717	-21.456	2.275
Country FE	YES	YES	YES
Program Initiation Year FE	YES	YES	YES
Observations	684	684	684

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel C. Volume of VC activity.

	(1) Equity	(2) Grant	(3) Debt
ln (VC investments in prior year)	0.0696***	0.138***	0.0419**
	(0.0220)	(0.0291)	(0.0179)
ln (Population)	-0.439**	-0.878**	-0.448**
	(0.214)	(0.394)	(0.211)
ln (Per capita GDP)	-0.0514	-0.0705*	-0.0357
	(0.0325)	(0.0414)	(0.0267)
Constant	0.640**	1.257**	0.735***
	(0.275)	(0.489)	(0.265)
Adjusted R^2	0.612	0.568	0.817
Std. beta	89.99	91.68	33.40
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	5112	5112	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9. New venture policies and innovation outcomes. This table reports the coefficients from the following specification:

$$Y_{it} = \alpha_i + \alpha_t + \beta POST_{it} + \gamma X_{it} + \epsilon_{it}$$

where $POST_{it}$ is a dummy variable equal to one the year of nation *i's* first program initiation, and every year thereafter. The specification includes country and year fixed effects as well as country-year specific controls X_{it}, specifically ln(Population), ln(Per capita GDP), and ln(Lagged venture capital activity). The construction of the patent outcome variables is described in the Data section of the text. All outcome variables are log transformed.

	(1) Patents	(2) Highly cited	(3) Basic class	(4) New inventor
Post Policy	0.344***	0.276***	0.244***	0.212**
	(0.0946)	(0.0734)	(0.0749)	(0.0823)
ln (Population)	0.186	0.0869	0.166	0.292*
	(0.179)	(0.0722)	(0.104)	(0.165)
ln (Per capita GDP)	0.0902*	0.0404	0.0445	0.0835*
	(0.0509)	(0.0270)	(0.0282)	(0.0440)
ln (VC investments in prior year)	0.0609**	0.0528**	0.0550***	0.0208
	(0.0253)	(0.0229)	(0.0189)	(0.0230)
Constant	1.137***	0.454***	0.639***	0.689**
	(0.301)	(0.140)	(0.166)	(0.270)
Observations	5,928	5,928	5,928	5,928
R-squared	0.958	0.941	0.948	0.948
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Internet Appendix

Appendix 1: Comparing Public and Private Entrepreneurial Finance Activity

Compiling data on traditional venture investment globally is difficult, due to the limited reporting. Probably the best regarded set of estimates over the past decade are compiled by Crunchbase, Crunchbase compiles the total amount of capital into venture-backed firms, and exclude "private equity rounds in non-venture-backed startups, undisclosed funding rounds, secondary market transactions, post-IPO transactions, debt financings, grants, non-equity assistance, initial coin offerings, and … investments in companies not part of the technology ecosystem" (https://news.crunchbase.com/methodology/). Their compilation does include investments into venture-backed firms by investors who are not venture capitalists, such as corporations and sovereign wealth funds.

It should be acknowledged that this methodology is likely to lead to some double counting. The Crunchbase funding includes equity invested directly by governments into companies already backed by venture capitalists (including by international organizations not included in our analysis, such as the International Finance Corporation and European Investment Fund). Some of the capital of the venture groups will come from governments acting as limited partners as well.

The analysis focuses on the period from 1995 to 2019. The choice of the start date is associated data availability, as discussed in the body of the paper. It should also be noted that the level of public funding doubtless increased sharply in 2020, as many tens of billions of dollars allocated to support entrepreneurial firms and venture funds across major industrialized nations in the months after the onset of the COVID-19 crisis.[16]

[16] See, for example, https://www.cnbc.com/2020/04/02/coronavirus-europe-races-to-rescue-tech-startups.html; https://betakit.com/bdc-launches-matching-investment-program-for-canadian-vc-backed-companies/; https://www.scribd.com/document/455681169/Letter-to-the-Chancellor; and https://www.businessinsider.com/uk-future-fund-government-loans-startups-coronavirus-2020-4.

Appendix 2: Model Details

This section provides further detail on the conceptual framework described in Section 2 of the main text. We consider a stylized depiction of the collaboration between public and private funds in financing heterogeneous projects based on the work of Lach, Neeman, and Schankerman (2021). We assume that both the government and VC firms can provide capital in return for an equity stake in a project, the realization of which is dependent upon project success. This equity stake varies with both p and σ, which are exogenous characteristics of the entrepreneur's project. While VC firms offer advice, networks, and effective monitoring, they are inherently concerned with private returns and do not consider social externalities of projects when making investment decisions.

The government can either fund the projects on its own in return for an equity investment, or split the required amount of investment, $1 - b$, with private sector investors. When a project is co-financed by the government and private market, the public and private investors split the capital provided but the government accepts a disproportionately lower equity share to encourage private venture investment. Section 2.1 of the main text contains the full model set-up and assumptions.

Our simplified setting abstracts away from a number of potential frictions but facilitates a focus on how the collaboration structure shifts with basic features of the economic environment.

Model implications

Result 1. For a given space of projects characterized by (p,σ), projects will be funded in the following order:

1. The highest quality projects are funded by the private sector only, that is, projects with $p \geq p^{**}$. Moreover, p^{**} is independent of project externalities σ.

2. Projects with $p^{*} \leq p < p^{**}$ and $\sigma > 0$ are co-funded by the government and the private sector. Moreover, p^{*} is weakly decreasing with project externalities σ.

3. Projects with $\hat{p} \leq p < p^{*}$ with sufficiently high social externalities are funded by the government only. $\hat{p}$ is decreasing with project externalities σ. Projects with $p < \hat{p}$ remain unfunded.

Proof. The boundary condition for the VC-only region, which we denote p^{**}, is implied from the VC's focus on expected private returns – the private market does not invest alone in projects with negative expected value and thus only invests if $p\beta R - 1 \geq 0$. Thus $p^{**} = 1/(\beta R)$. It is evident that p^{**} is independent of project externalities and the share of VC-only projects increases with both β and R.

The total equity stake in the co-financing region is given by $\alpha_J(p) = (1 - b)/(p\beta R)$. In order to incentivize VC co-investment, the government accepts a smaller share of the outside equity stake, forgoing profit for positive-σ projects only: $\alpha_J^G(p,\sigma) = (1 - b)/[2p\beta(R + \sigma)]$. For any $\sigma > 0$, the VC

makes a positive profit as a result of the subsidized equity from the government. Since projects for which breaking even is not possible will not be supported and the equity share cannot exceed 1, a lower bound of $p^{*'} = (1 - b)/(\beta R)$ for the co-financing region is implied. For $p < p^{*'}$, the VC will never join the co-investment – even in the limiting case that the government concedes the entire equity stake, the project's prospect of success is too low and the VC refuses to participate.

The expected social welfare from a jointly financed project (p,σ) is $W^J = \beta p(R + \sigma + PB) - 1$. The level of p at which the positive expected welfare constraint binds when jointly financed by both the government and the venture capitalist is $\tilde{p}^* \equiv 1/[\beta(R + \sigma + PB)]$. Note that

$$\tilde{p}^*|_{\sigma=0} = \frac{1}{\beta(R + PB)}$$

That is, projects with no social externalities will only be jointly financed if the government can derive a nonzero private benefit. There exists $\sigma^* > 0$ such that

$$p^* = \begin{cases} \dfrac{1}{\beta(R + \sigma + PB)} \text{ for } 0 < \sigma < \sigma^* \\ \dfrac{1 - b}{\beta R} \text{ for } \sigma \geq \sigma^* \end{cases}$$

Setting $\tilde{p}^*$ equal to $p^{*'}$ and solving for σ yields

$$\sigma^* = R\left(\frac{1}{1 - b} - 1\right) - PB$$

For $\sigma < \sigma^*$, we have $\tilde{p}^* > p^{*'}$, where $p^{*'}$ is the lower bound derived from the joint break-even condition. That is, there exists a set of projects that, despite being profitable enough to satisfy a break-even condition for its outside investors, have too small of a social externality to qualify for a joint-financing arrangement from the government and the VC. The required externality for joint-financing falls as the government's private benefit increases. That is, as private benefits rise, low-externality projects that have high enough success probabilities to attract VC participation can receive co-financed support. Hence, we have

$$\frac{\partial p^*}{\partial \sigma} = \begin{cases} < 0 \text{ for } 0 < \sigma < \sigma^* \\ = 0 \text{ for } \sigma \geq \sigma^* \end{cases}$$

The government funds alone projects that are not funded by VC firms due to insufficient private returns but nevertheless add value per the social welfare condition; that is, projects that cannot induce VC participation but with attractive enough externalities. Projects for which $p < \hat{p} \equiv 1/(R + \sigma + PB)$ generate negative expected welfare as perceived by the government and do not receive any outside financing. $\hat{p}$ decreases in the expected externality of the project and private benefits to the government. Setting $\hat{p}$ equal to p^* demonstrates that the externality of the project must satisfy

$$\sigma > \hat{\sigma} \equiv R\left(\frac{\beta}{1 - b} - 1\right) - PB$$

to justify government support.

Result 2. The likelihood of co-investment shifts with features of the private venture market:

1. As the effectiveness of private investors δ increases, co-investment funding becomes weakly more likely relative to government-only funding programs.
2. As the cost of search γ for VC funding increases, co-investment funding becomes weakly less likely relative to government-only funding programs.

Proof. Define β^* as β such that $\hat{p}(\beta) = p^*(\beta)$, where $\beta = \frac{1}{\gamma} + \delta$. It follows that

$$\beta^* \equiv 1 - b + \frac{1}{R}(1-b)(\sigma + PB)$$

Government support is not justified for $\beta > \beta^*$. That is, for high enough values of VC effectiveness, VC-participating investment overtakes government-only investment. Define $\Delta_J \equiv p^{**} - p^* = \frac{b}{\beta R}$ and $\Delta_G \equiv p^* - \hat{p} = \frac{1-b}{\beta R} - \frac{1}{R+\sigma+PB}$. The following function

$$\xi \equiv \frac{\Delta_J}{\Delta_G} = \frac{b(R+\sigma+PB)}{(1-b)(R+\sigma+PB) - \left(\frac{1}{\gamma}+\delta\right)R}$$

is defined and positive for $\frac{1}{\gamma} + \delta < \beta^*$. We have that $\frac{\partial \xi}{\partial \delta} > 0$ and $\frac{\partial \xi}{\partial \gamma} < 0$.

Result 3. As governments obtain more private benefits from funding, government-only programs become more likely relative to co-investments. The marginal project receiving private benefit induced financing from the government is of lower quality.

Proof. For the region where government-only support is viable defined by $\sigma > \hat{\sigma}$, it suffices to show that $\frac{\partial \hat{p}}{\partial \mathrm{PB}} < 0$. It is clear from the expression for $\hat{p}$ that this is the case.

Appendix 3: Examples of Criteria for Selecting Projects

Policies in advanced economies focused on emerging markets

We drop policies focused specifically on emerging markets and not on the country in which they are initiated.

Examples:

- (Credit Guarantee) U.S. Development Finance Corporation
    - Description: The U.S. DFC assists in financing projects in emerging market economies. The program offers both direct equity into projects in the developing world as well as debt financing in the form of loans and loan guarantees to support investment projects in developing countries.
    - URL: https://www.dfc.gov/
    - Status: Dropped from sample

Policies supporting innovation centers

We keep policies supporting innovation centers so long as the innovation center itself offers financing activities aimed towards SMEs or entrepreneurial firms.

Examples:

- (Grant) Norway Centers for Research-Based Innovation
    - Description: The Centers for Research-Based Innovation focus on fostering collaboration between R&D-performing companies and research institutions. The Norwegian Research Council allocates an annual budget to the 24 active centers in the form of grants. The centers recruit doctoral students and encourage research output in the form of academic publications and commercial innovation. There do not appear to be any notable restrictions (other than that the business is involved in R&D) on companies that can participate. There is no emphasis on direct financing activities of the centers themselves to support SMEs or entrepreneurial firms.
    - URL: https://www.forskningsradet.no/en/about-the-research-council/programmes/sfi/
    - Status: Dropped from sample
- (Credit guarantee) Swiss Innovation Parks
    - Description: The Swiss Innovation Parks offer support initiatives ranging from building networks, providing working space, and fostering collaboration with research institutes. While the Parks assist businesses in applying for grants and funding instruments, they do not specialize in financing activities for SMEs, but rather in mentorship-style support. The Swiss government supports the Innovation Parks with loans and loan guarantees.
    - URL: https://www.parkinnovaare.ch/innovation-park
    - Status: Dropped from sample

Policies that participate in international or joint initiatives

We keep policies that participate in international or joint initiatives so long as the participation is only for funding purposes and the policy itself is a national government policy financing SMEs or entrepreneurial firms.

Examples:

- (Grant) Norway BIA Competition Arena
    - Description: The BIA program provides funding for research-based innovation projects across Norwegian industries. The program contributes to EUROSTARS, a joint initiative of EUREKA and the European Commission to strengthen research performance in SMEs. As a result, the BIA benefits from EUROSTARS and project financing is shared by the Norwegian Research Council and the EU. However, the policy provides support for Norwegian businesses only.
    - URL: https://www.forskningsradet.no/om-forskningsradet/programmer/bia/
    - Status: Kept in sample

Policies for special economic zones

We keep policies that are special economic zones so long as the zone emphasizes financing activities aimed towards SMEs or entrepreneurial firms that fit the relevant policy type. There are few zones that meet these criteria, however.

Examples:

- (Grant) Thailand Eastern Economic Corridor of Innovation
    - Description: The Thai government aims to turn eastern provinces into a leading economic zone. Planned investment projects in the EEC include developing transportation infrastructure, promoting tourism, and developing business hubs. The Corridor of Innovation would involve establishing science parks to foster R&D. Overall, the emphasis of the policy is not on financing policies for SMEs but on creating a hub for innovation.
    - URL with information: https://www.aseanbriefing.com/news/thailand-eastern-economic-corridor/
    - Status: Dropped from sample
- (R&D tax credit) Russia Special Economic Zones for Technological Innovation
    - Description: Russian companies in any of the 26 Special Economic Zones can enjoy reduced profit and property tax rates. While a subset of the Zones are aimed at encouraging innovation activity and businesses in these Zones are allowed tax benefits, the reductions are for all profits and not specifically for R&D activities.
    - URL with information: https://www2.deloitte.com/content/dam/Deloitte/ru/Documents/tax/Tax_incentives_in_Russia.pdf
    - Status: Dropped from sample

Policies with subprograms

Some policies have many subprograms that are labelled separately by the government. These can become quite complex, though they generally fall into one of three categories. We address policies in each category as follows:

- Umbrella policies that encompass a number of clearly distinct programs with different types of financing. In this case, we split the policy up into its defined subprograms.
    - Example: The Danish Growth Fund (https://vf.dk/)
        - The Danish Growth Fund offers financing in the form of equity, loans, and matching for business angel investments, where these are clearly presented as separate programs, each with detailed criteria and structure:
        - Loans for Entrepreneurs (https://vf.dk/en/financing/loans-for-entrepreneurs/), Business Angel Matching Fund (https://vf.dk/en/products-for-partners/eaf-denmark-business-angel-matching-fund/), VF Venture (https://vfventure.com/da/)
        - Thus, we code each program separately in each sheet
- Policies with subprograms that have the same structures but with minor differences (e.g. each subprogram is separated by industry): we classify these together and aggregate any budget information for the individual subprograms. Moreover, we only include programs with an explicit provision geared towards SMEs, entrepreneurs, venture capitalists, or angels. If the program only funds innovation by firms or universities in general, we do not include it.
    - Example: (Grant) Innovate UK Funding Competitions (https://apply-for-innovation-funding.service.gov.uk/competition/search)
        - Description: The Biotechnology and Biological Sciences Research Council (BBSRC) and Innovate UK jointly fund a number of competitions to support collaboration between academia and businesses with the aim of developing innovative technologies and processes. The rules of the individual competitions vary, with some being geared to SMEs, some to all businesses, and others to any institution (including non-profit and academic)
        - We code any programs that fit our criteria together (which in this case, turns out to be only the Biomedical Catalyst Competition) and exclude the other competitions
- Policies where there is a clear primary financing type (e.g., equity programs with a small loan piece attached or loan programs that mention a guarantee). In these cases, we classify and code the policy where the primary financing is
    - Example: (Loan) U.S. Small Business Investment Company (https://www.sba.gov/partners/sbics)
        - SBICs use their own capital, together with funds borrowed with an SBA guarantee, to make investments in small businesses. Since the guarantee is not a distinct credit guarantee scheme or guarantee fund, however, we include this policy in loans but do not additionally code it as a credit guarantee

Appendix 4: Definitions of the Entrepreneurial Finance Policy Variables

	Variable	Description	Value
1	Policy ID	Unique ID assigned to each program.	ID
2	Policy Country	Country implementing the program.	Country
3	Agency Name	Name of the government agency implementing the program.	Name
4	Policy Name	Name of the policy.	Name
5	Policy Type	Form of financing to the program's targeted companies.	Credit Guarantee, Loan, Grant, Equity, Mezzanine, Angel Investment, R&D Tax Credit, Innovation Voucher
6	Website	Website of the policy (if available).	Website
7	Drop	We focus on national government policies that aim to finance SMEs or entrepreneurial firms. Policies with a regional, transnational, or municipal reach, as well as non-financing policies (such as policies that provide mentorship services only) are dropped. If a policy does not satisfy these criteria, we mark it as "drop" and provide the reason.	Drop; non-finance, regional, non-SME/Ent targeted, non-government
8	Start Year	The year the program is initiated. If the policy existed in multiple phases, we use the earliest year.	Year
9	End Year	The year the program ended. We code a "not ended" if the program has not ended, or a future year if the program states the expected year of completion.	Year; not ended

10	Screener	The level of private sector involvement in screening the application. Indicates whether the screening entity is fully public, fully private (i.e., government outsources to private board), or public-private (i.e., committee comprised of representatives from both private and public parties).	Public, private, public-private
11	Due Diligence	The level of private sector involvement in the appraisal of an application or investment.	Public, private, public-private
12	Investment Committee	The level of private sector involvement in the final investment or application decision.	Public, private, public-private
13	Disbursed Budget	Disbursed program budget.	Amount
14	Allocated or Appropriated Budget	Allocated or appropriated program budget if actual disbursement is not available.	Amount
15	Min Budget	If the available budget information is a range only, report the lower end of the range; otherwise NA.	Amount
16	Max Budget	If the available budget information is a range only, report the upper end of the range; otherwise NA.	Amount
17	Years Budget	The years associated with the allocated budget, disbursed budget, or min/max budget.	Year
18	Currency	The currency in which the program's monetary amounts are quoted from the available sources. All monetary amounts are ultimately converted to inflation-adjusted U.S. dollars.	Currency
19	Budget USD	Annual budget flow of the program in U.S. dollars. Average of the most recent three years of the program, if possible. For policies for which this information is not available, we use the average of the two most recent years or, failing that, the most	Amount in USD

		recent year. If available budget information is a cumulative amount over a longer period, we take the annual average.	
20	Max Budget per Project	The program's maximum possible disbursement of funds per company or project, if available.	Amount
21	Objective	The purpose of the program as stated by the government agency. Most objectives within a program type have similar goals, e.g. to facilitate access to financing for small businesses, or similarly to boost exports, competitiveness, or job growth. Programs that have less common objectives, such as those that service specific government needs, or those aimed at entrepreneur diversity, are additionally flagged (see below).	Text
22	Objective - Diversity	An indicator for whether the program's goal is to boost diversity. Coded as partial (0.5) if this is one of multiple goals or full (1) if diversity is the primary or sole goal.	0/0.5/1
23	Objective - Government Need	An indicator for whether the program's goal is to meet the government's direct need. A program's objective is not included under Government Need or Non-Traditional unless there is an explicit alternative goal; programs solely focused on an industry from which there may be positive social spillovers (e.g., cleantech) are not counted. Coded as partial (0.5) if one of multiple goals or full (1) if primary goal.	0/0.5/1
24	Objective - Non-Traditional	An indicator equal to 1 if the program goal is neither diversity nor a direct government need, but also not traditional. Coded as partial (0.5) if one of multiple goals or full (1) if primary goal.	0/0.5/1

25	Intermediary	An indicator for whether the program involves a non-governmental intermediary. This includes loan guarantees to banks, funds of funds, loans to PE groups, and subsidies to non-government owned venture capitalists or incubators. Takes a value of 0 if the program involves government funds to companies as direct investments or co-investments, or if the government (or government-owned corporation) operates a VC fund or incubator that directly funds companies. Takes a value of 0.5 if the program has elements of both direct and intermediated investments.	0/0.5/1
26	Matched	An indicator equal to 1 if the program involves a co-investment with the private sector or contains an explicit matching requirement. Takes a value of 0 if the program involves a direct investment or loan to companies with no matching requirement. Requirements on minimum levels of net worth or employee numbers are not counted as matching requirements.	0/1
27	Targeted Sectors	Sectors that are explicitly targeted by the program, if applicable.	Healthcare, technology, industrials, extractive, agriculture, sustainability, sin, financial
28	Excluded Sectors	Sectors that are explicitly excluded from the program, if applicable.	Healthcare, technology, industrials, extractive, agriculture, sustainability, sin, financial
29	Targeted Stage	Targeted stage of the program's investment.	Seed, venture, growth

30	Sources	List of sources containing program information. For cases where the primary website and its sub-pages have all the information, only the main page is listed.	Link

Appendix 5: Definitions of Country-Level Variables

Variable	Units	Level	Description	Source
GDP	USD billions	Country-Year	The total of all economic activity in one country, regardless of who owns the productive assets.	Primarily Economist Intelligence Unit. Supplemented with data from the CIA Factbook, UN Data, and the government website of the respective country.
Population	Millions	Country-Year	Total population of a country	Primarily Economist Intelligence Unit. Supplemented with data from the CIA Factbook, UN Data, and the government website of the respective country
Patent applications	Count	Country-Year	The total number of patent applications filed annually by the country of residence of the applicant.	World Intellectual Property Organization's Intellectual Property Statistics Database
VC funding	USD Millions	Country-Year	Venture capital investment in a country by both domestic and foreign VC firms across all industries. Excludes Buyout, Fund of Funds, Generalist Private Equity, Mezzanine, Other Investor (Non-Private Equity), Other Private Equity, and Real Estate investments	National and regional associations & SDC Platinum's VentureXpert
VC funding by industry	USD Millions	Country-Year-Industry	Venture capital investment in a country by both domestic and foreign VC firms across eight industries based on 4-digit sic industry classification. The eight industry categories are: 1. Healthcare: Life sciences, Bio-, Medical, Pharma 2. Manufacturing: Aerospace, Defense, Machinery, Industrial, Transport, Aviation 3. Extractive: Mining, Energy 4. Agriculture: Agriculture, Forestry, Fishing, Agri-food, Aqua-culture, Agri-business 5. Technology: Electronics, Software, AI, IT, TMT, Blockchain, Digital tech 6. Financial, insurance, and real estate industries 7. Sin: Gambling, Betting 8. Sustainability: Sustainable tech, Climate, Environment, Clean energy, Renewables, Clean-tech Note that we exclude Buyout, Fund of Funds, Generalist Private Equity, Mezzanine, Other Investor (Non-Private Equity), Other Private Equity, and Real Estate investments	SDC Platinum's VentureXpert
Government effectiveness and rule of law indices	Index	Country-Year	Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, Rule of law captures perceptions of the extent	World Bank's Worldwide Governance Indicators 2019

			to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The data are composite governance indicators based on over 30 underlying data sources. The six aggregate indicators are reported in two ways: (1) in their standard normal units, ranging from approximately -2.5 to 2.5 , with higher values corresponding to better outcomes.	
Ease of doing business and enforcing contracts	Index	Country-Year	The ease of doing business score helps assess the absolute level of regulatory performance over time. It captures the gap of each economy from the best regulatory performance observed on each of the indicators across all economies in the Doing Business sample since 2005. The enforcing contracts indicator measures the time and cost for resolving a commercial dispute through a local first-instance court, and the quality of judicial processes index, evaluating whether each economy has adopted a series of good practices that promote quality and efficiency in the court system. The scores run from 0 to 100, where 0 represents the lowest and 100 represents the best performance.	World Bank's Doing Business 2020
EIU overall business environment rating	Rating	Country-Year	The business rating model measures the quality or attractiveness of the business environment. The ratings run from 1 to 10, 1 being low and 10 being high. The rating examines ten separate criteria or categories, covering the political environment, the macroeconomic environment, market opportunities, policy towards free enterprise and competition, policy towards foreign investment, foreign trade and exchange controls, taxes, financing, the labor market, and infrastructure.	Economist Intelligence Unit

Appendix 6: Details on Construction of the U.S. Patent Dataset

To implement the methodology, we identify all U.S. utility patents awarded between 1976 and 2019 that are both in Clarivate's Derwent Innovation and PatentsView databases. While there are other classes of patents, such as design and plant awards, utility patents represent about 90% of the awards and are typically the focus of economic analyses.

We explain first why we use both databases. It should be noted that approximately 25 thousand patents are in Derwent and not in PatentsView. These appear to overwhelmingly be "withdrawn patents," and not included in many other patent compilations either, such as Google Patents.[17] (In addition, a small number of non-withdrawn patents may be missing from PatentsView because they are apparently omitted from the bulk files provided by the USPTO, as discussed at https://community.patentsview.org/forum/8/topic/127.)

We extract from PatentsView the name and nationality of each inventor and the patent class. (In general, the PatentsView data regarding assignee location is considerably cleaner than that of Derwent, which has much missing or miscoded information.) We assign patents to countries based on the location of the inventor denoted in the patent. In cases of where nations no longer exist, we use the successor countries, such as assigning patents from the German Democrat Republic to the Federal Republic of Germany. We use the WIPO mapping schemas at https://www.wipo.int/export/sites/www/pct/guide/en/gdvol1/annexes/annexk/ax_k.pdf to help identify these shifts. In 1944 of the 7.4 million patent-assignee pairs, the assignee nations are missing from PatentsView or assigned an abbreviation unassociated with the current or former codes used by WIPO. These cases are not included in the analysis.

Also using the USPTO's PatentsView database, we also identify the primary four-digit patent class associated with the patent using the Combined Patent Classification scheme, which the U.S. adopted in 2013 (henceforth referred to as CPC class). For patents awarded prior to 2013, we again use the CPC class, as determined by the USPTO concordance between the new and earlier (U.S. Patent Classification) scheme. We also use PatentsView to identify all citations to these patents, as of the end of September 2020.

We access from Derwent the patent number, application and award date, and assignee name. We want to identify new patentees, whether public or privately held, and thus compilations such as the NBER Patent Database and the UVA Darden Global Corporate Patent Dataset (both of which focus on publicly traded firms) are insufficient. We instead use Derwent's standardized version of the assignee names at issue. This standardized version of the name is applied by Derwent editors and seeks to ensure that names are applied consistently.

[17] These patent numbers are listed at https://www.uspto.gov/web/offices/ac/ido/oeip/taf/data/misc/data_cd.doc/custom_extract_dvd/BASIC_BIB_15/DOC/WITHDRAWN_63_15_PN.TXT. Allowed U.S. patent applications may be withdrawn prior to issue by either the applicant or the USPTO. Common reasons for withdrawal requests include the discovery of new prior art, an error in the application or an interference. The procedures are described in detail here: https://www.uspto.gov/web/offices/pac/mpep/s1308.html#sect1308.

Derwent data, like PatentsView, sometimes appends the inventors' names to the list of assignees, even when they are not assigned the patent (see the discussion of this issue in Lerner et al. 2021). So we focus on the identity of the first-listed assignee to minimize this issue. We define awards to "new" inventors in a given year as those filed to Derwent-cleansed first assignees that do not have an award (a) granted between 1976 and the year of the observation and (b) filed before the end of the fifth calendar year prior to the year of the observation.

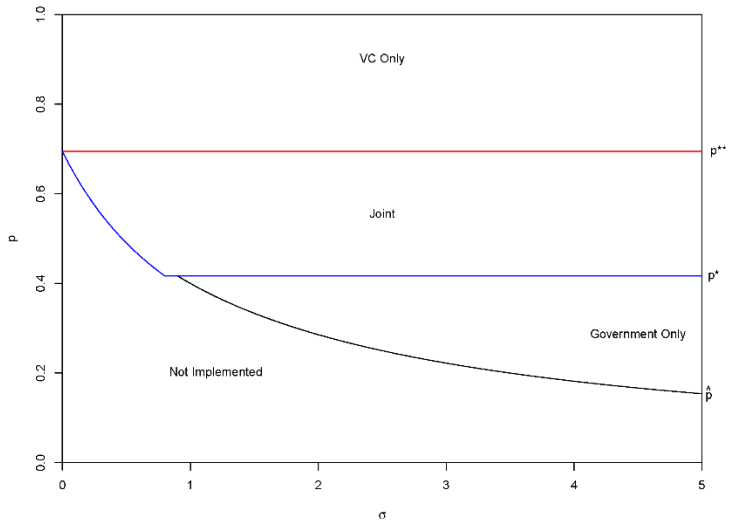
We determine academic citations in patents using Marx and Fuego (2019).

References Not Cited in the Paper:

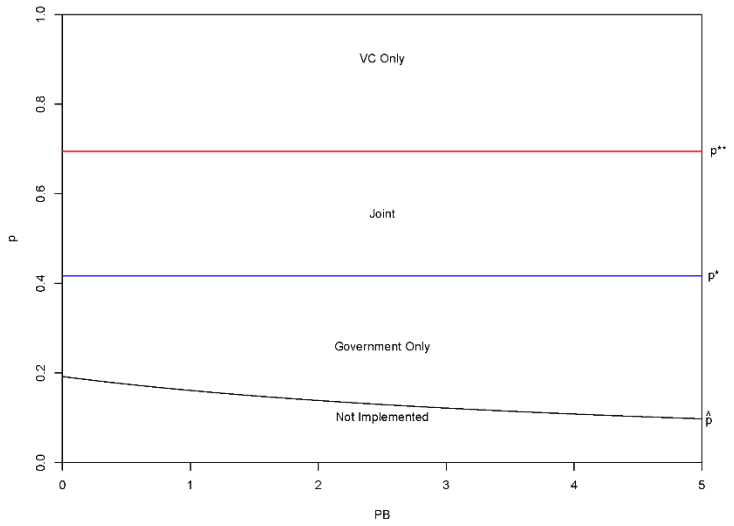
Josh Lerner, Amit Seru, Nicholas Short, and Yuan Sun, "Financial innovation in the 21st century: Evidence from U.S. patents," Working Paper no. 28980, National Bureau of Economic Research (2021).

Matt Marx and Aaron Fuego, "Reliance on science: Worldwide front-page patent citations to scientific articles." Research Paper no. 3331686, Boston University Questrom School of Business (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3331686.

Figure A-1. Boundary conditions for VC-only, joint, and government-only financing in terms of government private benefit.



Panel A: Boundary conditions in (σ, p) space, with increased PB.



Panel B: Boundary conditions in (PB, p) space.

Notes: This figure illustrates an alternative case in which governments can only extract private benefits from non-collaborative investments. Panel A provides a numerical illustration of the model across the project space characterized by (σ, p), where σ is the project externality and p is the success probability. Panel A assumes parameter values of β=1.2 (increase in success probability from VC), R=1.2 (private returns), b=0.4 (internal funds of entrepreneur), and PB=0.3 (government private benefits). Panel B provides an illustration of the model across the project space characterized by (PB, p), where PB is the government private benefit. Panel B assumes parameter values of β=1.2 (increase in success probability from VC), R=1.2 (private returns), b=0.4 (internal funds of entrepreneur), and σ=4 (social externality). The figures show that government-only investment increases with private benefit extraction.

Table A-1. Key summary statistics of sources that are used to identify policies.

Panel A: Year of publication of the academic papers or the reports.

Year of publication	Count of sources	Percent
1998	1	0.5%
1999	1	0.5%
2001	1	0.5%
2003	2	1.1%
2004	1	0.5%
2005	3	1.6%
2006	2	1.1%
2007	11	5.8%
2008	5	2.6%
2010	20	10.5%
2011	8	4.2%
2012	6	3.2%
2013	25	13.2%
2014	17	8.9%
2015	15	7.9%
2016	12	6.3%
2017	41	21.6%
2018	13	6.8%
2019	6	3.2%
Total	190	100.0%

Panel B: Year of publication of the academic paper or the report in five-year buckets.

Year of publication	Count of sources	Percent
1995-1999	2	1.1%
2000-2004	4	2.1%
2005-2009	21	11.1%
2010-2014	76	40.0%
2015-2019	87	45.8%
Total	190	100.0%

Panel C: Publisher of the report. If it is an academic paper.

Publisher of the Report	Count of sources	Percent
Organisation for Economic Cooperation and Development	139	73.2%
Academic papers	21	11.1%
European Union	5	2.6%
World Bank	3	1.6%
MTI	2	1.1%
United Nations	2	1.1%
African Development Bank Group and OECD	1	0.5%
Capgemini Consulting	1	0.5%
ERIA	1	0.5%
European Civil Society Platform	1	0.5%
European Investment Bank	1	0.5%
Finnish Ministry of Trade and Industry	1	0.5%
Foster Care Work Group	1	0.5%
Government of the United Kingdom	1	0.5%
Inter-American Development Bank	1	0.5%
International Monetary Fund	1	0.5%
Institut zur Zukunft der Arbeit	1	0.5%
Institute for Public Policy Research	1	0.5%
Manpower Group	1	0.5%
Migration Policy Institute	1	0.5%
Price Waterhouse Coopers	1	0.5%
Swedish Entrepreneurship Forum	1	0.5%
The Finance Project	1	0.5%
World Economic Forum	1	0.5%
Total	190	100.0%

Panel D: Type of source.

Type of source	Count of sources	Percent
Country-level reports	127	66.8%
Cross-national reports	42	22.1%
Academic	21	11.1%
Total	190	100.0%

Panel E: Country of focus for the reports. Note the count here is 140 (this includes 127 reports by country type and 13 academic papers with a country focus).

Country of focus (if any)	Count of sources	Percent
United States	11	7.9%
Italy	10	7.1%
Mexico	10	7.1%
Poland	9	6.4%
Canada	8	5.7%
Germany	8	5.7%
Russia	8	5.7%
Indonesia	7	5.0%
Hungary	6	4.3%
Israel	5	3.6%
Netherlands	5	3.6%
United Kingdom	5	3.6%
Portugal	4	2.9%
Thailand	4	2.9%
Bulgaria	3	2.1%
Denmark	3	2.1%
Ireland	3	2.1%
Kazakhstan	3	2.1%
Spain	3	2.1%
Sweden	3	2.1%
Belgium	2	1.4%
Chile	2	1.4%
China	2	1.4%
Finland	2	1.4%
Greece	2	1.4%
Slovenia	2	1.4%
Austria	1	0.7%
Czech Republic	1	0.7%
Estonia	1	0.7%
France	1	0.7%
Libya	1	0.7%
Malaysia	1	0.7%
Nigeria	1	0.7%
Slovak Republic	1	0.7%
Switzerland	1	0.7%
Tunisia	1	0.7%
Total	140	100.0%

Table A-2. Construction of the final sample of programs. This table describes the specifics of the construction of the final sample of programs that are active between 1995-2019. We identify public entrepreneurial finance programs from 190 sources published between 1998 and 2020, summarized in Table A-1. We keep programs implemented at the national level only, dropping policies with a solely local or regional focus within a country, as well as programs implemented by international bodies such as the European Union, unless the international body is involved for funding purposes only. Similarly, we drop policies focused specifically on other markets and not on the country in which they are initiated, such as programs initiated by wealthy nations to promote entrepreneurship in emerging economies. We exclude any policies that provide non-financing support only, such as training, mentoring, or similar activities, as well any programs without a focus on SMEs or entrepreneurial firms. Listed programs that are either duplicates of other programs or umbrella designations that encompass multiple programs already included in the sample are dropped as well. We exclude programs for which no details on program design or implementation can be found, as well as any programs started in 2020 or with designated future start years.

	Equity		Debt		Grant		Total	
	Dropped	Remaining	Dropped	Remaining	Dropped	Remaining	Dropped	Remaining
Starting Sample	--	351	--	315	--	660	--	1326
Regional	63	288	33	282	39	621	135	1191
International	36	252	8	274	24	597	68	1123
Non-Financing	2	250	15	259	28	569	45	1078
Non-SME/Ent targeted	12	238	25	234	67	502	104	974
Non-Government	24	214	10	224	0	502	34	940
Duplicate or Subprogram	13	201	48	176	45	457	106	834
Insufficient Information	10	191	15	161	5	452	30	804
Not Active during 1995-2019	17	174	8	153	22	430	47	757
No Country Data	0	174	2	151	0	430	2	755
Final Sample							--	**755**

Table A-3. Construction of venture capital activity by nation and year. This table describes the specifics of the construction of the sample of venture capital activity from Refinitiv VentureXpert used in the analysis, which is used in conjunction with the data from national and regional venture capital associations., Columns (1) and (2) characterize the number of deal-investor pairs, while Column (3) reports the number of associated deals.

	(1)	(2)	(3)
	Deal-Investor Pairs		Associated
	Dropped	Remaining	Deals
Starting Sample		741,650	342,832
Missing investment	99,117	642,533	
Zero investment	13	642,520	
Buyouts	85,824	556,696	
Fund of Funds	5,816	550,880	
Generalist Private Equity	46,375	504,505	
Mezzanine	3,516	500,989	
Other Investor (Non-Private Equity)	2,509	498,480	
Real Estate	2,206	496,274	
Final Sample (VC)		496,274	204,446

Table A-4. The determinants of private sector participation in public entrepreneurial finance programs. The observations are public entrepreneurial finance programs introduced between 1995 and 2019 akin to Table 3. The dependent variable is policy that has any private sector involvement, i.e., has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The dependent variable is weighted by the annual budget of the program. The independent variables include measure of the effectiveness of government and rule of law in the year of the policy introduction, natural logarithm of population and per capita GDP, and country and year fixed effects.

	(1)	(2)	(3)	(4)
Government effectiveness	0.204*	-0.036		
	(0.115)	(0.081)		
Rule of law score			0.220*	0.064
			(0.127)	(0.051)
ln (Population in prior year)	0.112**	0.096**	0.120**	0.104**
	(0.048)	(0.045)	(0.051)	(0.049)
ln (GDP in prior year)	-0.005	0.301*	-0.050	0.187**
	(0.093)	(0.155)	(0.123)	(0.091)
Constant	-0.289	1.346	-0.165	1.519
	(0.250)	(1.061)	(0.303)	(1.118)
Adjusted R^2	0.013	0.061	0.017	0.062
Std. beta	67.577	-11.928	86.137	24.983
Country FE	YES	YES	YES	YES
Year FE		YES		YES
Observations	637	637	637	637

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-5. The determinants and decomposition of private sector participation in public entrepreneurial finance programs using alternative measure of government quality. The independent variable uses EIUs business environment ratings as a proxy for quality of the government. The panels have similar structures to Table 3, Panel A of Table 7, and Panel A of Table 8 respectively. The observations are public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. In Panel A and C, the dependent variable is policy that has *any* private sector involvement: i.e., that has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. In Panel B, the dependent variable is *whether* the policy has a matching fund requirement, financed financial intermediaries, or involved the private sector in the investment decision-making process. Additionally, in Panel B, when a program is assigned to more than one dependent variable, we assign it randomly to one of these. The independent variables include EIU overall business environment rating in the year of the policy introduction, natural logarithm of population and per capita GDP, and country and year fixed effects.

Panel A. Determinants of private sector participation.

	(1)	(2)
EIU overall business environment rating	0.073**	0.074*
	(0.030)	(0.040)
ln (Population in prior year)	-0.031	-0.023
	(0.020)	(0.020)
ln (GDP in prior year)	0.050	0.074
	(0.052)	(0.077)
Constant	-0.096	-0.380
	(0.207)	(0.296)
Adjusted R^2	0.046	0.046
Std. beta	14.643	14.851
Country FE	YES	YES
Year FE		YES
Observations	582	582

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel B. Decomposition analysis of the determinants of private sector participation by the type of engagement in the program of the private investors.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
EIU overall business environment rating	0.097***	-0.040**	0.016
	(0.034)	(0.019)	(0.013)
ln (Population in prior year)	-0.036**	-0.014	0.027*
	(0.017)	(0.009)	(0.014)
ln (GDP in prior year)	-0.011	0.027	0.057**
	(0.063)	(0.042)	(0.023)
Constant	-0.427*	0.394**	-0.347**

	(0.234)	(0.164)	(0.137)
Adjusted R^2	0.055	0.036	0.023
Std. beta	24.716	-70.661	38.708
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	582	582	582

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel C. Decomposition analysis of the determinants of private sector participation by the security type the public sector uses.

	(1) Equity	(2) Grant	(3) Debt
EIU overall business environment rating	0.037*	0.083**	-0.047**
	(0.019)	(0.031)	(0.021)
ln (Population in prior year)	-0.007	-0.022	0.006
	(0.011)	(0.022)	(0.013)
ln (GDP in prior year)	0.046	-0.088	0.116**
	(0.036)	(0.070)	(0.049)
Constant	-0.375***	-0.151	0.146
	(0.120)	(0.272)	(0.187)
Adjusted R^2	0.049	0.034	0.054
Std. beta	31.001	29.659	-50.799
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	582	582	582

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-6. The determinants of private sector participation in public entrepreneurial finance programs. The observations are public entrepreneurial finance programs introduced between 1995 and 2019 akin to Table 4. The dependent variable is policy that has any private sector involvement, i.e., has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The dependent variable is weighted by the annual budget of the program. The independent variables include whether the program has an early-stage focus, natural logarithm of population and per capita GDP, and country and year fixed effects.

	(1)	(2)
Early-stage focus	0.097	0.052
	(0.137)	(0.126)
ln (Population in prior year)	0.098**	0.098**
	(0.042)	(0.044)
ln (GDP in prior year)	0.140**	0.240***
	(0.055)	(0.086)
Constant	-0.567**	-0.903**
	(0.263)	(0.349)
Adjusted R^2	0.009	0.056
Std. beta	22.531	86.137
Country FE	YES	YES
Year FE		YES
Observations	684	684

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-7. Panel analysis of private sector participation in public entrepreneurial finance with volume of venture capital activity. Observations are annual ones of each country in the sample between 1995 and 2019 akin to Table 5. The dependent variable is number of policies active in that year in a given nation that any private sector involvement, i.e., has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The dependent variable is weighted by the annual budget of the program. The independent variables include the natural logarithm of (one plus) lagged venture capital investment, natural logarithm of population and per capita GDP, as well as country and year fixed effects.

	(1)	(2)	(3)	(4)
ln (VC investments in prior year)	0.245**	0.229**	0.202**	0.201**
	(0.109)	(0.105)	(0.0955)	(0.0949)
ln (Population)	-0.00747	-0.145	-1.001*	-1.145*
	(0.0813)	(0.165)	(0.602)	(0.625)
ln (Per capita GDP)		0.207**		-0.195
		(0.0888)		(0.121)
Constant	0.417***	0.210	1.559**	2.036**
	(0.115)	(0.213)	(0.695)	(0.798)
Adjusted R^2	0.852	0.852	0.855	0.856
Std. beta	76.62	71.57	63.03	62.83
Country FE	YES	YES	YES	YES
Year FE			YES	YES
Observations	5125	5112	5125	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-8. Panel analysis of private sector participation in public entrepreneurial finance with the volume of venture capital activity. Observations are annual ones of each country in the sample between 1995 and 2019 akin to Table 5. The dependent variable is number of policies active in that year in a given nation that any private sector involvement, i.e., has a matching fund requirement, the involvement of the private sector in the investment decision-making process, or financed financial intermediaries. The independent variables include the natural logarithm of (one plus) lagged venture capital investment, (one plus) government expenditures as a fraction of GDP (multiplied by 100), population, and per capita GDP, as well as country and year fixed effects.

	(1)	(2)	(3)	(4)
ln (VC investments in prior year)	0.274***	0.252***	0.218***	0.218***
	(0.0639)	(0.0606)	(0.0549)	(0.0545)
ln (Govt expenditure in prior year)	0.105***	0.0923***	0.0709***	0.0708***
	(0.0194)	(0.0190)	(0.0191)	(0.0190)
ln (Population)	0.194	-0.0502	-1.415**	-1.527**
	(0.141)	(0.203)	(0.707)	(0.689)
ln (Per capita GDP)		0.394***		-0.155*
		(0.134)		(0.0838)
Constant	-0.316	-0.689**	1.775*	2.149**
	(0.240)	(0.331)	(0.907)	(0.887)
Adjusted R^2	0.646	0.654	0.682	0.683
Std. beta	77.52	71.22	61.72	61.58
Country FE	YES	YES	YES	YES
Year FE			YES	YES
Observations	5125	5112	5125	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-9. A decomposition analysis of the determinants of private sector participation in public entrepreneurial finance programs. Panel A explores the quality of the government, Panel B examines programs with early stage focus and Panel C looks at volume of VC activity. The panels have similar structures to Table 3, 7 and 8 respectively. In Panels A and B, the observations are of public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. In Panel C, the observations are annual ones of each country in the sample between 1995 and 2019. The dependent variables are whether the policy has a matching fund requirement, financed financial intermediaries, or involved the private sector in the investment decision-making process (or the count of such policies, in Panel C). The independent variables include measures of the effectiveness of government and the rule of law in the year of the policy introduction in Panel A, whether the program has an early-stage focus in Panel B, and the natural logarithm of (one plus) lagged venture capital investment in Panel C. Additional independent variables for the natural logarithm of population and per capita GDP, as well as country and year fixed effects, are included in all the three panels. Panel B is similar to Table 7 in the text, but when a program is assigned to more than one dependent variable, we assign it on a pro-rated basis (e.g., if in two categories, a dependent variable of one-half to each).

Panel A. Quality of the government.

	(1) Matching Fund	(2) Matching Fund	(3) Fin. Intermediary	(4) Fin. Intermediary	(5) Invt. Decision-making	(6) Invt. Decision-making
Government effectiveness	0.142***		-0.037		0.044***	
	(0.052)		(0.026)		(0.016)	
Rule of law score		0.132***		-0.021		0.044***
		(0.044)		(0.018)		(0.015)
ln (Population in prior year)	-0.009	-0.004	-0.013*	-0.013**	0.013	0.015*
	(0.019)	(0.020)	(0.006)	(0.006)	(0.008)	(0.009)
ln (GDP in prior year)	-0.009	-0.018	0.008	-0.006	0.008	0.000
	(0.058)	(0.057)	(0.037)	(0.033)	(0.014)	(0.014)
Constant	0.222	0.259	0.322	0.339	-0.006	0.012
	(0.226)	(0.238)	(0.217)	(0.223)	(0.081)	(0.087)
Adjusted R^2	0.052	0.056	0.038	0.035	0.035	0.042
Std. beta	25.495	27.998	-51.859	-34.211	78.969	94.514
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Observations	637	637	637	637	637	637

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel B. Programs with an early-stage focus.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
Early-stage focus	0.072*	-0.019	0.034**
	(0.039)	(0.018)	(0.013)
ln (Population in prior year)	-0.014	-0.016**	0.011
	(0.018)	(0.007)	(0.008)
ln (GDP in prior year)	0.132***	-0.045**	0.042**
	(0.037)	(0.022)	(0.016)
Constant	-0.229	0.420**	-0.156**
	(0.180)	(0.172)	(0.061)
Adjusted R^2	0.052	0.067	0.027
Std. beta	8.900	-16.628	42.081
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	684	684	684

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel C. Volume of VC activity.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
ln (VC investments in prior year)	0.204***	0.0128	0.0329**
	(0.0451)	(0.00982)	(0.0137)
ln (Population)	-1.287**	-0.286*	-0.192*
	(0.563)	(0.150)	(0.106)
ln (Per capita GDP)	-0.129*	0.00171	-0.0304
	(0.0661)	(0.0163)	(0.0190)
Constant	1.873***	0.458**	0.302**
	(0.707)	(0.183)	(0.138)
Adjusted R^2	0.613	0.854	0.621
Std. beta	87.73	14.38	155.6
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	5112	5112	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-10. A decomposition analysis of the determinants of private sector participation in public entrepreneurial finance programs. Panel A explores the quality of the government, Panel B examines programs with early stage focus, and Panel C looks at volume of VC activity. The panels have similar structures to Table 3, 4 and 5 respectively. In Panels A and B, the observations are of public entrepreneurial finance programs introduced between 1995 and 2019 with the requisite data. In Panel C, the observations are annual ones of each country in the sample between 1995 and 2019. The dependent variables are whether the policy has a matching fund requirement, financed financial intermediaries, or involved the private sector in the investment decision-making process (or the count of such policies, in Panel C). The independent variables include measure of the effectiveness of government and the rule of law in the year of the policy introduction in Panel A, whether the program has an early-stage focus in Panel B, and the natural logarithm of (one plus) lagged venture capital investment in Panel C. Additional independent variables for the natural logarithm of population and per capita GDP, as well as country and year fixed effects, are included in all the three panels. The table is similar to Table 7 in the text, but when a program is assigned to more than one dependent variables, we assign a dependent variable of one to each category.

Panel A. Quality of the government.

	(1) Matching Fund	(2) Matching Fund	(3) Fin. Intermediary	(4) Fin. Intermediary	(5) Invt. Decision-making	(6) Invt. Decision-making
Government effectiveness	0.172***		-0.029		0.070***	
	(0.048)		(0.026)		(0.023)	
Rule of law score		0.161***		-0.012		0.071***
		(0.042)		(0.019)		(0.022)
ln (Population in prior year)	0.003	0.009	-0.010	-0.009	0.023*	0.026*
	(0.019)	(0.020)	(0.007)	(0.007)	(0.013)	(0.014)
ln (GDP in prior year)	0.003	-0.010	0.009	-0.007	0.022	0.011
	(0.057)	(0.055)	(0.036)	(0.032)	(0.023)	(0.023)
Constant	0.228	0.275	0.299	0.320	0.003	0.032
	(0.245)	(0.260)	(0.217)	(0.223)	(0.165)	(0.175)
Adjusted R^2	0.063	0.068	0.026	0.024	0.045	0.051
Std. beta	28.399	31.411	-33.364	-16.317	73.922	88.046
Country FE	YES	YES	YES	YES	YES	YES
Program Initiation Year FE	YES	YES	YES	YES	YES	YES
Observations	637	637	637	637	637	637

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel B. Programs with an early-stage focus.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
Early-stage focus	0.111***	-0.008	0.063***
	(0.035)	(0.021)	(0.023)
ln (Population in prior year)	-0.005	-0.014*	0.018
	(0.018)	(0.007)	(0.012)
ln (GDP in prior year)	0.163***	-0.039*	0.073***
	(0.036)	(0.022)	(0.027)
Constant	-0.355*	0.393**	-0.275***
	(0.183)	(0.173)	(0.102)
Adjusted R^2	0.067	0.045	0.041
Std. beta	12.711	-5.785	46.888
Country FE	YES	YES	YES
Program Initiation Year FE	YES	YES	YES
Observations	684	684	684

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Panel C. Volume of VC activity.

	(1) Matching Fund	(2) Fin. Intermediary	(3) Invt. Decision-making
ln (VC investments in prior year)	0.229***	0.0185*	0.0557**
	(0.0510)	(0.0105)	(0.0231)
ln (Population)	-1.449**	-0.318*	-0.336*
	(0.634)	(0.161)	(0.182)
ln (Per capita GDP)	-0.155**	-0.00300	-0.0548
	(0.0776)	(0.0173)	(0.0336)
Constant	2.129***	0.522***	0.536**
	(0.799)	(0.198)	(0.236)
Adjusted R^2	0.623	0.864	0.644
Std. beta	88.35	18.06	150.5
Country FE	YES	YES	YES
Year FE	YES	YES	YES
Observations	5112	5112	5112

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-11. New venture policy introduction and innovation outcomes. This table reports the coefficients from the following specification:

$$Y_{it} = \alpha_i + \alpha_t + \delta \cdot 1\{t \leq Year_{init} - 5\} + \sum_{j=-4}^{j=4} \beta_j 1\{t = Year_{init} + j\} + \theta \cdot 1\{t \geq Year_{init} + 5\} + \gamma X_{it} + \epsilon_{it}$$

The specification includes country and year fixed effects, as well as country-year specific controls X_{it}, specifically ln(Population), ln(Per capita GDP), and ln(Lagged venture capital activity). $Year_{init}$ is the year of the first introduction of an entrepreneurial finance program observed in the sample period of 1990-2019 by country *i*. This analysis corresponds to the first alternative method described in Section 7 of the text. The year prior to initiation is the omitted baseline, normalized to 0. The construction of the patent outcome variables is described in the Data section of the text. All outcome variables are log transformed.

VARIABLES	(1) All patents	(2) Highly cited	(3) Basic class	(4) New inventor
<=5	-0.1000	0.0314	-0.0913	-0.0890
	(0.0902)	(0.0734)	(0.0803)	(0.0845)
-4	-0.0627	0.0340	0.0226	-0.0134
	(0.0772)	(0.0783)	(0.0791)	(0.0712)
-3	-0.0680	-0.0236	-0.0401	-0.0572
	(0.0587)	(0.0581)	(0.0738)	(0.0533)
-2	-0.0185	-0.0191	-0.0404	-0.0364
	(0.0454)	(0.0621)	(0.0566)	(0.0506)
0	0.114**	0.166**	0.0831	0.0687
	(0.0561)	(0.0672)	(0.0663)	(0.0601)
1	0.0541	0.143**	0.0153	0.0257
	(0.0630)	(0.0575)	(0.0690)	(0.0656)
2	0.0881	0.164***	0.0836	0.0316
	(0.0659)	(0.0620)	(0.0680)	(0.0737)
3	0.217***	0.195**	0.135*	0.168**
	(0.0707)	(0.0773)	(0.0776)	(0.0722)
4	0.254***	0.282***	0.253***	0.230***
	(0.0750)	(0.0723)	(0.0860)	(0.0822)
>=5	0.425***	0.396***	0.280***	0.216**
	(0.0963)	(0.0900)	(0.0915)	(0.0901)
ln (Population)	0.243	0.126	0.202*	0.317*
	(0.185)	(0.0773)	(0.111)	(0.170)
ln (Per capita GDP)	0.0905*	0.0406	0.0444	0.0832*
	(0.0507)	(0.0271)	(0.0282)	(0.0439)
ln (VC investments in prior year)	0.0463*	0.0429*	0.0460**	0.0144
	(0.0247)	(0.0223)	(0.0184)	(0.0222)
Observations	5,928	5,928	5,928	5,928
R-squared	0.959	0.942	0.949	0.948
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-12. New venture policy introduction and innovation outcomes. This table reports the coefficients from the following specification:

$$Y_{it} = \alpha_i + \alpha_t + \delta \cdot 1\{t \leq Year_{init} - 5\} + \sum_{j=-4}^{j=4} \beta_j 1\{t = Year_{init} + j\} + \theta \cdot 1\{t \geq Year_{init} + 5\} + \gamma X_{it} + \epsilon_{it}$$

The specification includes country and year fixed effects as well as country-year specific controls X_{it}, specifically ln(Population), ln(Per capita GDP), and ln(Lagged venture capital activity). $Year_{init}$ is the initiation year of an entrepreneurial finance program, including all first initiations as well as initiations without an introduction in the five years prior, observed in the sample period of 1990-2019 by country *i*. This analysis corresponds to the second alternative method described in Section 7 of the text. The year prior to initiation is the omitted baseline, normalized to 0. The construction of the patent outcome variables is described in the Data section of the text. All outcome variables are log transformed.

VARIABLES	(1) All patents	(2) Highly cited	(3) Basic class	(4) New inventor
<=5	-0.0948	-0.0138	-0.0973	-0.0777
	(0.0835)	(0.0688)	(0.0705)	(0.0769)
-4	-0.0101	-0.0370	0.0219	0.0261
	(0.0711)	(0.0731)	(0.0601)	(0.0718)
-3	-0.0564	-0.0512	-0.0328	-0.0291
	(0.0531)	(0.0546)	(0.0617)	(0.0504)
-2	0.0169	-0.0607	-0.0383	0.00153
	(0.0427)	(0.0536)	(0.0509)	(0.0480)
0	0.0963*	0.114*	0.0662	0.0693
	(0.0511)	(0.0599)	(0.0528)	(0.0534)
1	0.0610	0.0908*	0.0294	0.0383
	(0.0503)	(0.0482)	(0.0567)	(0.0525)
2	0.106*	0.123**	0.109*	0.0748
	(0.0549)	(0.0582)	(0.0597)	(0.0595)
3	0.241***	0.192***	0.163**	0.178***
	(0.0679)	(0.0732)	(0.0679)	(0.0633)
4	0.262***	0.251***	0.221***	0.224***
	(0.0637)	(0.0711)	(0.0724)	(0.0690)
>=5	0.383***	0.312***	0.218***	0.189**
	(0.0879)	(0.0807)	(0.0719)	(0.0762)
ln (Population)	0.229	0.115	0.185*	0.306*
	(0.182)	(0.0745)	(0.108)	(0.167)
ln (Per capita GDP)	0.0918*	0.0416	0.0452	0.0840*
	(0.0509)	(0.0272)	(0.0283)	(0.0441)
ln (VC investments in prior year)	0.0506**	0.0463**	0.0504***	0.0175
	(0.0250)	(0.0225)	(0.0184)	(0.0224)
Observations	5,928	5,928	5,928	5,928
R-squared	0.959	0.942	0.949	0.948
Country FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES

Robust standard errors in parentheses; clustered at the country level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$