The Effects of Government-Sponsored Venture Capital: International Evidence

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Abstract:

This paper examines the impact of government-sponsored venture capitalists (GVCs) on the success of client enterprises. Using international company-level data, we identify a surprising non-monotonicity in the effect of GVC on the likelihood of exit via initial public offerings (IPOs) or third party acquisitions. Enterprises that receive funding from both private venture capitalists (PVCs) and GVCs outperform benchmark enterprises financed purely by private venture capitalists if only a moderate fraction of funding comes from GVCs. However, enterprises underperform if a large fraction of funding comes from GVCs. Instrumental variable regressions suggest that endogeneity in the form of unobservable selection effects cannot account for the main effects of GVC financing. The underperformance result is largely due to poorly performing investment in technology intensive enterprises.

1. INTRODUCTION

Governments around the world have taken a strong interest in entrepreneurial finance, particularly in technology-intensive areas such as information technology. This interest stems in part from the fact that some of the world's most influential enterprises, such as Microsoft, Intel, and Apple began as small entrepreneurial ventures only relatively recently. Furthermore, there are many important examples from emerging economies. Infosys, for example, was founded in India in 1981 by N. Murthy on the basis of a loan of under US$ 1,000 from his wife and is now one of the world's leading software companies with annual revenues on the order of US$ 4 billion.

In addition, rapidly growing entrepreneurial enterprises are widely thought to be important sources of innovation, employment, and productivity growth. It is therefore not surprising that many governments have taken a significant interest in the provision of financial support for the development of entrepreneurial ventures. Often this interest has taken the form of direct or indirect support for venture capital finance.[4] Across the world as a whole the overall public sector commitment to venture capital is substantial, including forgone taxes, outright subsidies, preferential regulation, and public provision of investment capital on commercial terms.

The intellectual foundations for government intervention in venture capital markets, as described in the literature review, are well-established in economics. First, innovation often generates benefits that are not fully captured by the innovator and that therefore give rise to positive externalities that might justify public support. In addition, market failure in entrepreneurial finance might arise due to informational asymmetries. Specifically, investors might not understand the characteristics of an innovation or of an innovator as well as the innovator, leading to a possible adverse selection problem. Or investors might not be able to fully monitor or legally verify the actions of the innovator, leading to an agency problem. The resulting shortfall of finance creates a gap that governments often seek to fill. However, notwithstanding the possible merits of government support for venture capital, such intervention might be subject to the usual problems often attributed to government. Such problems might include poor incentives for government managers, insufficient information to make good decisions, and subversion of legitimate economic objectives in favour of short-run political expediency.

Our main objective in this paper is to empirically assess the record of government support for venture capital. We analyse over 22,700 enterprises based in 56 countries that received

[4] Our working characterization of venture capitalists is that they are financial intermediaries that seek out and invest in high-potential entrepreneurial ventures, predominantly in high- technology sectors, and that often provide managerial assistance to enterprises that they invest in. See Sahlman (1990) for a more detailed discussion.

venture capital funding in the 2000–2008 period. A large share of these enterprises (about 48%) were based in the United States but the data set also contains substantial representation from various European and East Asian economies, along with India, Canada, Australia, Israel, Brazil and various other countries. The enterprises cover a wide range of industries but have strong representation in technology-intensive sectors.

We consider enterprise performance in two main areas. Our primary performance measure is based on whether the enterprise becomes successful. For the purposes of this paper, we consider successful enterprises to be those that either 'go public' with an initial public offering (IPO) or are acquired by a third party. These 'exit' events signal the end of the firm's life as a privately-held enterprise and allow venture capitalists and other early investors to realize possibly large returns by selling some or all of their ownership shares in the enterprise.[5] In our data about 16% of enterprises had an IPO or were acquired by a third party over the time period studied. Many enterprises went out of business and others were not yet successful enough to have an IPO or to be acquired. While not every IPO and certainly not every acquisition is a definitive indicator of strong performance, we view these exit events as the best (or indeed only) available general indicator of enterprise success.[6]

The second performance measure we consider is patent production, which we use to reflect innovation. While not every innovation is patented and not every patent leads to successful economic activity, patenting and successful innovation are highly correlated, and patents are commonly used as a measure of innovation. (See, for example, Hall, Jaffe and Trajtenberg, 2001).

These performance measures – exits and patents – are of interest in part because they reflect 'private' returns – returns to venture capitalists, other investors and entrepreneurs associated with the successful enterprise. However, these performance measures also reflect benefits to other parties such as customers, workers, and governments. These measures are a long way from being complete or ideal measures of the social benefits of government support for venture capital but they provide an important first step in assessing the role of government in this area.

We seek to assess the impact of investment from government supported venture capitalists (GVCs) on an enterprise's likelihood of successful exit and on its patent performance. In considering this impact there are two methodological points to consider. One point concerns

[5] The term "exit" refers to exit of the venture capitalist, and possibly other early investors. It does not refer to the exit of the firm itself from relevant output markets. These exit events are sometimes called liquidity events.

[6] It is in principle possible for an "exit" of this type to generate a low return but we go to some effort to purge the data of such cases. Therefore the "exit' indicator variable should be a good indicator of success. Phalippou and Gottschalg (2009) provide evidence of a strong correlation between enterprise exits and returns to venture capitalists.

the form of any functional relationship between GVC support and success measures. At the simplest level we might test whether enterprises that receive GVC support have stronger or weaker performance than those that do not: essentially dividing the sample into two categories. However, we might think of GVCs and private venture capitalists (PVCs) as providing different inputs to success. If GVC and PVC support are like inputs (analogous to capital and labor) we might not expect the relationship between performance and the GVC share to be monotonic, just as output is not a monotonic function of the capital share (or the capital labor ratio). We therefore need to consider whether the relationship between performance and GVC support is non-linear and perhaps non-monotonic.

A second methodological point relates to the interpretation we place on any association between the GVC share in an enterprise's financing and enterprise performance. If there is, for example, a positive association between GVC support and a performance measure, such an association might arise from a "treatment" effect – the "treatment" of having GVC support causing improved performance. On the other hand, it is possible for such an association to arise through a "selection" effect.

Specifically, if GVCs are simply able to select enterprises that are likely to be successful then a positive relationship between success and GVC support will emerge even if GVCs do not actually do anything to improve the likelihood of success for a given enterprise. Both the possible treatment effect and the possible selection effect are of interest. We care about both whether GVC activity has a positive (or negative) effect on enterprise success, and whether GVCs are good at selecting promising enterprises. The combined effect is also of interest, as it is indicative of the overall performance of GVCs. However, it is important to be able to distinguish between the treatment effect and the selection effect. After all, governments provide support to venture capital in the hope of improving the performance of innovative enterprises – in the hope of a treatment effect.

From an econometric point of view, the selection effect falls into the general category of endogeneity. The regression contains GVC activity as an explanatory variable for performance. However, if the presence of GVC activity is caused by an enterprise having a high likelihood of success, then the explanatory variable partially endogenous. We therefore use an instrumental variables approach – based on market conditions at the time of fundraising that are exogenous to the enterprise's own financing - to correct for this endogeneity and to distinguish between the selection effect and the treatment effect of GVC support on enterprise success.

Our primary finding is that GVC activity has a significant and highly non-monotonic relationship with enterprise performance. The nature of this relationship is that a small

amount of GVC investment appears to be a good thing, increasing the likelihood of successful exit. However, larger amounts of GVC activity appear to be counterproductive.

We examine to what extent this finding is driven by a simple financing effect, that GVCs allow firms to raise larger amount of funding. While we find that GVC-backed firms indeed raise more investments, this effect alone cannot account for the main finding. Nor can the main finding be explained by a dynamic selection argument, where GVCs would merely fund later stage enterprises that have a higher likelihood of success anyway. In addition, our instrumental variable approach indicates that, while there may be some selection effect, this does not fully account for the effects of GVC financing. While the results are far from definitive, our results provide evidence in favour of a treatment effect: that GVC investment does affect performance.

We also consider why GVC finance might have the pattern we observe. Apparently GVCs and PVCs are different in some way. One possible difference arises from the fact that governments (and hence GVCs) often have different objectives than private sector firms (and hence PVCs). The different objectives are often reflected in "mandates" received by GVCs from governments. We consider the role of one possible such mandate – an emphasis on promoting technological innovation. We find some evidence for the existence of such a mandate and offer an interpretation as to how it might affect enterprise performance. However, we find only limited evidence that enterprises receiving GVC financing generate more new patents.

Section 2 provides a literature review, Section 3 is devoted to a description of the data and Section 4 contains the main empirical analysis. Section 5 examines alternative explanations, including selection on unobservables. Section 6 examines the role of technology mandates. Section 7 provides a discussion and interpretation of the main results.

2. LITERATURE REVIEW

Early work on venture capital, including Sahlman (1990), and Amit, Glosten, and Muller (1990) emphasizes the importance of both adverse selection and agency problems in venture capital finance and, by inference, in entrepreneurial finance more broadly.[7] The more recent literature explores how VCs with highly relevant technical background experience devote significant effort to obtaining information about particular enterprises and technologies, and

[7] Related to that, Amit, Brander, and Zott (1998) suggest that the venture capital market exists as a specialized component of financial markets precisely because venture capitalists (VCs) have or acquire a comparative (and absolute) advantage in dealing with situations of asymmetric information.

then help to add value to these enterprises.[8] However, the efforts by venture capitalists might not fully offset the market failure arising from asymmetric information in entrepreneurial finance. We might therefore still expect informational asymmetries to imply undersupply of entrepreneurial finance. Therefore, in the presence of asymmetric information of this type it is possible that government intervention might be helpful in partially offsetting the resulting market failure problems. Our research objective in this paper is based in large part on the fundamental question of whether government intervention can improve upon the response of private sector venture capitalists to information problems.

A second type of problem or market failure that is relevant to government intervention in venture capital is the externality associated with R&D and innovation. There is an extensive literature on this subject that we cannot do justice to here. A valuable textbook treatment of this topic is provided by Tirole (1988, Ch. 10). The key point is that there is reason to believe that innovation might be underprovided. One firm's innovation often provides benefits to other firms that can copy or learn from such innovation. These are positive externalities or spillovers. Because the original innovating firm cannot capture these external benefits it might undertake less innovative activity than would be best from a public policy point of view. Much effort has gone into estimating the extent of such externalities.[9]

For our purposes, it follows that an important question concerns the relationship between venture capital and successful innovation. If there is underprovision of innovation, does venture capital act to partially offset this underprovision? The literature on this topic is not extensive, but all studies typically suggest that venture capital does tend to promote innovation.[10] Accordingly, it is possible that government support for venture capital might expand the supply of venture capital and might therefore boost innovation towards the efficient level by partially offsetting the market failure associated with insufficient innovation.

Only a handful of papers address the effects of government intervention on venture capital. Both Cumming and MacIntosh (2006) and Leleux and Surlemont (2003) find significant 'crowding out' of private venture capital by government sponsored venture capitalists. On the other hand, Lerner (1999, 2002) suggests some evidence of success for the US Small Business Investment Research (SBIR) program. Anderson and Tian (2003) document the poor investor returns in the Canadian Labour-Sponsored Venture Capital Corporation (LSVCC) program. The most closely related work to the current paper is Brander, Egan and

[8] See, for example, Hellmann and Puri (2002), Kaplan and Strömberg (2004), Bottazzi, Da Rin and Hellmann (2008), Fulghieri and Sevilir (2008) or Chemmanur, Krishnan and Nandy (2008).
[9] One classic study of this type is Bresnahan (1986). See also Griliches (1992) and Jaffe (1996) for empirical evidence concerning the extent of R&D spillovers.
[10] See in particular Kortum and Lerner (2000), Gans and Stern (2000) Hellmann and Puri (2000), Hsu (2006) and Ozmel, Robinson and Stuart (2007).

Hellmann (2009), which addresses the performance of GVCs and PVCs in Canada. Our paper is also closely related to Lerner (2009), which provides a general critique of government efforts to promote entrepreneurship through venture capital finance and other channels, along with valuable suggestions for improvement.

3. DATA DESCRIPTION

The primary unit of observation in our analysis is the 'company', 'venture' or 'enterprise' that receives venture capital. We have two primary sources of venture capital data. The larger source, which has been widely used by researchers, is the VentureXpert (VX) database provided by Thomson Reuters. From this database, we use all recorded enterprises that received their first venture capital funding between 2000 and 2008. The sample period was chosen to account for the fact that VX has only limited international coverage prior to 2000. After 2000, VX has good coverage for the US and significant coverage for Canada and Europe, along with some but limited coverage for Asia. We were able to augment the VX data with data from *Asian Venture Capital Journal* (AVCJ), which has good coverage for Asia. The combined dataset contains 22, 706 enterprises, of which 2,192 are a net addition due to the AVCJ database. There are 6, 958 distinct venture capitalists represented in the data.

It is sometimes difficult to distinguish between true investments in venture capital and investments in other types of private equity, such as investments in large, well-established privately held enterprises. In order to do so, as a first step, we use the categorization provided by VenturXpert and AVCJ. We also do some additional checks and eliminate enterprises with more than U$1 billion in sales or that receive more than U$1 billion of investments (as venture capital investments are typically a lot less).

All variables are defined in Table 1. Our main dependent variable is EXIT, which is a dummy variable that takes the value 1 if the enterprise went public or was acquired. VentureXpert tends to underreport the exit events, so we also matched the VC-backed enterprises with the Global New Issuance and Mergers and Acquisitions databases in Thomson Reuters. Because we intend exit as a measure of success, we set exit equal to zero if we observe the exit value and find that it is below the total amount of investments. Ideally we would have liked to measure the success of venture capital investments with returns data. Short of that, it is sometime possible to use exit values or exit multiples as a measure of success (Brander, Egan and Hellmann, 2009). This dataset, however, does not offer any such opportunities due to missing data. We have no access to returns data at all, and we only observe exit values in 29% of all exits, so we cannot consider this data reliable enough for analysis. Note, however, that using exits as a measure of success is standard in the venture capital literature (Gompers and

Lerner, 2000; Brander, Amit, and Antweiler, 2002). Most important, Phalippou and Gottschalk (2008) actually demonstrate a high positive correlation between exit and returns to venture capitalists, suggesting that exits are an appropriate measure of success.[11]

Our main dependent variables relate to the presence of government sponsored venture capitalists. In identifying which venture capitalists are government sponsored venture capitalists (GVCs) there is an issue of definition – what should count as a GVC? We focus on three channels for such support. One channel is the direct provision of venture capital through government-owned venture capital funds. A second channel is investment in independently managed venture capital funds that also rely on private investors. A third channel is to provide subsidies or tax concessions to venture capitalists. See Brander, Du and Hellmann (2010) for details.

Our dataset includes enterprises from all major regions in the global economy. Panel A of Table 2 shows the number of enterprises supported by venture capital on a regional basis. It indicates that much of the data comes from the United States and Canada, but we also have significant coverage of Western Europe and East Asia, along with some coverage from other regions. Panel B provides information on the top ten countries in venture capital activity as measured by the number of supported enterprises. It indicates that the US accounts for 10,869 enterprises supported by VCs or about 48% of the total. There is large variation in the frequency of GVC activity by country. In Canada, over 50% of the enterprises had GVC support, whereas in the US the rate of GVC support was only about one-tenth as much – on the order of 5%. China, France and Germany all have relatively high levels of GVC involvement.

We obtain patent data from European Patent Office (EPO)'s PATSTAT database, which collects information on patent applications and granted patents worldwide. We have matched inventors in PATSTAT to our set of enterprises and will only focus on patents that have been granted to enterprises already. "New Patents" is an indicator variable that takes on the value 1 if the enterprise received any new patents during the period from its first receipt of venture capital finance and the end of the sample period. "Number of New Patents" is the number of such new patents. Prior patents is an indicator variable that takes on the value 1 if the enterprise had any patents prior to its first receipt of venture capital finance and the number of such patents is also shown .

[11] We track exits through 2009 but, even so, an enterprise that receives its first VC investment in 2008 or even 2007 is unlikely to have an exit event only a year or two later. While it would be possible to restrict attention to older enterprises, we believe it is better to include all the data. While quick exits are rare, they do occur and should not be arbitrarily discarded. Moreover, our econometric analysis includes year fixed effects that corrects for the enterprises' different time horizons.

We also include three sets of dummy variables which are hypothesized to be associated with exit events. Industry dummy variables represent six industry categories: Non-High-technology, Biotechnology, Communications and Media, Computer Related, Medical/Heath/Life Science, and Semiconductors/Other Electronics. Country dummy variables represent all countries if there are any VC investments in that country. Since it may take years for a start-up company to generate profits for its investors and the unit of analysis in our dataset is an individual company, we use dummy variables of first year of VC financing for each company.

Table 3 provides the main descriptive statistics, while Table 4 shows the correlation between the most important variables. Table 3 includes a comparison of enterprises financed entirely by private venture capitalists (PVCs) and those financed in part by government supported venture capitalists (GVCs). The last column of Table 3 reports the P-value for the t-test of the difference of means between PVCs and GVCs. We first note that 91% of enterprises (or 20,717) in the data set received only PVC funding, while the remainder 9% (or 1,989 enterprises) received some GVC support. The variables "Exit" and "IPO" are indicator variables showing whether an exit (IPO or acquisition) occurred, and whether an IPO occurred. The indicator takes on the value 1 if the event occurred so the mean shows the fraction of observations with the event. Thus, for example, 15.25% of the enterprises with pure PVC finance had successful exits, while 18.20% of the enterprises with some GVC finance had successful exits, with the difference being significant at the 1% level.

4. THE EFFECT OF GVC ON EXIT

4.1 Empirical results

Our main objective is to assess whether government-sponsored venture capitalists (GVCs) are associated with better or worse enterprise performance than private venture capitalists (PVCs). We also wish to explain the pattern of performance that we observe.

In our econometric analysis the unit of observation is the enterprise and the primary measure of performance is whether or not the enterprise experiences a successful exit event – either an IPO or a third party acquisition. We use the Probit regression model. If the probability of exit is Y and GVC is a measure of the share of government venture capital, then we are interested in a regression that has the form $Y = f(GVC,X) + \varepsilon$, where X is a vector of control variables and ε is the random error.

We seek to explain performance on the basis of the extent of GVC activity after taking account of other factors, namely industry effects, country effects and 'vintage' effects.

Country effects are important to account for the many institutional differences across countries and to control for country-to-country variations in data collection methods. Vintage effects are captured by the year in which an enterprise received its first VC investment and reflect the possibility that some years yield different average times to exit than others due to the business cycle and other related factors.

We pay particular importance to the functional form of the GVC measure to account for possible non-monotonicity. Our base measure is the share of the enterprise's VC funding that comes from GVCs. For enterprises that are fully funded by PVCs, this variable is zero. At the other extreme, enterprises that receive all of their venture capital finance from GVCs have a value of 1 for this GVC share variable. For all other enterprises, the GVC variable is strictly between 0 and 1. We explore two possible methods for capturing non-monotonicities, one based on higher-order polynomials and the other on partitioning the interval [0,1] for the GVC share using a set of categorical indicator variables.

In Panel A of Table 5 we show the results of using various polynomial functions of the GVC share. We denote the GVC share itself by GVC-Share – the linear term in any polynomial, GVC-Share-2 is the square of the GVC share, GVC-Share-3 is the cubic power and GVC-Share-4 is the fourth power. Column (1) shows that if we simply use a linear form—regressing exit on the GVC share, there is no apparent significance of government venture capital. Even a quadratic form has no significant explanatory power, as shown in column (2). However, the cubic functional form shown in column (3) provides a high degree of significance. Each power of the GVC share is highly significant and the three coefficients are of course jointly significant.

Figure 1 shows the estimated cubic polynomial implied by the coefficients of this column. As can be seen from the figure, the cubic regression implies the striking result that a modest amount of GVC support is a good thing, but high levels are associated with lower exit performance. Column (4) shows that adding higher order polynomials adds essentially no explanatory power. We conclude that the cubic form yields the best fit with the data.

The pattern shown in Figure 1 is quite striking and calls for some interpretation. The basic message is that a little GVC support is a good thing but that higher levels of GVC support are counterproductive. It is as if GVC support acts like a complementary productive factor at low levels but becomes a problem once GVCs approach having a dominant position in the financing mix. Put differently, it appears that the marginal complementarity benefit of GVC finance decreases as the GVC share increases.

To further validate these findings, our second approach measures the non-monotonicity using categorical variables. The results are reported in Panel B of Table 5. The simplest categorical

approach is to divide the sample of enterprises into just two categories: those that received some GVC finance and those that did not. Over 90% of all enterprises are funded purely by PVCs. We therefore use this as our omitted or base category. Column (1) shows the results of a regression using only the GVC indicator as an explanatory variable, along with the standard control variables. The GVC indicator is statistically significant at the 10% level, suggesting that there is some positive association between GVC finance and exit performance. However, the polynomial analysis above suggests that we should use a finer partition of the GVC share to identify possible non-monotonicities.

Approximately 3% of the enterprises are fully funded by GVCs, and we can treat these enterprises as a distinct category. For the values of GVC strictly between zero and one, reflecting mixed financing from both PVCs and GVCs, we partition the interval (0,1) in two different ways – dividing it into halves or thirds, as shown in Panel B of Table 5. In column (2), GVC-minor refers to enterprises with mixed funding that get less than 50% of their funding from GVCs, GVC-major refers to enterprises with mixed funding that get 50% or more (but less than 100%) of their funding from GVCs. In column (3), GVC-1st tercile refers to enterprises with mixed funding that get less than one third of their funding from GVCs, GVC-2nd tercile to those that get between one and two thirds from GVCs, and GVC-3rd tercile that get more than two thirds (but less than 100%) of their funding from GVCs.

While the first column shows that overall GVC has a small positive effect, the second column reveals a strong non-monotonic effect. Enterprises receiving a positive but minority share of their VC funding from GVCs have significantly better exit performance than the base category of no GVC funding. However, enterprises with the majority of their venture capital funding (but less than 100%) coming from GVCs have significantly worse exit performance than enterprises with pure PVC funding (and therefore have much worse performance than those with a minority GVC share). Those enterprises with pure GVC funding have exit performance almost exactly like the pure PVC enterprises.

The third result column provides yet another representation of the data. Enterprises with a positive but low GVC share – less than a third – have very good exit performance with the effect being highly significant in both statistical and economic terms. Enterprises in the intermediate category – with between 1/3 and 2/3 of their funding from GVCs – have exit performance that is not significantly different from and very similar to the base category of pure PVC enterprises. Enterprises with a high GVC share, but less than 100% have worse exit performance than the base category. Finally, enterprises with only GVC funding are similar to the base category.

This categorical characterization closely matches the result from the cubic polynomial in Figure 1. We also tried finer partitions of the data with, for example, four interior categories or five interior categories, but no additional structure becomes apparent. We conclude that the results from Panel B of Table 5 confirm the results from Panel A. For much of the subsequent analysis we will focus on the specification of column (2) in Panel B of Table 5 This is because it provides a succinct characterization of the main non-monotonicity effect that lends itself to further analysis.

4.2 Theoretical interpretation

To develop our interpretation of the fundamental non-monotonicity found in Table 5 it is useful to briefly consider a possible formal representation of the interaction between GVC finance and PVC finance in generating successful exit events. This is far from a full-fledged economic theory, but might serve to clarify our interpretation of the main results from Table 5. Let us think of exit as the output of a production function, where we focus on the investor mix as the key input, and where all other inputs X enter separately into the production function. We use the simplest possible functional form, given by

$$Y = a*PVC + b*GVC + c*PVC*g(GVC) + h(X)$$

where $g(GVC) = d*GVC - e*GVC^2$, h(X) is a general production function for all the other inputs X, and a,b,c,d,e > 0.

The most interesting aspect of this production function is that instead of assuming standard linear complementarities (c*PVC*GVC) we allow for diminishing marginal complementarity between GVC and PVC finance. Formally, we capture this by allowing the GVC share to have a non-linear effect on the complementarities term. For simplicity we use the quadratic function $g(GVC) = d*GVC - e*GVC^2$, so that the marginal complementarity benefit is given by $g' = d - 2e*GVC$, which is a decreasing function of GVC. This term turns negative for GVC > d/2e. Using PVC = 1 – GVC we obtain the following expression for Y.

$$Y = (b - a + c*d)*GVC - (c*e + d)*GVC^2 + e*GVC^3 + a + h(X)$$

This expression indicates that the effect of GVC can be expressed as a third order polynomial where the coefficient on the linear term is positive under the condition (b + c*d) > a. The coefficient on the squared term is negative and the coefficient on the cubic term is positive. This prediction matches the empirical results from Panel A of Table 5. We can thus interpret the fundamental non-monotonicity as the result of decreasing marginal complementarity of GVC with PVC.

5. ALTERNATIVE EXPLANATIONS

Before inferring a causal relationship for the effect of GVC finance, in this section we consider two possible alternative explanations. First we consider the possibility that any apparent benefits of GVC funding arise simply because more funding is provided, not because the venture capitalist is a GVC. This possibility can be addressed by including total investment as an explanatory variable.

Another possible explanation for a positive association between GVC finance and performance is endogeneity of the reverse causality type. For example, it is possible that GVCs make small investments in successful enterprises shortly before a successful exit event. Such investments, sometimes called "window-dressing", might be expensive for the investor (reflecting the revealed quality of the enterprise) but allow the investor to "look good" by being associated with a successful exit. If so, then the anticipation of a successful exit would cause the GVC investment – a type of reverse causality endogeneity. We can eliminate this effect by focussing just on early stage investment by GVCs and test for its presence by comparing results based on just early stage investments with the results for the full set of investments.

More broadly, endogeneity of the GVC explanatory variable could be induced by any selection effect that allows GVCs to simply choose enterprises that are likely to be successful rather than having a "treatment" effect in improving the chances of enterprise success. Thus the variable GVC would endogenous in the sense of being affected by the value of dependent variable. We test for and correct for any such unobservable selection effects using an instrumental variable approach.

5.1. Fundraising and later stage selection

Table 6 provides regression results addressing the possibility that GVC funding has its effect simply because if makes more funding available. Column (1) shows that enterprises with minority GVC investment (i.e. with a GVC share that exceeds zero but is less than 50%) tend to have more total fund-raising in total. The effect of a majority GVC share is statistically insignificant and pure GVC financing has a significant negative effect on total VC fundraising. It is noteworthy that, among enterprises with both GVC and PVC funding, it is those with a low share of GVC investment that have (by far) the strongest fundraising results.

As previously noted, one possible concern with the result column (1) is reverse causality, namely that enterprises with large funding needs eventually add GVC financing. Put differently, GVC might simply add a little money to larger deals at a later stage. However, we can focus on whether a small amount of early stage GVC funding can help enterprises raise

additional money. The remaining three columns address this point. Column (2) in Table 6 is the same as the first column except that the GVC level indicators are based entirely on the first investment round. The question being asked here is whether a first round investment from a GVC increases overall investment in an enterprise. The answer is yes and the results are remarkably similar to the results for the total GVC share, the main difference being that GVC-major is now significant at the 10% level.

Column (3) indicates the effect of first round GVC financing on whether there is a later round of investment at all. In our data, 40.2% of enterprises receive at least one follow-on investment round. The results show that enterprises with low but positive GVC shares have much better prospects for later investment rounds than enterprises in any other category. Column (4) further shows that this effect also holds true for the investment amount in these later rounds. Overall the evidence of Table 6 suggests that enterprises that receive a modest share of GVC finance at an early stage also raise more funds in total

Table 6 raises the question of whether the fundraising effect can explain the effects of GVC found in Table 5. We re-estimate the main regression results for successful exit including the total amount of funds raised by enterprise as an additional explanatory variable. Table 7 shows that total investment is strongly associated with successful exits, regardless of the specification. After correcting for total investment, the effect of the GVC share on exit performance is similar to the earlier regressions. As before, a cubic polynomial for the GVC-share or the categorical partition of GVC shares captures the structure of the data and, as before, a minority GVC share has a strong positive association with successful exits, while a majority GVC share has a significant negative association.

The second related concern with the result from Table 5 is that it might be driven by later stage behaviour of GVCs. Of particular concern is the possibility that GVCs make small late stage "window-dressing" investments in enterprises that have a high probability of exit. To address this concern we rerun the regressions of Table 5 using only the first round shares of GVC finance. Columns (3) and (4) of Table 7 report the results of the exit regressions, also controlling for investment amounts. We find similar effects as with earlier regressions based on total investment. However, the coefficient on GVC-major, although still negative, is no longer significant at conventional significance levels**.** We suspect that one of the reasons for the loss of significance is the reduced number of GVC-sponsored enterprises from which to estimate this effect. Note also that the polynomial specification continues to be significant and that it retains a shape similar to that of Figure 1.

5.2 Unobservable selection

While the analysis of Section 5.1 addresses one type of selection effect – the possibility of investing at a later stage – we also need to be concerned about other selection effects, in particular selection based on variables known by GVCs but unobservable to us. As noted in the introduction, it is possible that the presence of GVC finance does not change the likelihood of successful exit, but that GVCs are either better or worse at selecting enterprises in which to invest than PVCs. In other words it is possible that both successful exit and the presence of GVC finance are affected by an omitted factor – enterprise potential – making the GVC explanatory variable endogenous and causing us to falsely identify any treatment effect of GVC finance on enterprise success.

A standard approach to dealing with potential endogeneity of this type is to use instrumental variables. We need instruments that are themselves exogenous in the sense that they are not affected by the exit performance of the specific enterprise (the so-called "exclusion" restriction). However, the instruments do need to be related to the GVC share of the enterprise: they need to be variables that would identify exogenous variations in the GVC share. For the instrument we suggest that, other things equal, GVC shares would tend to be higher when the general availability of government supported venture capital is high. In the corporate finance literature, this approach of using local financing availability as instruments, specifically using local market aggregates, goes back to the seminal work by Berger et al. (2005). In our case, we can use the total amount of GVC investment in a given country in a given year as the basis for constructing instruments.

We expect a given enterprise to have more GVC investment, other things equal, if that enterprise is seeking funding in a time and place when GVC funding is in plentiful supply. More precisely, as an instrument for GVC-minor, for example, we identify the ratio of GVC-minor funding rounds to total funding rounds for that country and that year. Because a firm may be fundraising at different points in time, we then weight each fundraising event by the fraction of dollars raised in that round relative to the total amount of funds raised by the enterprise. Thus, in effect, we construct an instrument representing the overall availability of GVC funding, broken down by each type of GVC financing. Our instrumentation approach can be naturally applied to the categorical specification of Panel B in Table 5, but not the polynomials Panel A, hence our attention on the categorical variable specification.

For the first stage we regress the potentially endogenous indicator variables for the various shares of GVC activity (minor, major and pure) on the associated instruments. These instruments reflect the availability of the various levels of GVC funding available at the time when finance was sought by the enterprise. We then use the predicted values of these GVC

shares – the estimated exogenous component of GVC activity – as explanatory variables for exit in second stage regressions.

Columns (1) to (3) of Table 8 show that the instruments in the first stage are significantly related to the regressors (the GVC shares). Most important, column (4) shows that when the predicted values of the GVC-share regressors are used as explanatory variables, a similar pattern to the original regressions is found. In particular, we find that GVC-minor has a positive significant and GVC-major a negative significant effect on exit. This suggests that once any (endogenous) selection effects are purged using instrumental variables, there is a remaining treatment effect that has the by now familiar non-monotonic effect on exit performance.

6. THE ROLE OF TECHNOLOGY MANDATES

The analysis of Section 5 suggests that reverse causality or endogeneity more broadly does not does not seem to be the driving force behind the main findings from Table 5. In particular, even after controlling for fundraising, later stage selection, and unobservable selection effects, we still find that the main pattern of the effect of GVC finance on performance remains valid. Therefore we cannot reject the hypothesis that GVC has a causal effect on the exit probabilities. In other words, our results are suggestive regarding a possible non-monotonic treatment effect of GVC financing on enterprise success. In this section we seek to deepen our understanding of why such an effect might arise. We start by focussing on a key difference between GVC from PVC finance.

6.1 Do GVCs have a technology mandate?

We suggest that a likely that a fundamental difference between GVCs and PVC concerns their overall objectives or mandates. Governments and private sector firms do not have the same objective functions. Therefore, GVCs and PVCs are not likely to have the same objective functions either. A prior literature has established that there are 'strategic' venture capitalists such as corporations or banks that pursue slightly different objectives than private venture capitalists, leading to observable differences in investment behaviour.[12] Here we argue that government venture capitalists are likely to have even sharper differences from PVCs in the form of distinct mandates or objectives that affect their investment behaviour. While there may be several such mandates commonly in force, we focus here on one mandate that seem to be important in many countries, namely the mandate to promote high technology industries.

[12] See Gompers and Lerner (2000), Hellmann (2002), Chemmanur and Loutskina (2006), Fulghieri and Sevilir (2009), Hellmann, Lindsey and Puri (2008) and Masulis and Nahata (2009).

As noted in the literature review, there is a well-established theoretical and empirical literature arguing that market forces typically lead to underinvestment in technological innovation relative to the efficient allocation. Such underinvestment arises from knowledge externalities and other sources of market failure. To redress this problem governments often seek to promote technological innovation. One tool for such a policy is to use government-supported venture capital as an instrument to promote technology commercialization. This seems to be particularly important for medically-related technologies such as biotechnology and medical instruments.

We first ask whether our data is consistent with the existence of such technology mandates. Table 9 shows what fractions of enterprises receive GVC support in high versus low technology industries. We find that minority GVCs investments are more likely to be associated with high technology. For example, Panel A shows that 4.73% of high technology enterprises in the data have minority GVC investment while only 2.36% of low technology enterprises in the data have minority GVC investment. Thus minority GVCs are more inclined to fund high technology than low technology enterprises relative to other venture capitalists.

We can therefore infer that minority GVCs have a strong tendency to support high technology enterprises than PVCs. Panel A shows that for all GVCs, there is no statistically significant preference of GVCs for high technology. The preference is present only for minority GVCs. Moreover, the percentage of enterprises with pure GVC participation is actually significantly lower in high technology than in low technology, suggesting that pure GVCs might have a different mandate. The final row in Table 9 compares the exit rate across the two segments, showing that exits are significantly higher for high technology enterprises. Panel B uses the same format for the comparison of enterprises in biomedical industries versus other industries. A similar pattern emerges, except that there are no significant differences for pure GVC funded enterprises.

Panels A and B identify high technology enterprises on the basis of industry categorization. The remaining panels focus on patents as a measure of innovation. We focus on the simple dichotomy between enterprises that either have some or no patents. Panel C considers the presence or absence of patents at the end of the sample period. We find a similar pattern as in high technology. Panel D considers patents at the time of the first venture capital investment. The probability of having minority GVC is almost identical for enterprises with or without patents before receiving the first round financing. Overall, the analysis from Table 9 provides an interesting and somewhat subtle picture of the technology mandate. When GVCs invest alongside PVCs and only provide a minor part of the financing, there is some evidence for a technology mandate. There is no such evidence for majority or pure GVC investments.

Table 10 further examines the relationship between GVC financing and patenting using regression analysis. In particular we ask whether GVC financing is associated with greater patent production, as measured by patents granted after the first round of financing. The regressions therefore control for the initial level of patents. Columns (1) and (2) use a Probit model, where the dependent variable measures whether or not the enterprise obtained any additional patents. Columns (3) and (4) use OLS regressions for the subsample of enterprises with new patents, where the dependent variable is the natural logarithm of the number of new patents granted. The results are somewhat inconclusive. While Column (1) suggests some positive association between new patents and minority and majority GVC financing, these results are not confirmed in the other three columns. There is thus little evidence that the GVCs technology mandate has a direct impact on innovation as measured by patents.

6.2 Does the technology mandate help to explain the effects of GVC finance on exit?

The evidence from Table 9 clearly suggests that certain types of GVCs are more technology focused than PVCs. We can now use this insight to gain a deeper understanding of the main finding of this paper, the performance non-monotonicity of GVC. In particular, we ask whether the strong performance of enterprises obtaining only minority funding from GVCs, as well as the weak performance of enterprises obtaining majority funding from GVCs, can be partially explained by (or traced back to) a technology mandate.

A conceptual challenge becomes immediately apparent when we consider the distinction between high versus low technology industries: the regressions from Table 5 already control for industry. This says that we should not treat the mandates as mere control variables. Instead we are interested in how the GVC effect changes across different industry segments. This requires us to look at interaction of the technology mandate with the various types of GVC financing. Specifically, we break down the performance effects of the three GVC categories into a high and low technology segment.

Panel A of Table 11 reports for the resulting six coefficients of interest, as well as a test of difference across the high and low technology segment. Note that while the table contains two coefficient columns, both were estimated jointly in a Probit regression with interaction effects. Panel B repeats the procedure for the distinction between biomedical and other industries; Panel C for enterprises with or without patents at the end of the sample, and Panel D for enterprises with or without patents at the time of the first round. The most important finding is that the negative effect for GVC-major seems to stem mainly from high technology enterprises. In first three panels the coefficient for GVC-major is more negative for the technology-intensive category, and the difference of coefficients is always significant. [Panel D is different.] This finding gives some credence to the concern that the GVCs technology

mandate may actually lead to overinvestment in technology, at least if one takes the perspective of private (as opposed to social) returns to investments.

Another interesting finding is that this negative effect of the technology mandate seems to be focused mainly on enterprises where GVCs provide the majority of funding. The difference of coefficients is never significant for GVC-minor. Moreover, for enterprises financed purely by GVC we find little difference, except that the performance coefficient is actually higher in low tech industries.

7. CONCLUDING REMARKS

Our most striking result is something we have not seen mentioned in previous work. Specifically, GVC activity seems to have a non-monotonic relationship with our performance indicators. A modest amount of GVC finance seems to improve the performance of entrepreneurial ventures relative to ventures supported purely by private venture capitalists (PVCs). However, high levels of support from GVCs are associated with weaker performance.

Perhaps the most obvious way of testing whether GVC activity affects performance is to regress a performance measure, such as whether a successful exit occurs, on some measure of GVC activity, such as the share of VC investors in the enterprise that are GVCs. A typical such specification would presume a monotonic relationship. One might find that GVC activity tends to increase success, to reduce success, or have no significant effect on the likelihood of a successful exit. In this case, such analysis does not reveal a clear picture.

We separately identify enterprises that receive only a small amount of GVC finance, those that receive a moderate amount, those that receive a large amount, and those who obtain all their venture capital from GVCs. Using this partition of the data allows the strong monotonic effect of GVC shares in the data to be identified. We can think of this effect as being like a cubic polynomial. In fact, a cubic polynomial in GVC finance shares fits the data quite well. At low levels of GVC finance, success is increasing in the GVC share. At high levels of GVC support, additional government support reduces success. Thus, a little bit of government support appears to be a good thing but it is also possible to have too much government support.

The observation that moderate government activity is associated with good performance but extensive government activity is associated with weaker performance is consistent with other results reported in an earlier working paper version of this paper (Brander, Du and Hellmann, 2010) concerning different types of GVCs. Full GVCs are fully owned and operated by

governments. Partial GVCs receive investment from governments but also receive private investment and are independently managed. Indirect GVCs are not based on investment by government but receive subsidies and/or preferential tax treatment. The partial GVCs have the strongest performance among these three types, particularly on the value creation measures. If our results are indicative of genuine causal effects, the model of having independent venture capitalists who receive some government investment would appear to have a better track record than government-owned venture capital funds.

Overall, we observe good performance when government support is present but not dominant. This applies to both enterprises and venture capital funds. The evidence suggests that GVCs may be helpful in providing certain kinds of support, including financial support, but may become less useful when they have actual control over business decisions. If they lack control then the usual concerns about governments subverting sound economic objectives to achieve questionable political objectives is less likely to arise. Put differently, government venture capital may be at its most effective when it remains disciplined by private venture capital.

We hasten to re-emphasize the usual warning about causal interpretations. Given the preliminary nature of our inquiry, and the fact that we do not have direct experimental evidence, we suggest a cautious interpretation of our results. What we know is that, in our data, low levels of GVC activity are associated with good performance by enterprises. This does not mean that GVC activity is necessarily the cause of this good performance. If GVCs really do contribute to good enterprise performance, we can describe this as a 'treatment' effect: GVC funding would be like a treatment that improves the outcome for the client enterprise. Any treatment effect would presumably arise in large part from the resources, mentoring and other management services provided by the GVC to the client enterprise.

However, the possibility remains that there might be no treatment effect. There are several other possible explanations of the positive association between moderate GVC activity and enterprise performance. One possibility that often comes up with regression analysis is endogeneity of the reverse causality type: perhaps high-performing enterprises cause or induce GVCs to invest – possibly through some sort of bandwagon effect or "window-dressing" effect. A related possibility is that GVCs do well through a 'selection effect' – simply by selecting good enterprises in which to invest. It is also possible that the relationship between moderate GVC activity and enterprise performance is induced by some other factor, including simple coincidence.

In the absence of direct experimental evidence it is difficult to be confident about causality. However, we use two methods in an effort to assess the significant any causal effect. One method is to define GVC shares using only the first round of investment – making any

endogeneity issues much less likely to be present. A second approach is to use instruments to estimate the exogenous component of variations in GVC shares and then to use these estimated values in appropriate regressions. Both of these methods suggest that, while some selection effect may well be present, there is also fairly strong evidence of the treatment effect proposed here.

Our results raise the question as to why modest amounts of GVC finance seem to be positive while larger amounts have a negative effect. It is as if GVC finance and PVC finance are complementary inputs, implying that GVCs and PVCs are different in some important respects. One possible difference arises from the different objectives or governments and the private sector. In particular, GVCs may have a mandate to encourage high technology innovation as a distinct objective.

If GVCs do have different mandates from PVCs it is possible that when GVCs exercise high levels of control in an enterprise they induce behaviour that might be consistent with their mandated objectives but that might not be highly profitable. If so, the restraining influence of PVCs might be helpful when GVCs are in a minority position. The evidence is also consistent with the hypothesis that GVCs really do bring useful skills to the enterprises that are not necessarily provided by PVCs.

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Table 1: List of Variables

Variable Name	Definition
Exit	Dummy variable, equal to 1 if the enterprise provides successful exits for its investors through IPO or acquisition. Exit is set to 0 if exit value is known to lie below the total amount of investments received by the enterprise.
IPO	Dummy variable, equal to 1 if the enterprise had an IPO;.
GVC-Share	Total amount of funding provided by GVCs divided by total amount of funding provided by all investors; funding is calculated over all financing rounds. If in any round no information is available on the relative amounts provided by the different investors, it is assumed that all investors provided equal amounts.
GVC-Share-2/3/4	The second, third and fourth order polynomial of GVC-Share.
GVC Indicator	Dummy variable, equal to 1 if there is at least one GVC that investing in the enterprise; otherwise equal to 0.
GVC-Minor	Dummy variable, equal to 1 if GVC-Share is greater than 0 and strictly less than 0.5.
GVC-Major	Dummy variable, equal to 1 if GVC-Share is greater or equal than 0.5 and strictly less than 1.
GVC-1st Tercile	Dummy variable, equal to 1 if GVC-Share is strictly greater than 0 and strictly less than 1/3.
GVC-2nd Tercile	Dummy variable, equal to 1 if GVC-Share is greater or equal than 1/3 and strictly less than 2/3.
GVC-3rd Tercile	Dummy variable, equal to 1 if GVC-Share is greater or equal than 2/3 and strictly less than 1.
GVC-Pure	Dummy variable, equal to 1 if GVC-Share is equal to 1.
FRGVC-(...)	Same as above GVC measures, except that the funding shares are based solely on the enterprise's first round of funding.
IVGVC-(...)	The instruments for all the GVC variables are constructed as follows. For each enterprise we define the local market as all the enterprises that received funding in the same year in the same country. For each local market we calculate the fraction of enterprises that received each of the different types GVC financing (minor, major, pure). For each enterprise we then calculate the weighted average across years, where the weights are determined by relative amount of funding that was raised in each year.
Total Investment	The natural logarithm of the total amount of funding received by the enterprise.
Later Round	Dummy variable, equal to 1 if the enterprise received additional financing after the first round.
LR Investment	The natural logarithm of the total amount of funding received by the enterprise in financing rounds after the first round.
Patents	Dummy variable, equal to 1 if the enterprise was granted at least one patent by the end of 2008
New Patents	Dummy variable, equal to 1 if the enterprise was granted at least one patent between the time of the first round and the end of 2008.
Prior Patents	Dummy variable, equal to 1 if the enterprise already was granted one or more patents before receiving the first round financing.
No. of New Patents	Number of patents granted between the time of the first round and the end of 2008.
No. of Prior Patents	Number of patents granted prior to receiving the first round financing.
Hightech	Dummy variable, equal to 1 if an enterprise's industry classification is Biotechnology, Communications and Media, Computer Related, Medical/Health/Life Science, or Semiconductors/Other Electronics industry
Biomed	Dummy variable, equal to 1 if an enterprise's industry classification is Biotechnology or Medical/Health/Life Science industry.

Table 2: Venture Capital Activities

This table presents VC activities by region in Panel A and by 10 countries with most VC activities in Panel B between 2000 and 2008. The unit of observation is the individual enterprise. Number of Enterprises reports number of enterprises financed by VCs. Enterprises with GVC finance (%) reports percentage of enterprises financed by at least one GVCs. Enterprises with an exit (%) and Enterprises with an IPO (%) report percentage of enterprises that provide VCs with successful exits or IPOs, respectively.

Panel A: Venture Capital Activity by Region: 2000-2008

Region	Number of Enterprises	Enterprises with GVC finance (%)	Enterprises with an exit (%)	Enterprises with an IPO (%)
North America	11,295	6.31	17.57	1.72
East Asia	5,016	10.49	15.05	11.76
Western Europe	4,729	12.46	11.44	3.4
Oceania	780	3.97	16.79	7.69
Middle East	369	13.55	13.55	4.61
Latin America	246	20.33	12.20	6.5
Eastern Europe	218	11.01	9.17	4.13
Africa	53	11.32	20.75	15.09
Total	22,706	8.76	15.51	4.65

Table 2 (continued)

Panel B: Venture Capital Activity by Top 10 Countries: 2000-2008

Country name	Number of Enterprises	Enterprises with GVC finance (%)	Enterprises with an exit (%)	Enterprises with an IPO (%)
United States	10,869	4.53	17.4	1.55
United Kingdom	1,515	3.43	12.94	3.96
South Korea	1,394	4.23	13.2	13.92
China	1,308	19.8	15.67	13.3
India	855	18.13	14.5	6.78
France	815	24.91	12.39	4.05
Japan	771	1.30	14.66	8.3
Australia	659	3.95	17.91	8.5
Germany	492	34.76	10.77	3.66
Canada	426	51.88	21.83	6.1

Table 3: Descriptive Statistics

This table describes the sample in which the unit of observation is the individual enterprise. Mean and Standard Deviation of variables are reported for the entire sample, the PVC sample, and the GVC sample. The last column report P-values of differences in means between the PVC sample and the GVC sample, based on the two-sample T Test (two-sided) assuming unequal variance. All variables are defined in Table 1.

	Entire Sample			**PVC**		**GVC**		**PVC-GVC**
Variable	Obs	Mean	S.D.	Mean	S.D.	Mean	S.D.	P-value
EXIT	22706	0.1551	0.3620	0.1525	0.3595	0.1820	0.3859	0.0011
IPO	22706	0.0465	0.2105	0.0445	0.2062	0.0669	0.2499	0.0001
GVC-Indicator	22706	0.0876	0.2827					
GVC-Minor	22706	0.0411	0.1986	0.0000	0.0000	0.4696	0.4992	
GVC-Major	22706	0.0204	0.1413	0.0000	0.0000	0.2328	0.4227	
GVC-Pure	22706	0.0261	0.1594	0.0000	0.0000	0.2976	0.4573	
FRGVC-Minor	22706	0.0203	0.1412	0.0000	0.0000	0.2323	0.4224	
FRGVC-Major	22706	0.0203	0.1409	0.0000	0.0000	0.2313	0.4218	
FRGVC-Pure	22706	0.0311	0.1737	0.0000	0.0000	0.3555	0.4788	
Total Investment	22706	23.7973	56.2303	23.7151	56.9707	24.6536	47.8454	0.4119
Later Rounds	22706	0.402	0.4903	0.395	0.4889	0.4746	0.4995	0.0000
LR Investments	9128	36.8144	69.2103	37.3343	70.8112	32.3067	53.1732	0.0082
Patents	22706	0.1604	0.3669	0.1578	0.3646	0.1865	0.3896	0.0016
New Patents	22706	0.1421	0.3491	0.1391	0.3461	0.1730	0.3783	0.0001
Prior Patents	22706	0.0488	0.2154	0.0488	0.2155	0.0483	0.2144	0.9154
No. of New Patents	22706	1.0643	6.5857	1.0339	6.5634	1.3811	6.8083	0.0294
No. of Prior Patents	22706	0.3572	7.0084	0.3719	7.3208	0.2046	1.5683	0.0068

Table 3 (continued)

	Entire Sample			PVC		GVC		PVC-GVC
Variable	Obs	Mean	S.D.	Mean	S.D.	Mean	S.D.	P-value
Non-High Tech	5920	0.2607		0.2609		0.2584		0.8061
Biotechnology	1364	0.0601		0.0583		0.0784		0.0013
Communications and Media	3054	0.1345		0.1345		0.1347		0.9739
Computer Related	8753	0.3855		0.389		0.3494		0.0004
Medical/Health/ Life Science	1896	0.0835		0.0835		0.084		0.9383
Semiconductors/ Other Electronics	1719	0.0757		0.0739		0.095		0.0019
2000	6299	0.2774		0.2789		0.2619		0.1148
2001	2807	0.1236		0.1199		0.1619		0.0000
2002	1597	0.0703		0.0679		0.096		0.0000
2003	1498	0.066		0.0634		0.0925		0.0000
2004	1646	0.0725		0.0718		0.0794		0.2289
2005	1948	0.0858		0.0868		0.0749		0.0553
2006	2334	0.1028		0.1043		0.0875		0.0121
2007	2424	0.1068		0.11		0.0729		0.0000
2008	2153	0.0948		0.0969		0.0729		0.0001
Number of enterprises		22706		20717		1989		

Table 4: Correlation Matrix of Key Variables

The matrix is based on the sample of 22,706 enterprises. I use ***, **, and * to denote significance at the 1%, 5%, and 10% level, respectively.

ID	Variable Name	1	2	3	4	5	6	7	8
1	Exit	1							
2	IPO	0.4487***	1						
3	GVC-Minor	0.0497***	0.0259***	1					
4	GVC-Major	-0.0162	-0.0052	-0.0299***	1				
5	GVC-Pure	-0.0067	0.0256***	-0.0339***	-0.0236***	1			
6	Total Investment	0.0534***	-0.0011	0.0668***	-0.0306***	-0.0477***	1		
7	New Patents	0.0288***	0.018***	0.0612***	0.0127	-0.0389***	0.1749***	1	
8	Prior Patents	-0.0151	0.0074	0.0077	-0.0008	-0.0101	-0.0191***	0.3132***	1

Table 5: Effects of GVC on Exit

Panel A: GVC on Exit – Polynomials

The unit of observation in these Probit regressions is the individual enterprise. All variables are defined in Table 1. Robust and clustered standard errors at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

	(1)	(2)	(3)	(4)
VARIABLES	Exit	Exit	Exit	Exit
GVC-Share	-0.0392	0.327	3.271***	4.249***
	(0.0893)	(0.317)	(0.576)	(1.296)
GVC-Share-2		-0.417	-10.66***	-17.10**
		(0.338)	(1.650)	(8.002)
GVC-Share-3			7.369***	19.48
			(1.158)	(14.35)
GVC-Share-4				-6.645
				(7.647)
Industry FE	YES	YES	YES	YES
First Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Constant	0.500***	0.500***	0.495***	0.494***
Pseudo R-squared	0.0824	0.0825	0.0839	0.0839
No. of Obs.	22,706	22,706	22,706	22,706

Table 5 (continued)

Panel B: GVC on Exit - Categorical variables

The unit of observation in these Probit regressions is the individual enterprise. All variables are defined in Table 1. Robust and clustered standard errors at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

	(1)	(2)	(3)
VARIABLES	Exit	Exit	Exit
GVC-Indicator	0.0874*		
	(0.0506)		
GVC-Minor		0.235***	
		(0.0661)	
GVC-Major		-0.203***	
		(0.0740)	
GVC-1st Tercile			0.268***
			(0.0619)
GVC-2nd Tercile			-0.0114
			(0.105)
GVC-3rd Tercile			-0.355*
			(0.183)
GVC-Pure		-0.0133	-0.0138
		(0.0991)	(0.0989)
Industry FE	YES	YES	YES
First Year FE	YES	YES	YES
Country FE	YES	YES	YES
Constant	0.497***	0.493***	0.493***
Pseudo R-squared	0.0833	0.0846	0.0844
No. of Obs.	22,706	22,706	22,706

Table 6: Effects of GVC Shares on Fundraising

The unit of observation in these regressions is the individual enterprise. Columns (1), (2) and (4) use OLS regressions whereas Column (3) uses a Probit regression. All variables are defined in Table 1. Robust and clustered standard errors at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

	(1)	(2)	(3)	(4)
VARIABLES	Total Investment	Total Investment	Later Rounds	Later Rounds Total Investment
	OLS	OLS	Probit	OLS
GVC-Minor	1.151***			
	(0.114)			
GVC-Major	0.141			
	(0.167)			
GVC-Pure	-0.642***			
	(0.235)			
FRGVC-Minor		0.837***	0.242***	0.122**
		(0.124)	(0.0646)	(0.0593)
FRGVC-Major		0.212*	-0.0398	-0.153
		(0.123)	(0.0703)	(0.115)
FRGVC-Pure		-0.455**	-0.141	-0.304
		(0.199)	(0.0904)	(0.197)
ALL FE	YES	YES	YES	YES
Constant	0.305	0.332	-6.125***	-0.00897
R-squared	0.2242	0.2131	0.1521	0.2087
No. of Obs.	22,706	22,706	22,670	9,128

Table 7: Effects of GVC on Exit: Controlling for Total Investment

The unit of observation in these Probit regressions is the individual enterprise. All variables are defined in Table 1. Robust and clustered standard errors at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

	(1)	(2)		(3)	(4)
	GVC shares (all rounds)			First-round GVC shares	
VARIABLES	Exit	Exit		Exit	Exit
GVC-Share	2.570***		FRGVC-Share	2.373***	
	(0.500)			(0.666)	
GVC-Share-2	-8.766***		FRGVC-Share-2	-7.460***	
	(1.488)			(2.051)	
GVC-Share-3	6.230***		FRGVC-Share-3	5.068***	
	(1.077)			(1.464)	
GVC-Minor		0.155***	FRGVC-Minor		0.197***
		(0.0553)			(0.0680)
GVC-Major		-0.205**	FRGVC-Major		-0.110
		(0.0835)			(0.0924)
GVC-Pure		0.0417	FRGVC-Pure		-0.0270
		(0.0868)			(0.0852)
Total Investment	0.0755***	0.0751***	Total Investment	0.0767***	0.0764***
	(0.0143)	(0.0140)		(0.0145)	(0.0144)
ALL FE	YES	YES	ALL FE	YES	YES
Constant	0.478***	0.477***	Constant	0.481***	0.481***
Pseudo R-squared	0.091	0.0909	Pseudo R-squared	0.0904	0.0905
No. of Obs.	22706	22706	No. of Obs.	22706	22706

Table 8: Exit Regressions with Instrumental Variables

The unit of observation in these instrumental variable Probit regressions is the individual enterprise. All variables are defined in Table 1. First stage regressions are reported in Columns (1) to Column (3). We report the second stage IV regressions in Column (4). Due to non-convergence of the maximum likelihood estimators, the Heckman two-step procedure was followed. Standard errors at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

VARIABLES	(1) GVC-minor 1st stage	(2) GVC- major 1st stage	(3) GVC-pure 1st stage	(4) Exit 2nd stage
IVGVC-Minor	1.3258***	-0.005	0.0294	
	(0.0746)	(0.0529)	(0.0583)	
IVGVC-Major	0.0888	1.0476***	0.0598	
	(0.0843)	(0.0598)	(0.0659)	
IVGVC-Pure	0.0137	0.051*	1.0866***	
	(0.0417)	(0.0295)	(0.0326)	
GVC-Minor				1.0283*
				(0.5298)
GVC-Major				-2.317***
				(0.789)
GVC-Pure				-0.0171
				(0.369)
ALL FE	YES	YES	YES	YES
Constant	0.0295	-0.0006	-0.0027	0.4747
Adj. R-squared	0.0618	0.0687	0.11	
No. of Obs.	22706	22706	22706	22706

Table 9: Do GVC's follow a technology mandate?

Panel A: High technology

Panel A reports differences in means of two sub-samples, in which Hightech is equal to 1 and 0, respectively. P-values of differences are based on the two-sample T-test (two-sided) assuming unequal variance. All variables are defined in Table 1.

VARIABLES	Obs.	Mean	Obs.	Mean	Difference	P-value
	Hightech=1		Hightech=0			
GVC Indicator	16786	0.0879	5920	0.0868	0.0011	0.8061
GVC-Minor	16786	0.0473	5920	0.0236	0.0237***	0.0000
GVC-Major	16786	0.0212	5920	0.0181	0.0031	0.1278
GVC-Pure	16786	0.0194	5920	0.0451	-0.0257***	0.0000
EXIT	16786	0.1629	5920	0.1329	0.03***	0.0000

Panel B: Biomedical industries

Panel B reports differences in means of two sub-samples, in which Biomed is equal to 1 and 0, respectively. P-values of differences are based on the two-sample T-test (two-sided) assuming unequal variance. All variables are defined in Table 1.

VARIABLES	Obs.	Mean	Obs.	Mean	Difference	P-value
	Biomed=1		Biomed=0			
GVC Indicator	3260	0.099	19446	0.0857	0.0134**	0.0168
GVC-Minor	3260	0.0546	19446	0.0389	0.0157***	0.0002
GVC-Major	3260	0.0206	19446	0.0204	0.0002	0.9441
GVC-Pure	3260	0.0239	19446	0.0264	-0.0025	0.3898
EXIT	3260	0.1187	19446	0.1612	-0.0425***	0.0000

Table 9 (continued)

Panel C: All Patents

Panel C reports differences in means of two sub-samples, in which Patents is equal to 1 and 0, respectively. P-values of differences are based on the two-sample T-test (two-sided) assuming unequal variance. All variables are defined in Table 1.

VARIABLES	Obs.	Mean	Obs.	Mean	Difference	P-value
	Patents=1		Patents=0			
GVC Indicator	3641	0.1019	19065	0.0849	0.017***	0.0016
GVC-Minor	3641	0.0659	19065	0.0364	0.0295***	0.0000
GVC-Major	3641	0.0233	19065	0.0198	0.0035	0.1924
GVC-Pure	3641	0.0126	19065	0.0286	-0.016***	0.0000
EXIT	3641	0.1706	19065	0.1522	0.0184***	0.0065

Panel D: Prior Patents

Panel D reports differences in means of two sub-samples, in which Prior Patents is equal to 1 and 0, respectively. P-values of differences are based on the two-sample T-test (two-sided) assuming unequal variance. All variables are defined in Table 1.

VARIABLES	Obs.	Mean	Obs.	Mean	Difference	P-value
	Prior Patents =1		Prior Patents=0			
GVC Indicator	1107	0.0867	21599	0.0876	-0.0009	0.9154
GVC-Minor	1107	0.0479	21599	0.0408	0.0071	0.2801
GVC-Major	1107	0.0199	21599	0.0204	-0.0005	0.8995
GVC-Pure	1107	0.019	21599	0.0264	-0.0075*	0.0788
EXIT	1107	0.131	21599	0.1563	-0.0254***	0.0153

Table 10: Effects of GVC on Patents

The unit of observation in these regressions is the individual enterprise. Probit regressions are used in Columns (1) and (2) whereas OLS regressions are used in Columns (3) and (4). All variables are defined in Table 1. Standard errors, robust and clustered at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

	(1)	(2)	(3)	(4)
VARIABLES	New Patents	New Patents	Log (No. of New Patents)	Log (No. of New Patents)
GVC-Minor	0.110**		0.0170	
	(0.0476)		(0.0411)	
GVC-Major	0.153*		-0.189	
	(0.0927)		(0.142)	
GVC-Pure	-0.0482		0.0699	
	(0.117)		(0.152)	
FRGVC-Minor		0.00412		-0.0531
		(0.0668)		(0.0722)
FRGVC-Major		0.0925		-0.233*
		(0.0959)		(0.118)
FRGVC-Pure		0.00146		-0.0538
		(0.0895)		(0.125)
Prior Patents	1.580***	1.580***	0.669***	0.671***
	(0.0965)	(0.0962)	(0.0348)	(0.0359)
Total Investment	0.123***	0.125***	0.160***	0.160***
	(0.0232)	(0.0220)	(0.0120)	(0.0114)
ALL FE	YES	YES	YES	YES
Constant	-5.765***	-5.762***	0.969***	0.967***
Pseudo R-squared	0.2496	0.2493	0.2518	0.2520
No. of Obs.	22,248	22,248	3226	3226

Table 11: Effects of GVC on exit: the role of technology mandates

This table reports Probit regressions of interaction effects. The model is specified as

PROBIT (EXIT) = ***f*** (GVC-Minor x Indicator, GVC-Minor x (1- Indicator), GVC-Major x Indicator, GVC-Major x (1- Indicator), GVC-Pure x Indicator, GVC-Pure x (1-Indicator), Indicator, Total Investment, Industry dummies, First year of financing dummies, Nation dummies).

Panels A, B, C, and D report regression results when the Indicator is Hightech, Biomed, Patents, and Prior Patents, respectively. We only report coefficients of the interactions between the GVC measures (shown in rows) and indicators (shown in columns), so that the coefficients in each table are all derived from the Probit regression. The third columns shows the P values for the differences of coefficients test. All variables are defined in Table 1. Robust and clustered standard errors at the enterprise's country level are reported in parentheses, where ***, **, and * denote significance at the 1%, 5%, and 10% levels (two-sided), respectively.

Panel A

	(1)	(2)	(3)
	EXIT	EXIT	EXIT
	Hightech=1	Hightech=0	P-value of Difference
GVC-Minor	0.123**	0.321***	0.1284
	(0.0617)	(0.110)	
GVC-Major	-0.262***	-0.0219	0.0873
	(0.0791)	(0.145)	
GVC-Pure	-0.0517	0.154	0.1067
	(0.103)	(0.111)	
Pseudo R-squared	0.0912	0.0912	0.0912
No. of Obs.	22706	22706	22706

Table 11 (continued)

Panel B

	(1)	(2)	(3)
	EXIT	EXIT	EXIT
	Biomed=1	Biomed =0	P-value of Difference
GVC-Minor	0.250*	0.133***	0.3813
	(0.147)	(0.0476)	
GVC-Major	-1.021**	-0.148**	0.0334
	(0.442)	(0.0674)	
GVC-Pure	0.225	0.0175	0.4986
	(0.306)	(0.0846)	
Pseudo R-squared	0.0913	0.0913	0.0913
No. of Obs.	22706	22706	22706

Panel C

	(1)	(2)	(3)
	EXIT	EXIT	EXIT
	Patents=1	Patents =0	P-value of Difference
GVC-Minor	0.139	0.161***	0.8069
	(0.103)	(0.0502)	
GVC-Major	-0.526**	-0.144**	0.0613
	(0.218)	(0.0667)	
GVC-Pure	-0.143	0.0528	0.5039
	(0.329)	(0.0807)	
Pseudo R-squared	0.0912	0.0912	0.0912
No. of Obs.	22706	22706	22706

Table 11 (continued)

Panel D

	(1) EXIT	(2) EXIT	(3) EXIT
	Prior Patents=1	Prior Patents =0	P-value of Difference
GVC-Minor	-0.152	0.169***	0.2792
	(0.301)	(0.0521)	
GVC-Major	-0.269	-0.203**	0.8357
	(0.335)	(0.0817)	
GVC-Pure	-0.382	0.0503	0.2661
	(0.425)	(0.0865)	
Pseudo R-squared	0.091	0.091	0.091
No. of Obs.	22706	22706	22706

Figure 1: The effect of GVC share on exit, estimated with a cubic polynomial