Venture Capital and New Business Creation: International Evidence*

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Abstract

Using a comprehensive database of European firms from 21 countries over the period 1998-2008, we find that venture capital investment has a positive effect on the rate of new business creation. This is especially true in R&D-intensive industries and in countries with lower taxes on capital gains and higher human capital. We address endogeneity by exploiting data on buyout fundraising, pension fund assets, and on laws that regulate risk capital investments by pension funds. Our results hold when we account for barriers to entry, general access to credit, protection of intellectual property, and labor regulations.

Keywords: venture capital, new business creation

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1 Introduction

It is generally accepted that access to credit is an important determinant of new business creation. In a seminal study, Rajan and Zingales (1998) find that the development of financial markets affects positively the growth of new establishments. Aghion, Fally, and Scarpetta (2007) find that deeper and more developed credit markets are associated with higher firm entry and higher post-entry firm growth in sectors which are more dependent on external finance. Such effects have mostly been attributed to developments in the banking sector. For example, Black and Strahan (2002) provide evidence that the rate of new business incorporation increases as a result of banking deregulation, and Cetorelli and Strahan (2006) show that average firm size decreases with bank competition, arguably due to increased entry rates.

However, banks are not always best suited to promote new business creation, as they are often reluctant to finance small new firms because of high uncertainty, information asymmetries, and agency costs (Beck, Demirgüç-Kunt; and Maksimovic (2005)). In comparison, venture capitalists are specialized to overcome these problems through the use of staged financing, private contracting, and active monitoring (Hellmann (1998), Gompers and Lerner (1999, 2001a), Kaplan and Stromberg (2001), Repullo and Suarez (2004)) and are therefore more likely to finance early stage and technology companies than banks. Recent research (Mollica and Zingales (2007), Samila and Sorenson (2010)) has suggested that firm entry increases in U.S. regions that attract more venture capital (VC). However, there is no empirical evidence as to the ability of VC to mimic this success in an international context. Our paper fills this void by providing the first comprehensive study of the effect of venture capital on new business creation in 21 European countries.[1] The cross-country setting employed

[1]The question is highly relevant to policy makers given that they often perceive venture capital as an

also allows us to look at which characteristics of the regulatory and business environment magnify the effect of VC on firm entry.

Our papers adds to a remarkably limited research on the effects of venture capital on aggregate economic outcomes, rather than on firm-level performance. Among the few studies on the subject, Kortum and Lerner (2000) and Hirukawa and Ueda (2008) show that venture capital investment in the United States is associated with more innovation as measured by patent counts and patent citations at the industry level. Tang and Chyi (2008) find that venture capital investment enhances aggregate productivity growth. Finally, looking at private equity rather than venture capital, Bernstein, Lerner, Sorenson, and Stromberg (2010) find that in a sample of OECD countries, buyout activity has been associated with higher productivity and employment growth. In this context, our paper addresses one possible link between risk capital and industry growth.

There are three main mechanisms suggested by the literature via which venture capital should lead to higher rates of business incorporation. First, venture capitalists may directly assist the birth of new firms. Keuschnigg (2004) develops a model in which the entrepreneur's own wealth constitutes a binding constraint, and so venture capitalists stimulate new business creation by ensuring that good ideas receive funding (seed capital) even when conceived by entrepreneurs without substantial assets. Alternatively, venture capitalists may raise the firm's survival chances through value-added services by mentoring entrepreneurs, hiring executives, formulating strategies, and helping the companies they finance establish themselves in the marketplace (see Sahlman (1990) for early field evidence). Kaplan and Stromberg (2001) suggest that venture capitalists both screen and monitor companies, thereby improv-

important contributor to the rising leadership of US firms in high technology industries (Gompers and Lerner (2001b)). Hoping to rival this success, the European Union stimulates venture capital investment in an attempt to make Europe a hotbed for entrepreneurship (Aernoudt (1999); Gilson (2003)).

ing their market strategy and early-life survival probability. Hellmann and Puri (2002) argue that venture capitalists play an active role in helping their portfolio companies recruit professional CEOs and skilled workers at various hierarchy levels. Bottazzi and Da Rin (2002) find that venture capital in Europe is effective in helping firms grow faster conditional on entry.

Second, nascent entrepreneurs may recognize the need for capital in the future and only establish firms when they have reasonably high expectations of obtaining such funding. This implies that the availability not just of seed and start-up capital, but of VC capital at later financing stages should matter too for firm entry (Samila and Sorenson (2010)). Third, firms may be engaged in "entrepreneurial spawning" or in spin-offs. Gompers, Lerner, and Scharfstein (2005) examine the propensity of publicly traded firms to create new venture backed firms. They find that younger public firms located in main hubs of venture capital activity are the most likely to create new ventures. The employees of these firms are more likely to start their own business because of their exposure to the entrepreneurial process and by working in a network of entrepreneurs and venture capitalists. Sevilir (2010) develops a model in which the availability of new firm financing through venture capitalists makes it more desirable for employees to exert effort, generate a new business idea, and start their own firm. Alternatively, new firms may be established by existing corporations themselves. For example, Fulgieri and Sevilir (2009) argue that when the competition to innovate intensifies, firms move from internal to external organization of projects to increase the speed of product innovation and to obtain a competitive advantage with respect to rival firms in their industry. While we investigate the effect of venture capital on firm entry, distinguishing among the various channels through which this effect is realized is beyond the scope of the paper.

The literature has distinguished entry into an industry from new business creation. The

first accounts for the migration of firms across industries, while the second emphasizes pure entrepreneurship (*de novo* firms). We focus on the second approach and define entry as the incorporation of a previously nonexistent firm in the respective industry and country. To that end, we use data from Amadeus, a comprehensive database of corporations across a number of developed and transition countries in Europe, which allows us to calculate the share of new firms to total firms in each industry for the period 1998-2008. We combine that data with industry-level data on venture capital investment in Europe from VentureXpert. This allows us to study the contribution of venture capital to new business creation over the longest period for which both firm entry can be calculated and venture capital investment is substantial. In addition, we capture a full business cycle, encompassing the peak of the dot-com bubble, the slowdown in VC fundraising in the early 2000s, and the resurgence of VC activity in the mid-2000s.

Finally, we address standard concerns about omitted variable bias and reversed causality, in three different ways. First, we employ a panel approach which allows us to eliminate the effect of various country and industry level left-out variables. Second, we use past levels of venture capital investment to extract the endogeneous element of current VC investment. Third, we employ the variation over time in the behavior of buyout fund managers and pension funds managers in an Instrumental Variable setting. Specifically, we use buyout fundraising and changes in laws regulating the investment behavior of pension funds, alongside their size, as instruments for venture capital investment. The logic behind this approach is that the size of buyout funds and pension funds is correlated with risk capital investment, while at the same time the general demand of buyout fund managers and institutional investors for alternative assets should not depend on entrepreneurship.

We find that the rate of new business creation increases in industries which involve

sizeable venture capital investment. This finding is robust to a variety of data issues, as well as to using venture capital investment averaged over different time periods. Crucially the evidence that VC stimulates new business creation does not disappear once we address the endogeneity of venture capital using data on buyout fundraising, on rules guiding the risk capital investment of pension funds, and on the size of pension funds, as instruments. We find that the effect of venture capital is not influenced by its high correlation with other types of finance, or by the sensitivity of venture capital-intensive industries to other characteristics of the business environment. In general, we find that venture capital investment has a higher effect on new business creation in capital-intensive and in R&D-intensive industries. We also show that venture capital works better in countries with lower capital gains taxes and with higher human capital. This implies that VC is more effective in industries and in countries with a more dynamic supply of ideas and with higher returns to entrepreneurship relative to employment. Finally, these results are robust to controlling for standard determinants of new business creation, notably barriers to entry.

The paper proceeds as follows. In Section 2 we summarize the data. Section 3 describes the empirical methodology. Section 4 presents the empirical results. Section 5 concludes with the main findings of the paper.

2 Data

This section describes the two main data sources used in the empirical analysis. We first describe the data on *de novo* firm creation, and then the data on VC investments.

2.1 Amadeus Database

The firm-level data come from the Amadeus database. Amadeus is a commercial pan-European database provided by Bureau van Dijk, containing financial information on over 10 million public and private companies in 38 European countries. The database contains detailed firm-level accounting data for a number of financial ratios, activities, and ownership. Initially received from over 50 different vendors across Europe, the data are then transformed into a single format enabling comparison across countries. The focus of the Amadeus database is on financial information, like firm profit, revenue, assets, debt and value added. In addition to that, Amadeus provides firm-level information on year of incorporation and employment. We use the year of incorporation to calculate the age of the firm, hence the share of "new" firms in each industry-country-year. The variable we create is referred to as $Entry_{ijt}$, and it denotes the share of firms less than 2-years old in country i in industry j in year t over the longest period for which reliable data is available, 1998-2008. We only count the firms that are at least 1 full year of age to reduce measurement error. Finally, Amadeus uses the 3-digit NACE industry classification standard, which we aggregate at the 2-digit level in order to have a sufficient number of firms in each industry for each country.

We employ the same sample selection procedure to the Amadeus dataset as Klapper, Laeven, and Rajan (2006). From each Amadeus DVD, the last year is not used due to lags in data collection and hence intrinsic incompleteness of the information. The years prior to three years before the current year are not used due to the survivorship problems of the Amadeus database: when a firm ceases existing, Amadeus keeps a record of it for 4 years, and then takes it out of the database. Consequently, while each yearly addition of Amadeus contains data for more than 4 years back, the sample of firms one will find reported for the time-period 4 years and more prior to the year of issuing, will not include many firms which

existed in that year, but exited the market after that. For example, the data for firms in 2000 as reported in the 2004 database will not include firms that exited in 2000 or before. Using the data indiscriminately will therefore induce survivorship bias and misrepresent the volume of entry, and so we should focus our attention to the years 2-3 prior to the year the database was issued. In practice, for a set of 11 databases over 1998-2008, we focus in each one on the year two years before the year of issuance (that is, we use the data on 2002 from the 2004 database, and so on).

Firms in the final dataset we use are also required to have basic accounting information. This approach excludes phantom firms created for tax purposes. We drop firms that report only consolidated statements in order to avoid double-counting firms and subsidiaries abroad. We exclude industries where the activities are country-specific, namely agriculture, forestry, fishing and mining. We exclude Luxembourg due to insufficient availability of data on venture capital investment, although this country is covered by Amadeus. We also exclude utilities and post and telecommunications, which tend to be heavily regulated and/or state-owned, and the financial services sector because financial firms are subject to specific regulations which do not apply for other firms (for example, initial capital requirements). We exclude properietorships and partnerships because in most European countries only limited liability companies are required to file statements. Finally, we exclude the public sector, education, the social sector, private households, and activities that cannot be classified. We are left with 37 NACE industries. The final sample consists of an annual average of 3,191,881 firms in 21 countries: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, and UK.

<< Table 1 >>

Table 1 summarizes the Amadeus data by country. We record sizeable variation across countries. In particular, "high-entry" countries like Denmark, Iceland, and Norway, have two to three times the average new business creation rates of "low-entry" countries like Italy, the Netherlands, and Belgium. Switzerland is an outlier, with average new business creation at 1.3%. The reason is that small firms are not required to file, for which reason we later drop all observations from Switzerland in robustness tests. The third column of Table 1 also summarizes the "Amadeus coverage", namely, the ratio of the number of firms in each country present in Amadeus to the number of firms in each country according to Eurostat. The coverage ranges from a low of 8.3% in Slovakia to a high of 100% in Norway.

<< Table 2 >>

In Table 2, we report aggregated entry rates per industry for our European sample over the 1998-2008 period. Clearly, the variation in industry entry rates is substantial, with the long-term share of firms younger than 2 years out of total firms as low as 0.049 in industry "Pulp, paper, and paper products" and as high as 0.124 in industry "Computer and related services".

2.2 VentureXpert

The venture capital investment data comes from Thomson VentureXpert. The Thomson VentureXpert database contains information for all venture capital deals realized in 21 European countries (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Switzerland, Sweden, and UK) over a 19 year period from January 1, 1990 to December 31, 2008. Venture capital investment in the database only includes seed/start-up,

development, early, balanced, expansion and later stage investments. It therefore excludes buyouts, mezzanine financing, turnaround financing, distressed debt investments, and other private equity investments by secondary funds and fund of funds. These investments can be made by venture capitalists from the same country in which the portfolio firm is located but also by foreign venture capitalists. We downloaded all venture capital deals from Thomson VentureXpert for each country for the period 1998-2008. While VentureXpert contains data on VC deals back to 1990, 1998-2008 is the longest period for which the database on firm entry we use - Amadeus - offers extensive coverage of firms.[2]

The original data contain information about deal value as well as each portfolio company's industry affiliation codes (VE Primary Industry Sub-Group 3 and NAICS code). However, for 13.8% of the deals, the NAICS industry affiliation information is missing. For these cases we developed a unique concordance key to translate these companies' VE Primary Industry Sub-Group 3 to a NAICS code. The concordance key is constructed based on the most frequently observed NAICS code from all deals in that VE Primary Industry Sub-Group 3 realized in 21 European countries from 1990 until 2008. By using this key, we are able to assign all target companies to a NAICS code. Aggregate values of venture capital invested in each industry are then calculated for each year and for each country. Finally, the NAICS codes are converted into NACE Rev. 1.1 codes using the already available concordance key from the U.S. Census Bureau.

<< Table 3 >>

Table 3 summarizes the venture capital data by country. It contains information on the number of deals per country over the period 1998-2008, as well as on the average annual volume of total venture capital investment and on the ratio of that investment to GDP.

[2]Nevertheless, we use VC data as far back as 1994 to construct lagged VC variables in some exercises.

Clearly, venture capital investment varies markedly across countries. For example, Hungary, Iceland, Ireland, the Netherlands, Sweden, and the UK attracted over the period in question an average of more than 0.1% of venture capital investment to GDP, approaching U.S. levels in that respect. At the same time, countries like Italy, Poland, and Portugal each had an average ratio of venture capital investment to GDP of less than a sixth of the U.K. one. In terms of total investment, venture capital disbursements are clustered too: France, Germany, and the UK accounted for around 2/3 of all investment over the period. Overall, around 82 bln. USD were invested in venture capital finance over the period, in a total of 21,413 deals. The average European venture capital deal over the period thus involved 3.83 mln. USD worth of investment. For comparison, over the same period Thomson VentureXpert covers 56,403 venture capital deals in the U.S. involving a total of 544.4 bln. USD. The European venture capital market is thus around 2.5 times smaller in terms of number of deals, and the average deal in Europe also involves about 2.5 less money invested.

<< Table 4 >>

Table 4 provides a time-dimension look at the venture capital data. The most venture capital deals recorded were at the peak of the dot.com bubble, in 2000 and 2001, whereas by 2003-2004 venture capital investment had fallen by more than two thirds from its peak, only to recover again in subsequent years. In relation to GDP, venture capital in Europe in 2000 approached average U.S. levels, and its decline in the wake of the dot-com bust was equally impressive. It is worth noting that part of the recovery in VC investment in the mid-2000s was due to a sequence of regulatory changes favorable to venture capital, mainly reforms of pension funds laws, allowing automonous pension funds to invest in risk capital. In particular, in 2003 EU-wide Directive 2003/41/EC liberalized the pension fund regime for all EU member countries, preventing governments from imposing any but modest

quantitative restrictions to the share of assets a pension fund could devote to risk capital.[3] Overall, this development is similar to the one in the U.S., where in 1978, the Department of Labor clarified that investments in venture capital funds by pension funds do not violate the prudent man rule in Employee Retirement Income Security Act (ERISA), leading to a large increase in VC disbursement in subsequent years.[4]

3 Empirical Methodology

We use a panel regression where the main unit of observation is the industry-country:

$$Entry_{ijt} = \beta_0 + \beta_1 \cdot Venture\ capital_{ijT} + \beta_2 \cdot Share_{ijt} + \beta_3 \cdot D_i + \beta_4 \cdot D_j + \beta_5 \cdot D_t + \varepsilon_{ijt} \quad (1)$$

As in Klapper, Laeven, and Rajan (2006), $Entry_{ijt}$ denotes the share of firms less than 2-years old in country i in industry j in year t. $Venture\ capital_{ijT}$ denotes venture capital investment in country i in industry j in period T. Because we expect that historical investment will be responsible for contemporaneous firm creation to a larger degree than contemporaneous VC investment, in the main specification we use a 3-year VC investment average at the industry-country level. We test for sensitivity to this time period by also considering contemporaneous investment, as well as up to 5-year averages. We expect that venture capital is conducive to new business creation, and hence a positive sign for the main regression coefficient of interest, β_1.

Studies of cross-sector industrial growth consistently predict that sectors which have

[3] See EVCA yearbook 2004 for details.

[4] See Gompers and Lerner (1999b) for details.

already grown fast in the past grow less in the future (see, for example, Rajan and Zingales (1998)) and have larger average firm size (see, for example, Cetorelli and Strahan (2006)). By extension, larger sectors should have lower entry rates. In addition, theories of the industry's life cycle predict that sectors which are already relatively large should have lower rates of new business incorporation (see, for example, Klepper (1996)). Hence, the variable $Share_{ijt}$, which denotes industry j's share of total employment in country i during year t, is included in the regression, and it should capture the different propensity to entry and growth due to life-cycle specific reasons.

Next, D_i is a matrix of country indicator variables controlling for any market-specific, time-invariant effects on *de novo* business creation. D_j is a matrix of industry indicator variables controlling for any industry-specific, time invariant effects on *de novo* business creation. D_t is a matrix of year dummies controlling for the effect of the business cycle on *de novo* entry which is common to all countries and industries. In an alternative specification, we replace D_i, D_j, and D_t with D_{it} and D_{jt}. D_{it} is a matrix of country-year indicator variables controlling for any market-specific, time-varying effects on *de novo* business creation. Analogically, D_{jt} is a matrix of industry-year indicator variables controlling for any industry-specific, time varying effects on *de novo* business creation. These fixed effects account for convergence phenomena as in Barro and Sala-i-Martin (1992). Finally, ε_{ijt} is the idiosyncratic error.

4 Results

This section reports the results from the main empirical exercise, from the tests which correct for the endogeneity of the VC series, and from the various robustness checks.

4.1 Venture Capital and New Business Creation: Main Results

In Table 5, column (i) we present the estimates from the basic OLS regression of entry rates on venture capital investment. The main explanatory variable is the average VC investment over the past 3 years in a particular industry-country pair in each year. The estimate of β_1 is significantly positive, implying that de novo business creation is higher in industries with higher venture capital investment. Numerically, a two standard deviation increase in venture capital investment increases entry rates by 5.9% for an industry with the sample mean entry rate. As expected, larger industries have lower entry rates, albeit this effect is not statistically significant. This simple first empirical test confirms the hypothesis that venture capital investment has a real contribution to firm creation.[5]

<< Table 5 >>

In this basic case, the main explanatory variable has a missing value when there has been no VC investment in the past 3 years in that industry-country, and so we only estimate the effect of higher VC investment conditional on the industry-country pair being in the set of VC-receiving industries. In column (ii), we use an alternative VC measure, namely an indicator variable equal to 1 if the industry-country pair has received any venture capital investment in the past 3 years. In this case, we compare entry in industries that receive VC funds to entry in industries that do not. The estimate of β_1 is again positive and significant, and its magnitude implies that de novo firm creation rates are on average higher by 7.1% in industries that receive VC funds relative to industries that do not.

It is a logical question whether the effects we have observed so far are caused by the high end of VC investment, or average VC investment accounts for the bulk of the result.

[5]However, before addressing the endogeneity probelm, we will be using the word "effect" with caution.

In column (iii), we report the estimates from a model where the variable for VC investment has been replaced with dummies for whether VC investment in that particular industry-country pair falls in the 1st, 2nd, 3rd, or 4th quartile of the VC investment distribution.[6] We record that the high-end VC investment is associated with higher firm entry, both relative to middle-, low-, and no-VC industries.

In the rest of the columns of Table 5, we test the basic result using different specifications of our empirical model. In columns (iv)-(vi), we account for left and right censoring by replacing the OLS specification with a Tobit one. The rationale behind this is that entry rates are left-truncated at 0 and right-truncated at 1. The coefficients on the main variables of interest do not change, and they stay significant at the 5%. Finally, we replace the matrix of country, industry, and year dummies with country-year and industry-year interactions, to account for unobservable trends at the market and sector level. While the magnitude of the coefficient on the main variable of interest decreases slightly, column (vii) shows that the effect is still statistically and economically significant (numerically, a two standard deviation increase in venture capital investment increases entry rates by 4.9% for an industry with the sample mean entry rate).

4.2 Addressing Various Data Issues

Next, in Table 6 we address various potential questions about the validity of the VC measures we use and the quality of the underlying Amadeus data. First, the decision to average VC investment over a 3-year period is certainly arbitrary. It might make more sense to allow for longer gestation periods. Alternatively, the effect of VC could be immediate, given that a non-negligible portion of VC investment is seed and start-up capital. Columns (i) and

[6] A similar estimation strategy is pursued in Bernstein, Lerner, Sorenson, and Scharfstein (2010).

(ii) address these questions. We find that it makes sense to look at longer rather than shorter periods, and that averaging over 3-years does not lead to much different estimates relative from using longer time periods, making the main empirical strategy we have chosen a reasonable one.

<< Table 6 >>

We also need to account for initial firm business creation. Venture capital activity only picked up in Europe in the late 1990s, and so we may be measuring a simple correlation due to the fact that VC investment has been highest in industries which already had high entry rates in the beginning of the sample period. In column (iii), we estimate a version of model (1) which includes a variable equal to the share of new firms to all firms for each industry-country pair in 1998, and excludes all observations for 1998 from the regression. Variations in entry rates in 1998 explain a large portion of the variations in entry rates over the rest of the sample period. Nevertheless, while our estimates decrease in magnitude, they remain statistically significant.

Next, we address the issue of the varying representativeness of Amadeus across countries. As demonstrated in Table 3, in some countries Amadeus covers too few firms relative to the total firms in the country according to Eurostat. We start by excluding Switzerland, which has comprehensive coverage on venture capital investment, but its Amadeus coverage is compromised by the fact that small firms are not required to file. This leads to a very low observed entry rate (1.28% relative to the sample average of 7.21%). We then exclude Iceland, Portugal, and Slovakia, for which the ratio of firms in Amadeus relative to firms in Eurostat is less than 0.33.[7] The sample thus reached should represent the best match of Amadeus and VentureXpert data that is possible to construct while avoiding limited

[7] A similar sample selection is applied to Amadeus by Klapper, Laeven, and Rajan (2006).

coverage, insufficient observations, and legal requirements problems. However, our estimates of the effect of venture capital on firm entry (column (iv)) do not suffer much from this sample selection procedure.

Next, in column (v) of Table 6, we exclude the sub-sample of transitional economies and countries with limited venture capital investments. This sample consists of the 4 transition economies (Czech Republic, Hungary, Poland, and Slovakia), as well as Greece and Iceland. The 1990s were a vibrant period in the economic history of Central Europe in terms of privatization, and we would like to eliminate the possibility that a large number of new private firms are actually old state-owned firms which have been counted only after they became private.[8] We also want to eliminate countries with too little venture capital that may be biasing the results if these countries happen to be very low-entry. Our results are robust to the exclusion of this set of countries, but the statistical significance of the magnitude of the coefficients decreases somewhat.

Finally, in column (vi) we exclude the UK and France from the regressions. These two countries account, on average, for close to 50% of all VC deals in the sample, and for over 50% of total disbursements. We want to make sure that our results are not driven by the industrial composition of these two economies. We find that they are not - in fact, once the two countries are dropped from the sample, the estimates are significant at the 1% statistical level.

4.3 Endogeneity and Selection

The empirical methodology chosen is traditionally prone to endogeneity problems. A measured positive regression coefficient on the variable of interest does not automatically imply

[8] This cannot be inferred from Amadeus.

causality; it could be that venture capital investment is driven by industries with high entry rates, or it could be that a set of omitted variables is jointly driving both the propensity to enter and the propensity to invest in start-up companies. One simple way to account for the endogeneity of current VC investment is to use lagged values of VC investment. Such a definition of VC investment should be less correlated with the current industry structure, and hence should partially address the concern that the effects we measure are due to VC investors reacting to current opportunities (see Bernstein et al. (2010)).

However, lagged VC variables are not a perfect solution to the endogeneity problem because entrepreneurial opportunities and industry dynamics are likely to be correlated along longer periods. Therefore, it is preferred to find an instrumental variable which is correlated with VC investment but not with entrepreneurial opportunities, and use it to extract the endogenous element of VC investment. It has been generally agreed that the country's legal origin is a strong predictor of the degree of legal regulation and by extension the quality of the financial system nowadays (La Porta, Lopes-de-Silanez, Shleifer, and Vishny (1998)). However, in the case of venture capital investment, there are two problems which reduce legal origin to a suboptimal instrument. First, the exogenous component of the legal system is likely more strongly correlated with traditional types of finance than with venture capital investment, which violates the validity condition. Second, legal systems most probably affect entry via channels other than venture capital investment, like barriers to entry, which violates the exclusion restriction.

One alternative approach suggested by the VC literature (Kortum and Lerner (2000), Samila and Sorenson (2010)), is to use the size of pension funds and buyout fundraising as instruments for VC investment. The rationale for the latter is clear: given that buyout companies frequently invest locally, the magnitude of domestic buyout fund-raising should

be correlated with VC investment, while at the same time, being targeted at later-stage investment, it should be orthogonal to the rates of new business creation. Regarding the former, as pointed out in Gompers and Lerner (1999b), the 1979 clarification of the ERISA by the U.S. Department of Labor led to a five-fold increase in VC investment in the next two decades. European law also offers variation over time and across countries in that respect: while the UK has been allowing pension funds to invest in risk capital since pre-1991, for many European countries restrictions were only lifted by the EU-wide Directive 2003/41/EC in 2003, which eliminated restrictions on the investment behavior of pension funds, only allowing national governments some discretion on, for example, maximum amounts pension funds are allowed to invest in risk capital markets.[9] (However, in one case - Sweden - the Directive was followed by a national legislative ban on investment in risk capital by pension funds, deeming such investments too risky). Finally, how much pension funds would invest in reality is of course a function of their size.

Therefore, in an attempt to address the endogeneity problem, we create three instruments. First, we create a variable "3-period lagged 3-year VC" equal to the 3-period lagged value of average 3-year VC investment. Second, we use data from EVCA on fund-raising by private equity firms, whose anticipated allocation is buyout investment, and create a variable "Buyout funds raised" equal to the value of buyout funds raised over the past 3 years. This variable should constitute a VC supply-shifter, for the reasons described in the previous paragraph.[10] Finally, we follow Kortum and Lerner (2000) in using pension funds size

[9] See Appendix 2 for details.

[10] The argument could be made that private equity companies frequently invest abroad, and so we should look at the cross-country pattern of fund-raising. However, theoretical arguments and empirical evidence suggest that venture capitalists employ most of their capital close to their headquarters. For example, Kaplan and Stromberg (2001) argue that the most valuable commodity for a VC is time, and due to extensive monitoring venture capitalists choose portfolio companies as to minimize travel. In addition, Sorenson and Stuart (2001) show that most VC investments in the U.S. are made in a 500-mile radius. Therefore, the portion of private equity funds ultimately allocated to VC follows more of a domestic than cross-border

and liberalization events as an instrument. We create a "Liberalization dummy", namely, an indicator variable equal to 1 if the respective country has already liberalized risk capital investment rules for pension funds in that particular year. We also acquire information on the assets of domestic pensions funds from Eurostat, and take the natural logarithm of it to create a variable "Pension fund size". Finally, we create an "Early VC" variable equal to average VC investment in a particular industry-country prior to pension funds liberalization events. Then, we interact these three variables with the "Liberalization dummy". As explained by Kortum and Lerner (2000), this variable should constitute a VC supply-shifter: larger pension funds should lead to higher VC investment, but only if pension funds are allowed to invest in risk capital, and only in industries that were of interest to venture capitalists before the change in pension laws.

The latter instrument is subject to one caveat. It is possible that the laws regulating risk-capital investment by pension funds were enacted following pressure from a growing VC industry, which would make them endogenous to the size of venture capital investment and hence violate the exclusion restriction. However, our investigation into the genesis of these laws confirmed that the formal motive expressed during the legislative process was universally diversification of risk (EVCA yearbooks, 1991-2008).

<< Table 7 >>

In Table 7, we report the results from the first stage of the 2SLS regression, where we have regressed the main VC variable used in the paper on the three instruments, one at a time. In all cases, the sign is positive and the effect is significant at the 1% statistical level. The F-statistics in each case is higher than the critical value required for the IV estimates

pattern.

to have no more than 10% of the bias of the OLS estimates (see Stock and Yogo (2005) for details).

In Table 8, we report the estimates from the second stage of the regression. Our main measure of VC is instrumented by lagged VC (column (i)), buyout fundraising (column (ii)), pension funds size interacted with a liberalization dummy and with pre-pension law change VC levels (column (iii)), and the latter two instruments jointly (column (iv)). We find that in all cases, the estimates of β_1 are still positive and significant, and the magnitudes of the effect increases substantially. While conceptually it is clear that the general demand of institutional investors for alternative assets, including venture capital, should not depend on entrepreneurship, we also test formally the correlation between the instruments and the second stage error term, that is, the probability that they violate the validity of the exclusion restriction (see Hansen (1982) for details). In column (iv), the Hansen J-statistic does not exceed the critical value required to reject the null hypothesis that the institutional investors instruments are valid.

<< Table 8 >>

While the results from these tests are satisfactory, certain endogeneity concerns can still be raised. For example, it could be that countries with large industries with high natural entry may have both higher entrepreneurial culture (resulting in more entry regardless of venture capital investment) and have higher levels of venture capital investment (due to higher demand for all types of finance). One method to control for that possibility is to exclude the industries that are in the right tail of the industry size distribution. We restrict our sample to the industries that are in the bottom tertile, bottom two tertiles, or outside the top 10% of their country's industries in terms of size. When we do that, in all cases we get estimates which are still positive and significant, similar to magnitude to the ones estimated

previously, and they do not vary much regardless of the definition of "small industries" that we use. The coefficient after the exclusion of the top 10% is reported in column (v). The effect of VC on firm entry still stands.

Another consideration is that economic development is correlated with VC investment, and so we need to control for GDP per capita. We do so in column (vi), and the effect of VC doesn't go away. Finally, it could be the case that poor countries are naturally more adverse to entrepreneurial activity (and hence, there is naturally less entry), and so there will also be stricter rules guiding private investment in risk capital, as the local legislatures would be adverse to business activity in general. The above argument would imply that if it is a selection problem, venture capital investment will have a larger effect in poorer countries where VC investment is more limited. This is not the case; in fact as indicated in columns (vii), the effect goes in the opposite direction – venture capital is relatively more conducive to business creation in richer countries, implying no omitted variable bias.

4.4 Alternative Proxies for Finance

We next account for the possibility that venture capital investment is a mere proxy for other types of finance or for return to investment. For instance, countries with higher venture capital investment will tend to have better developed banking sectors, so our measure of venture capital investment may partially be capturing the effects of credit markets on entry via business loans. Also, countries with dynamic VC industries will tend to have higher investor protection, and so again our estimates may be contaminated by the effect of the expected return on investment on entry. Most importantly, the volume of finance may matter less than access to finance per se. For example, Ayyagari, Demirgüç-Kunt, and Maksimovic (2010) show that access to external financing is associated with greater firm innovation by

small firms. Hence, our VC variables might be picking up the effect on new business entry by innovative companies of easier access to all kinds of finance, including consumer loans and mortgages. In all of those cases, our estimates would be biased.

Therefore, in Table 9 we proceed to measure the effect of venture capital investment on entry alongside the effect of finance in general. In column (i), we show the estimates of a regression which includes a measure of private credit by commercial banks, normalized by GDP, and interacted with an indicator equal to 1 if the industry has received any VC investment in the past 3 years. This measure is widely accepted as a good proxy for a range of financial issues, like access to business loans, depth of the financial sector affecting the ability of financial players to gain access to investment opportunities, etc. (Rajan and Zingales (1998), Beck, Demirguc-Kunt, Laeven, and Levine (2008)). The effect of private credit on new business entry is positive and statistically significant, implying an independent effect of credit on *de novo* firm creation. However, the effect of VC remains positive and significant, and so it is not through VC-intensive industries that private credit affects *de novo* firm creation.

<< Table 9 >>

Next, we account for the fact that private credit is also a volume measure and thus an imperfect proxy for access to finance. Therefore, we employ a formal proxy for access to financial services (column (ii)) taken from the World Bank's "Finance for All? Policies and Pitfalls in Expanding Access" which is a composite indicator measuring the percentage of the adult population with access to an account with a financial intermediary. While this index captures mere access to business loans, it is a better measure than the volume of private credit of how easy it is to access financial services in general. The correlation between the two measures is 0.71, implying that they are highly but not perfectly correlated, and so the

formal index could indeed be capturing more access issues than private credit. Again, while it is positively (but insignificantly) correlated with new business incorporation, including it in the regression does not eliminate the effect of venture capital on firm entry.

We also look at investors' protection. Rajan and Zingales (2003) argue that the absence of regulation protecting investors could be a very efficient barrier to new firm creation. The right measure of financial development, the argument goes, would capture not only the ease with which any entrepreneur or company with a sound project can obtain finance, but also the confidence with which investors anticipate an adequate return. The previous two measures we used would then be a poor proxy for this investor confidence, and we next proceed to incorporate in our regression a direct measure of the degree to which individual investments are protected by the legal system in the country. The indicator we employ is a composite of the quality of three indices: transparency of transactions, liability for self-dealing, and shareholders' ability to sue officers and directors for misconduct. This index has a negative effect on entry of firms in VC-intensive industries, again pointing to the fact that venture capital investment is not contaminated by the investors' taking into account how the degree of legal protection impacts the expected return to individual investments in start-up companies. Tellingly, the effect of venture capital investment on business entry survives this extension of the basic model (column (iii)).

Finally, we perform a horse race in which we include all country-level measures used in Table 9 so far (column (iv)). We find that both private credit and investor protection enter significantly, while access to finance has an insignificant effect on *de novo* firm creation in VC-intensive industries. Importantly, venture capital finance continues to affect positively firm entry, with a little changed order of magnitude.

4.5 Sensitivity to Industry and Country Characteristics

Next in Table 10, we estimate the effect of venture capital investment on entry, accounting for the standard industry determinants of entry that have been suggested by the literature, as well as for the standard country-level determinants of entry. In particular, it has been pointed out that entry rates are affected negatively by financial dependence, and positively by technological opportunities, among else.[11] We want to therefore make sure that the effects we are measuring are not driven by other industry characteristics correlated with what makes an industry attractive to venture capitalists. For example, the positive effect of venture capital investment on entry might be partially driven by the fact that the VC-intensive industries may also be more dependant on external finance. Hence, higher entry in those could be caused by the availability of credit in general, which may be highly correlated with venture capital investment. We also want to check whether venture capital investment affects entry for industries that are likely to be affected by targeted investment, like R&D intensive industries. We do not look at industry characteristics which have been shown to have an ambiguous or slow effect, like profitability.

At the country level, Klapper, Laeven, and Rajan (2006) have shown that entry barriers are associated with relatively lower entry in industries that have higher natural entry (and so the relaxation of barriers to entry is relatively more beneficial in those). The propensity to enter can also be affected by labor regulations: if the industries that have naturally higher entry also are the most labor-intensive ones, then lower entry rates may be the result of stricter labor regulations rather than the unavailability of start-up financing. The average human capital in the economy could also play a crucial role - it could be argued that the most dynamic industries tend to be at the same time the ones that require the most up-

[11] See Geroski (1995) for a summary of the empirical evidence on that.

do-date knowledge and skills, like the software industry. Hence, observed lower entry rates in VC-intensive industries in countries with fewer venture capital investments may actually be the result of the lack of enough skilled workers due to the inability of the education system to provide those skills. The effect of intellectual property rights protection could also contaminate our estimates if the VC-intensive industries are at the same time the ones that rely most on intangible inputs. Finally, there could be a tax issue involved: entrepreneurs may be less able to garner funds to enter more dynamic industries leading to IPOs if there are high taxes on capital gains. Also, fewer people will undertake the transition from employees to entrepreneurs if this is the case (Da Rin, Di Giacomo, and Sembenelli (2010)).

<< Table 10 >>

In columns (i) and (ii) of Table 10, we examine the effect of venture capital on industries with higher technological opportunities, proxied by R&D intensity and capital intensity.[12] In terms of specification (1), we simply replace the measure of 3-year average VC investment at the country-industry level with industry measures of median capital usage and R&D investment per worker, respectively, interacted with the measure of 3-year average VC investment at the country-industry level. We find that the effect of venture capital investment is relatively higher in capital-intensive and in R&D intensive industries. These results are quite natural: while VC finance can certainly alleviate the difficulties in acquiring productive capital, we also confirm that venture capitalists have a natural advantage in funding firms which rather rely on intangible capital. In the sense that intangible-intensive industries are more prone to innovation, our results confirm previous findings that market-based financial systems have a generally positive effect on innovation (see Tadesse (2006)). Importantly, the

[12] All industry "natural" intensities are calculated using data on mature Compustat firms averaged over the period 1990-2000. See Appendix for detail.

sign and significance of both coefficients confirms that venture capital investment is relatively more beneficial for industries which have naturally higher technological opportunities (for example, manufacturing of chemicals and chemical products - industry 24 - will benefit relatively more than transport via pipelines - industry 60).

In columns (iii)-(v), we carry out our basic regression (1), accounting for three other industry characteristics - dependence on external finance, R&D intensity, and propensity to entry - and the characteristics of the business environment that have been shown to matter most for those. For instance, Rajan and Zingales (1998) have shown that the general measure of private credit by commercial banks, normalized by GDP, has a differential effect on industry growth after distinguishing by external financial dependence; Park and Ginarte (1997) have shown that intellectual property protection has an effect on economic growth through the channel of R&D investment; and various authors (for example, de Soto (1990) and Klapper, Laeven, and Rajan (2006)) have shown that entry barriers are detrimental to growth, especially in naturally high-entry industries. We find that all of these characteristics of the business environment matter for entry exactly as predicted: higher private credit is associated with higher firm entry in financially dependent industries; higher intellectual property protection is associated with higher entry in industries that naturally invest more in R&D; and lower entry costs are associated with relatively higher entry in industries that are growing faster. Importantly, in all cases higher venture capital investment keeps its independent effect on entry.

Finally, the effect of venture capital on entry survives the second "horse race": when all interactions from columns (iii)-(v) are included in the regression, the effect of venture capital still stands. However, now it is only significant at the 10%, pointing to the fact that it is partially correlated with other relevant characteristics of the business environment that are

conducive to new business creation.

4.6 Other Characteristics of the Business Environment

Finally, in Table 11 we ask the question, what characteristics of the business environment augment the effect of VC investment on entry? The large cross-country dataset we work with is ideally suited to answer this question. We interact venture capital investment with the rest of the relevant country-level variables we have so far been working with - namely, barriers to entry (proxied by the number of procedures necessary to start a business), labor regulations (proxied by how difficult it is to hire and fire workers), intellectual property rights protection, tax on capital gains, and human capital (proxied by average years of schooling).

<< Table 11 >>

We find that the effect of venture capital on new business creation does not depend on entry costs. While one would expect that the ability to raise external funds will enable entrepreneurs to start new business more easily in less regulated countries, institutional substitutabilities could cancel that effect if access to finance tends to decrease the marginal cost of meeting certain regulations (Ahlin and Pang (2008)). However, we find that venture capital investment has a stronger effect on *de novo* firm creation in countries with stricter labor regulations. In this case, VC seems to alleviate barriers to entry, and so it acts as a substitute for labor market flexibility. We also find that venture capital investment has a stronger effect on new business creation in countries with lower taxes on capital gains. This relates to previous research which has found that a larger portion of venture funds raised is allocated to early-stage finance in countries where the returns to entrepreneurship are higher (Da Rin, Nicodano, and Sembenelli (2006)). We also find that the effect of VC on

firm entry is stronger in countries with higher intellectual property rights protection (or with higher return to investment), but this effect disappears in the horse race. Finally, higher venture capital investment results in more dynamic industries in countries with higher human capital. This result broadly confirms a strand of research which has documented the value of VC-university hubs in fostering entrepreneurship (see Gompers and Lerner (1999b)).

5 Conclusion

We use a large panel of 21 countries and 37 industries over the 1998-2008 period to identify the impact of venture capital investment on entrepreneurship. We use the Amadeus database, which includes data on about ten million firms all across Europe over the 1998-2008 period, and match that data to data from VentureXpert on the size and number of venture capital deals. We find that venture capital investment has a beneficial effect on new business creation, which is relatively higher for industries which are more capital- and R&D-intensive. The effect holds for different averaging of past VC data. The results stand when we correct for the endogeneity of the venture capital investment series by using an IV procedure in which past VC investment, variation in buyout fundrasing, and prudential regulation guiding the investment behavior of domestic pension funds is used as an instrument for the supply of VC funds.

We also find that the effect of venture capital is higher in countries with higher human capital and with lower taxes on capital gains. To the extent that venture capitalists target industries that rely heavily on intangible assets and have high IPO activity, the effect of their activity should be more pronounced in countries where the market for ideas is more dynamic and where the returns to entrepreneurship are higher. At the same time, we find

that the relatively higher effect of venture capital investment on entry is generally robust to accounting for other industry characteristics, as well as for other characteristics of the business environment that have been suggested by the literature as important determinants of new business creation, notably barriers to entry.

This paper is, to our knowledge, the first attempt to empirically link venture capital investment to industry entry in a large cross-country setting. Our results strongly suggest that venture capital investment is conducive to bringing new ideas to the marketplace in the shape of young companies. In this paper we have nothing to say about the private return to this process, but as far as aggregate economic effects are concerned, VC investment does seem to generate value through fostering entrepreneurial activity in the economy. A number of important questions remain unanswered due to the nature of our data. For example, what is the relative importance of the different channels via which venture capital affect entry? Is it more anticipatory considerations where nascent entrepreneurs are aware of future financing needs and are more likely to decide to start their own business at a time when more venture capital is available? Or is it entrepreneurial spawning where venture-backed firms are more likely to create other new ventures? Future research can greatly contribute by addressing those questions.

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Table 1
Summary Statistics: New Business Creation, By Country

Country	Total firms	% new firms (1 and 2 years old)	Amadeus coverage
Austria	60,895	8.73	54.3
Belgium	127,569	5.18	73.4
Czech Republic	52,090	6.07	42.9
Denmark	39,454	11.11	94.3
Finland	42,513	6.66	79.4
France	327,208	7.35	68.1
Germany	360,604	7.97	37.8
Greece	11,533	9.08	86.6
Hungary	95,952	8.87	56.0
Iceland	6,654	12.40	28.4
Ireland	46,901	7.72	37.7
Italy	346,960	4.64	55.9
Netherlands	88,800	4.52	48.2
Norway	89,454	10.43	100.4
Poland	27,572	7.71	38.8
Portugal	135,463	5.56	31.2
Slovakia	8,028	7.21	8.3
Spain	399,478	5.42	47.3
Sweden	69,190	5.47	57.0
Switzerland	56,533	1.28	33.5
UK	799,024	8.08	97.4
Total	3,191,881	7.21	59.3

Note: Table 1 summarizes the data on total firms and on new business creation averaged over the period 1998-2008, for all countries in the sample. Data come from Amadeus. The fraction of new firms is calculated as the number of firms 2 or less years old over all firms in a particular industry, and then aggregated over industries, where each industry is weighted by its relative share in a country's overall employment. The last column compares the number of firms in Amadeus to the number of firms in Eurostat.

Table 2
Summary Statistics: New Business Creation, By Industry

2-digit NACE rev 1.1 code and industry name	% new firms
Manufacturing	
15. Food products and beverages	5.75
16. Tobacco products	7.29
17. Textiles	5.12
18. Wearing apparel; dressing and dying of fur	5.28
19. Tanning and dressing of leather; luggage, handbags, saddlery, harness, and footwear	4.89
20. Wood and products of wood and cork, except furniture	6.26
21. Pulp, paper and paper products	4.91
22. Publishing, printing and reproduction of recorded media	6.19
23. Coke, refined petroleum products, and nuclear fuel	9.86
24. Chemicals and chemical products	5.32
25. Rubber and plastic products	5.07
26. Other non-metallic mineral products	4.98
27. Basic metals	6.18
28. Fabricated metal products, except machinery and equipment	5.91
29. Machinery and equipment not elsewhere classified	5.34
30. Office machinery and computers	7.56
31. Electrical machinery and apparatus not elsewhere classified	5.41
32. Radio, television, and communication equipment and apparatus	6.85
33. Medical, precision, and optical instruments, watches, and clocks	5.57
34. Motor vehicles, trailers, and semi-trailers	5.87
35. Other transport equipment	7.71
36. Furniture; manufacturing not elsewhere classified	5.91
Construction	
45. Construction	9.05
Trade	
50. Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel	6.66
51. Wholesale trade and commission trade, except of motor vehicles	6.85
52. Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	7.89
Hotels and restaurants	
55. Hotels and restaurants	10.49
Transportation	
60. Land transport; transport via pipelines	7.84
61. Water transport	8.49
62. Air transport	9.10
63. Supporting and auxiliary transport activities, and travel agencies	7.65
Services	
70. Real estate activities	9.15
71. Renting of machinery and equipment without operator and of personal and household goods	10.51
72. Computer and related services	12.44

73. Research and development	11.68
74. Other business activities	8.33
Other	
93. Other services activities	10.56

Note: Table 2 summarizes the data on new business creation by industry, averaged over 1998-2008, for all countries in the sample. The fraction of new firms is calculated as the number of firms 2 or less years old over all firms in a particular industry. Data come from Amadeus.

Table 3
Summary Statistics: Venture Capital Data, By Country

Country	VC deals	VC deals volume	VC/GDP in %
Austria	339	1,109.5	0.0459
Belgium	622	2,093.9	0.0803
Czech Republic	101	187.0	0.0633
Denmark	790	1,867.0	0.0865
Finland	990	760.3	0.0525
France	4,016	17,492.0	0.0827
Germany	2,593	9,193.6	0.0337
Greece	43	78.8	0.0739
Hungary	194	788.5	0.1609
Iceland	26	120.4	0.1935
Ireland	607	2,151.6	0.1787
Italy	568	3,043.2	0.0226
Netherlands	1,115	5,476.1	0.1059
Norway	480	937.7	0.0825
Poland	311	346.1	0.0284
Portugal	286	285.8	0.0183
Slovakia	29	36.0	0.0413
Spain	886	4,299.5	0.0494
Sweden	1,358	3,365.4	0.1115
Switzerland	545	2,042.5	0.0568
UK	5,514	26,245.2	0.1274
Total	21,413	81,920.1	0.0786

Note: Table 3 summarizes the data on venture capital investment, aggregated over the period 1998-2008, as well as over industries. In the first column, the total number of deals involving venture capital investment is reported. In the second column, the total volume of venture capital finance involved over the period is reported, in millions of USD. In the third column, the average annual ratio of venture capital investment to GDP is reported. Data come from VentureXpert.

Table 4
Summary Statistics: Venture Capital Data, By Year

Year	VC deals	VC deals volume	VC/GDP in %
1998	629	2,184.5	0.0485
1999	1,221	6,598.7	0.1202
2000	3,019	16,056.3	0.1991
2001	2,507	10,582.7	0.1439
2002	1,481	8,988.5	0.1015
2003	2,782	5,285.4	0.0908
2004	2,782	5,932.5	0.0665
2005	2,290	7,030.2	0.1054
2006	1,850	8,368.7	0.1214
2007	1,469	6,232.1	0.0924
2008	1,383	4,660.7	0.0729
Total	21,413	81,920.1	0.0786

Note: Table 4 summarizes the data on venture capital investment. The data are aggregated over countries, as well as over industries, per year over the 1998-2008 period. In the first column, the total number of deals involving VC is reported. In the second column, the total volume of venture capital finance involved over the period is reported, in millions of USD. In the third column, the average annual ratio of venture capital investment to GDP is reported. Data come from VentureXpert.

Table 5
Venture Capital And New Business Creation

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
		OLS			Tobit		OLS
				Fraction of new firms			
3-year VC	0.127			0.128			0.097
	(0.046)***			(0.046)***			(0.044)**
3-year VC industry		0.278			0.275		
		(0.139)**			(0.139)**		
3-year VC, 2nd quartile			-0.089			-0.080	
			(0.144)			(0.143)	
3-year VC, 3rd quartile			0.069			0.075	
			(0.146)			(0.145)	
3-year VC, 4th quartile			0.359			0.352	
			(0.175)**			(0.174)**	
Share	-0.081	-0.044	-0.038	-0.078	-0.042	-0.037	-0.017
	(0.118)	(0.078)	(0.078)	(0.119)	(0.115)	(0.078)	(0.105)
			Country				Country × Year
			Industry				Industry × Year
			Year				
Observations	2,501	6,439	6,439	2,501	6,439	6,439	2,501
R^2	0.54	0.48	0.48				0.67

Note: Table 5 reports estimates from OLS regressions (columns (i)-(iii) and (vii)) and from Tobit regressions (columns (iv)-(vi)). The dependent variable is the ratio of all new firms (1 or 2 years old) to total firms in each industry-country-year, at the 2-digit NACE rev. 1.1 industry level. The variable is calculated using data from Amadeus. '3-year VC' denotes the natural logarithm of average venture capital investment for the respective industry in the respective country over the past 3 years. '3-year VC industry' is a dummy equal to 1 if the respective industry in the respective country had any VC investment in the past 3 years. '3-year VC, 2nd quartile' is a dummy equal to 1 if the industry belongs in the second quartile of VC-receiving industries in terms of total volume; '3-year VC, 3rd quartile' is a dummy equal to 1 if the industry belongs in the third quartile of VC-receiving industries in terms of total volume; '3-year VC, 4th quartile' is a dummy equal to 1 if the industry belongs in the fourth quartile of VC-receiving industries in terms of total volume. The omitted category in columns (iii) and (vi) is industries in the 1st quartile of VC investment. All VC variables are calculated using data from VentureXpert. 'Share' equals the total employment in a given industry-country-year divided by total employment in the corresponding country-year, and is calculated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies, and year dummies, not reported. In column (vii) country-year and industry-year dummy interactions are used. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Table 6
Venture Capital And New Business Creation: Data Issues

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
			Fraction of new firms			
5-year VC	0.099					
	(0.043)**					
1-year VC		0.092				
		(0.056)*				
3-year VC			0.103	0.098	0.082	0.181
			(0.051)**	(0.042)**	(0.048)*	(0.052)***
Initial entry			0.543			
			(0.033)***			
Share	-0.058	0.052	-0.137	-0.114	-0.133	-0.106
	(0.109)	(0.142)	(0.127)	(0.109)	(0.125)	(0.123)
Fixed effects			Country Industry Year			
Observations	2,825	1,595	2,100	2,358	2,324	1,980
R^2	0.54	0.60	0.56	0.59	0.54	0.53

Note: Table 6 reports estimates from OLS regressions. The dependent variable is the ratio of all new firms (1 or 2 years old) to total firms in each industry-country-year, at the 2-digit NACE rev. 1.1 industry level. The variable is calculated using data from Amadeus. '3-year VC' denotes the natural logarithm of average venture capital investment for the respective industry in the respective country over the past 3 years. '5-year VC' denotes the natural logarithm of average annual venture capital investment for the respective industry in the respective country over the past 5 years. '1-year VC' measures total venture capital investment for the respective industry in the respective country over the current year. All VC variables are calculated using data from VentureXpert. 'Initial entry' denotes the fraction of 1 and 2 years old firms in the respective NACE Rev. 1.1 industry in 1998; observations in 1998 are excluded. In column (iv), the countries for which the share of firms in Amadeus relative to Eurostat is less than 0.33 (Iceland, Ireland, Portugal, Switzerland, and Slovakia) are excluded. In column (v), all transitional economies and countries with too little VC activity (Greece, Iceland, Czech Republic, Hungary, Poland, and Slovakia) are excluded. In column (vi), France and the UK are excluded. 'Share' equals the total employment in a given industry-country-year divided by total employment in the corresponding country-year, and is calculated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies, and year dummies, not reported. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Table 7
Lagged Venture Capital, Buyout Fundraising, and Pension Fund Size: 1st Stage of 2SLS Regressions

	(i)	(ii)	(iii)
		3-year VC	
3-period lagged 3-year VC	0.756		
	(0.014)***		
Buyout funds raised		0.059	
		(0.037)*	
Early VC * Pension fund size * Liberalization dummy			0.409
			(0.028)***
Share	0.061	0.309	0.183
	(0.034)*	(0.050)***	(0.062)***
Fixed effects		Country	
		Industry	
		Year	
F-statistics	130.71	35.41	26.11
Observations	2,258	2,670	1,275

Note: Table 7 reports estimates from OLS regressions. The dependent variable is the natural logarithm of average venture capital investment for the respective industry in the respective country over the past 3 years. '3-period lagged 3-year VC' is the 3-period lagged value of the dependent variable. The VC variables are calculated using data from VentureXpert. 'Buyout funds raised' is the average volume of private equity funds raised in the respective country, expected to be allocated to buyouts, over the past 3 years. Data come from the EVCA yearbooks. 'Early VC' equals the average VC investment in the respectyive country-industry in the years before pension laws allowed for risk capital investment in the respective country. 'Pension fund size' is the average euro value of autonomous pension funds assets in the respective country over the past 3 years. Data come from EUROSTAT. 'Liberalization dummy' is an indicator variable equal to 1 if pension funds in the respective country are allowed to invest in risk capital in the respective country and year. See Appendix 2 for pension fund related events. 'Share' equals the total employment in a given industry-country-year divided by total employment in the corresponding country-year, and is caluclated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies (coulm (i) only), and year dummies, not reported. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Table 8

Venture Capital And New Business Creation: Endogeneity And Selection Issues

	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vi)
	2SLS				OLS		
	Fraction of new firms						
3-year VC	0.196	1.902	1.870	1.341	0.115	0.124	
	(0.064)***	(1.040)*	(0.805)**	(0.250)***	(0.051)**	(0.050)**	
VC * GDP per capita						0.104	
						(0.092)	
VC * High GDP per capita							0.161
							(0.062)***
VC * Low GDP per capita							0.079
							(0.064)
Share	-0.415	-0.760	-0.837	-0.896	0.109	-0.129	-0.176
	(0.157)***	(0.194)***	(0.285)***	(0.480)*	(0.208)	(0.128)	(0.152)
Fixed effects				Country			
				Industry			
				Year			
Hansen *J*				2.317			
Hansen *J* (*p*-value)				0.13			
Observations	1,899	2.206	1,162	1,053	2,228	2,268	2,501
R^2	0.34	0.30	0.35	0.37	0.52	0.53	0.54

Note: Table 8 reports estimates from 2SLS regressions (columns (i)-(iv)) and from OLS regressions (columns (v)-(vii)). The dependent variable is the ratio of all new firms (1 or 2 years old) to total firms for each country-industry-year, at the 2-digit NACE rev. 1.1 industry level. The variable is calculated using data from Amadeus. '3-year VC' denotes the natural logarithm of average venture capital investment for the respective industry in the respective country over the past 3 years. Data come from VentureXpert. 'GDP per capita' is the gross domestic product divided by population for each particualr country in each year. 'High GDP per capita' is a dummy equal to 1 if GDP per capita is in the top half of its distribution. 'Low GDP per capita' is a dummy equal to 1 if GDP per capita is in the bottom half of its distribution. Data come from the Penn Tables. In column (i), VC has been instrumented by the 3-period lagged value of the '3-year VC' variable. In column (ii), VC has been instrumented by the average volume of private equity funds raised in the respective country, expected to be allocated to buyouts, over the past 3 years. Data on those come from the EVCA yearbooks. In column (iii), VC has been instrumented by an interaction term of a dummy equal to 1 if domestic pension funds are allowed to invest in risk capital in this particular country-year with the asset size of autonomous pension funds in this particular country-year and with a variable equal to average VC investment in that particular industry-country in the years before pension laws in that respective country were changed to allow investment in risk capital. Data on pension fund size come from EUROSTAT. See Appendix 2 for pension fund related events. In column (iv), VC has been instrumented by the two instruments used in columns (ii) and (iii). In column (v), the top 10% of the industries in terms of size are excluded. 'Share' equals the total employment in a given industry-country-year divided by total employment in the corresponding country-year, and is calculated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies (columns (i) and (v)-(vii)), and year dummies, not reported. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Table 9
Venture Capital And New Business Creation: Alternative Proxies For Finance

	(i)	(ii)	(iii)	(iv)
		Fraction of new firms		
3-year VC	0.125	0.124	0.126	0.128
	(0.050)**	(0.050)**	(0.050)**	(0.050)**
3-year VC industry * Private credit/GDP	0.018			0.020
	(0.005)***			(0.005)***
3-year VC industry * Access to finance		0.029		-0.003
		(0.036)		(0.037)
3-year VC industry * Investors' protection			-0.134	-0.600
			(0.337)	(0.356)*
Share	-0.110	-0.119	-0.119	-0.105
	(0.128)	(0.128)	(0.128)	(0.128)
Fixed effects		Country Industry Year		
Observations	2,236	2,268	2,268	2,236
R^2	0.54	0.53	0.53	0.54

Note: Table 9 reports estimates from OLS regressions. The dependent variable is the ratio of all new firms (1 or 2 years old) to total firms for each country-industry-year, at the 2-digit NACE rev. 1.1 industry level. The variable is calculated using data from Amadeus. '3-year VC' denotes the natural logarithm of average venture capital investment for the respective industry in the respective country over the past 3 years. '3-year VC industry' is a dummy equal to 1 if the respective industry in the respective country had any VC investment in the past 3 years. All VC variables are calculated using data from VentureXpert. 'Private credit/GDP' measures the ratio of private credit allocated by commercial banks to country total GDP. Data come from the IMF-IFS. 'Access to finance' measures general access to external finance by households and businesses. Data come from *Finance for All?*¸The World Bank, 2007. 'Investor's protection' measures the degree of legal protection of private investment in the country. Data come from the Doing Business Database. 'Share' equals the total employment in a given industry-country-year divided by total employment in the corresponding country-year, and is calculated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies, and year dummies, not reported. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Table 10
Venture Capital And New Business Creation: Sensitivity To Industry And Country Characteristics

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
			Fraction of new firms			
3-year VC			0.124	0.080	0.103	0.083
			(0.051)***	(0.050)*	(0.050)**	(0.045)*
R&D intensity $_{US}$ * 3-year VC	0.014					
	(0.005)***					
Capital intensity $_{US}$ * 3-year VC		0.511				
		(0.146)***				
Financial dependence$_{US}$ * Private credit/GDP			0.606			0.096
			(0.339)*			(0.350)
R&D intensity $_{US}$ * Int. property protection				0.139		0.099
				(0.024)***		(0.026)***
Entry $_{US}$ * Entry cost					-0.060	-0.049
					(0.009)***	(0.009)***
Share	-0.133	-0.141	-0.126	-0.221	-0.064	-0.150
	(0.128)	(0.128)	(0.128)	(0.129)*	(0.127)	(0.129)
Fixed effects			Country			
			Industry			
			Year			
Observations	2,224	2,268	2,236	2,224	2,268	2,194
R^2	0.53	0.53	0.53	0.54	0.54	0.54

Note: Table 10 reports estimates from OLS regressions. The dependent variable is the ratio of all new firms (1 or 2 years old) to total firms for each country-industry-year, at the 2-digit NACE rev. 1.1 industry level. The variable is calculated using data from Amadeus. '3-year VC' denotes the natural logarithm of average venture capital investment for the respective industry in the respective country over the past three years. 'R&D intensity $_{US}$' measures the per-industry median R&D usage per worker, by 2-digit NACE rev. 1.1. 'Financial dependence$_{US}$' measures the per-industry median share of operating expenses financed externally. 'Industry growth $_{US}$' measures per-industry median growth in sales, by 2-digit NACE rev. 1.1. The variables are calculated using data on mature Compustat companies for the 1990-1999 period. 'Entry$_{US}$' is the ratio of new firms to total firms in the US, by 2-digit NACE rev. 1.1. Data come from Dun and Bradstreet. 'Private credit/GDP' measures the ratio of private credit allocated by commercial banks to country total GDP. Data come from the IMF-IFS. 'Int. property protection' measures the degree of protection of intellectual property. Data come from the Heritage Foundation. 'Entry cost' measures the monetary cost of establishing a limited liability company normalized by per-capita GDP, Data come from the Doing Business Database. 'Share' equals the total employment in a given industry-country-year divided by total employment in the corresponding country-year, and is calculated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies, and year dummies, not reported. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Table 11
Venture Capital And New Business Creation: What Makes VC Work?

	(i)	(ii)	(iii)	(iv)	(v)	(v)
			Fraction of new firms			
3-year VC * Entry cost	0.018					0.024
	(0.019)					(0.021)
3-year VC * Labor regulation		0.003				0.007
		(0.003)				(0.003)**
3-year VC * Int. property protection			0.136			-0.039
			(0.083)*			(0.106)
3-year VC * Capital gains tax				-0.625		-0.851
				(0.646)		(0.484)*
3-year VC * Human capital					0.084	0.125
					(0.035)**	(0.041)***
Share	-0.257	-0.356	-0.332	-0.325	-0.174	-0.114
	(0.147)*	(0.146)**	(0.147)**	(0.147)**	(0.141)	(0.142)
Fixed effects			Country Industry Year			
Observations	2,268	2,268	2,268	2,268	2,268	2,268
R^2	0.35	0.35	0.35	0.35	0.40	0.41

Note: Table 11 reports estimates from OLS regressions. The dependent variable is the ratio of all new firms (1 or 2 years old) to total firms for each country-industry-year, at the 2-digit NACE rev. 1.1 industry level. The variable is calculated using data from Amadeus. '3-year VC' denotes the natural logarithm of average venture capital investment for the respective industry in the respective country over the past 3 years. The variable is calculated using data from VentureXpert. 'Entry cost' measures the monetary cost of establishing a limited liability company normalized by per-capita GDP in the respective country. 'Labor regulation' measure how difficult it is to hire and fire a worker in the respective country. Data on both variables come from the Doing Business Database. 'Int. property protection' measures the degree of protection of intellectual property in the respective country. Data come from the Heritage Foundation. 'Capital gains tax' measure the average tax on capital gains in the respective country. Data come from the PriceWaterhouseCoopers Worldwide Taxes. 'Human capital' measures the average years of schooling in the respective country. Data come from the Barro-Lee "International Data on Educational Attainment" dataset. 'Share' equals the total employment in a given industry-country -year divided by total employment in the corresponding country-year, and is calculated using data from Amadeus. All regressions include a constant, 2-digit industry dummies, country dummies, and year dummies, not reported. Heteroskedasticity adjusted standard errors are reported in parentheses. ***, **, and * report significance at the 1%, 5% and 10% level, respectively.

Appendix 1.
Variables: Definitions and Sources

Variable	Definition and source
<u>Venture capital data</u>	
Venture capital	Venture capital investment, in USD, allocated to all private equity deals expect for buyouts; by country. Source: VentureXpert.
Venture capital deals	Number of venture capital investment deals, in USD, allocated to all private equity deals expect for buyouts; by country. Source: VentureXpert.
1-year VC	Venture capital investment in a country-industry over the past year. Source: VentureXpert.
3-year VC	Average volume of venture capital investment in a country-industry over the past 3 years. Source: VentureXpert.
5-year VC	Average volume of venture capital investment in a country-industry over the past 5 years. Source: VentureXpert.
3-year VC industry	A dummy variable equal to 1 if the respective country-industry had any VC investment in the past 3 years. Source: VentureXpert.
3-year VC, 2nd quartile	A dummy variable equal to 1 if the industry-country belongs in the second quartile of VC-receiving industries in terms of total volume in the past 3 years. Source: VentureXpert.
3-year VC, 3rd quartile	A dummy variable equal to 1 if the industry-country belongs in the third quartile of VC-receiving industries in terms of total volume in the past 3 years. Source: VentureXpert.
3-year VC, 4th quartile	A dummy variable equal to 1 if the industry-country belongs in the fourth quartile of VC-receiving industries in terms of total volume in the past 3 years. Source: VentureXpert.
<u>Industry-level data</u>	
Entry	Number of firms 2 years or younger as a fraction of the total firms, at the 2-digit NACE rev. 1.1 level. Source: Amadeus.
Initial entry	Number of firms 2 years or younger as a fraction of the total firms, at the 2-digit NACE rev. 1.1 level, in 1998. Source: Amadeus.
Share	Fraction of employment in each country-industry-year over total employment in that country-year, at the 2-digit NACE rev. 1.1 level. Source: Amadeus.

Entry $_{US}$	Entry rates for US corporations. Calculated for 2-digit NACE industries (original data on a 4-digit SIC level). Average for the years 1998-99. Source: Dun & Bradstreet.
Capital intensity $_{US}$	Measure of physical capital usage, equal to the industry-level median of the ratio of physical capital used to sales. The numerator and denominator are summed over all years for each firm before dividing. Computed for all U.S. firms for the period 1990-99. Calculated for 2-digit NACE industries (original data on a 4-digit SIC level). Source: Compustat.
R&D intensity $_{US}$	Measure of dependence on research and development, equal to the industry-level median of the ratio of R&D expenses to sales. The numerator and denominator are summed over all years for each firm before dividing. Computed for all U.S. firms for the period 1990-99. Calculated for 2-digit NACE industries (original data on a 4-digit SIC level). Source: Compustat.
Financial dependence	Industry-level median of the ratio of capital expenditures minus cash flow over capital expenditures. The numerator and denominator are summed over all years for each firm before dividing. Cash flow is defined as the sum of funds from operations, decreases in inventories, decreases in receivables, and increases in payables. Capital expenditures include net acquisitions of fixed assets. This definition follows Rajan and Zingales (1998). We compute this measure for all U.S. firms for the period 1990-99. Calculated for 2-digit NACE industries (original data on a 4-digit SIC level). Source: Compustat.
<u>Country-level variables</u>	
GDP per capita	GDP divided by the population in each country-year. Source: Penn Tables.
Private credit over GDP	Ratio of domestic credit to the private sector scaled by GDP, in each country-year. Source: International Monetary Fund's International Financial Statistics (IMF-IFS).
Access to finance	General index of access to external finance by households and businesses, averaged over 1995-2005 Source: *Finance for All?* The World Bank, 2007.
Investors' protection	Index of the degree of protection of investors, calculated as an average of three indices: transparency of transactions, liability for self-dealing, and shareholders' ability to sue officers and directors for misconduct, for each country-year. Source: Doing Business Database (WB).
Int. property protection	Index of degree of protection of intellectual property rights, for each country-year. Source: Heritage Foundation.
Entry cost	Number of procedures to register a business, for each country-year. Source: Doing Business Database (WB).
Labor regulations	Index of the legal ease of hiring and firing workers, for each country-year. Source: Doing Business Database (WB).

Capital gains tax	Measure of the marginal tax on capital gains, for each country-year. Source: PriceWaterHouseCoopers Worldwide Taxes (1999-2008).
Human capital	Average years of schooling for an individual in the respective country, for each country-year. Source: Barro and Lee "International Data on Educational Attainment" dataset.
Buyout funds raised	Private equity funds raised, whose expected allocation is a buyout investment, for each country-year. Source: EVCA yearbooks (1998-2008).
Pension funds size	Assets held by all pension funds in the respective country normalized by GDP, for each country-year. Source: Eurostat.

Appendix 2.
Changes in Prudential Rules Concerning Risk Capital Investment by Pension Funds

Country	Year enacted	Type of change
Austria	2003	EU-wide Directive 2003/41/EC.
Belgium	2003	EU-wide Directive 2003/41/EC.
Czech Republic	2003	EU-wide Directive 2003/41/EC.
Denmark	2003	An 'action plan for risk capital' by the Danish Government to enable owners of private pension funds to spend a share of their funds on direct investment in non-listed companies.
Finland	1995	EU-wide Directive 2003/41/EC.
France	2003	EU-wide Directive 2003/41/EC.
Germany	2003	EU-wide Directive 2003/41/EC.
Greece	2003	EU-wide Directive 2003/41/EC.
Hungary	1998	New legislation has facilitated the channeling of domestic savings into private equity funds and the new national pensionse scheme now involves a privately managed element.
Iceland		None.
Ireland	1993	The government has requested the pension fund industry to increase its investment in Irish unquoted equities as a means of developing small and medium sized businesses. The pension fund industry and government jointly undertook a study of the equity requirments of SMEs and also the performance of unquoted equities over the past 20 years. The study concluded that the provision of funds to established VCs with good track records is an activity which the members of the pension fund industry should participate in.
Italy	1993	On 8 April 1993, as a part of the Pension Reform, a specific law on private pension plans was approved. One of its requirements is that closed-end funds must invest between 40% and 80% of the total value of the fund in unquoted companies.
Netherlands	1993	A new fund was initiated by the Dutch government for larger investments in larger industrial firms. The fund, partly financed by banks, insurance companies and pension funds, amounts to some Dfl 1 billion.

Norway		None.
Poland	2001	A law came into place providing Polish investment institutions with new types and structures of investment funds, such as securitisation funds. The law will also permit the soliciting of funds from the Polish financial institutions, such as pension funds and insurance companies, for investment into private equity.
Portugal	2003	EU-wide Directive 2003/41/EC.
Slovakia	2002	The current government has started pension and tax reforms, in part intended to produce measures to allow pension funds to invest in risk capital.
Spain	2003	Spanish pension funds may now invest up to 30% of their assets in free transferable securities issued by audited OCDE PE entities, provided that the investment does not imply a direct or indirect control over the investor entity and there are no economic links with the investor entity's shareholders or directors.
Sweden	2003	EU-wide Directive 2003/41/EC.
	2005	A new legislation entered into force stating that pension funds and employment saving trusts may not invest in partnerships or act as a general partner in a limited liability partnership. The reason behind is that this such investments are deemed too risky for the beneficiaries of the trusts.
Switzerland	2000	Swiss pension fund regulations were revised as of April 1, 2000 in order to permit Swiss pension funds to invest in both Swiss and foreign VC funds.
UK	Pre-1991	Pension funds allowed to invest in risk capital.