UNIVERSITEIT GENT

FACULTEIT ECONOMIE
EN BEDRIJFSKUNDE

HOVENIERSBERG 24
B-9000 GENT
Tel. : 32 - (0)9 – 264.34.61
Fax. : 32 - (0)9 – 264.35.92

WORKING PAPER

Supply of Venture Capital by European Governments

Sophie Manigart[1]

Christof Beuselinck[2]

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[1] Vlerick Leuven Gent Management School and Ghent University - Faculty of Economics and Business Administration, Department of Corporate Finance, Kuiperskaai 55[E], 9000 Gent Belgium; (T) +32 (0)9/2643508; (F) +32 (0)9/2643577; sophie.manigart@rug.ac.be

[2] Ghent University, Faculty of Economics and Business Administration, Department of Corporate Finance, Kuiperskaai 55[E], 9000 Gent Belgium; (T) +32 (0)9/2643515; (F) +32 (0)9/2643577; christof.beuselinck@rug.ac.be

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ABSTRACT

This study focuses on the determinants of supply of venture capital (VC) by governments in Europe. Since VC plays an important role in the creation and growth of start-ups and innovative firms, national authorities have initialised programs to stimulate VC (OECD, 1997). Governments may chose to stimulate the VC industry either by directly investing in the industry, or by indirect measures. Panel data analyses suggest that national governments react on macro-economic impulses: the supply of government funds to the VC industry increases (resp. decreases) when the overall economic situation is negative (resp. positive), and when the supply of private VC in previous years is smaller. Contrary to expectations, high (resp. low) overall levels of seed and start-up investments lead to higher (resp. lower) supply of government VC funds. No significant relation between the level of high-tech VC investments and the supply of government VC funds is found.

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1. INTRODUCTION

Financing is one of the critical resources for entrepreneurial, fast growing firms. Therefore, VC is important for companies that have difficulties accessing more traditional financing resources, such as bank financing (Berger and Udell, 1998). Young, fast growing firms typically have negative cash-flows in their early trading years as a result of large R&D expenses, sales and marketing costs, purchases of equipment and facilities, etc. The higher a firm's growth ambitions, the more voracious its appetite for cash is (Bygrave and Timmons, 1992). Access to equity finance is also restricted for smaller businesses as they cannot obtain similar terms and conditions as larger businesses (Harrison and Mason, 2000), due to higher information asymmetries and business risk. All these elements make VC important to help young, fast growing firms or firms with a high growth potential in their development (Bygrave and Timmons, 1992). Earlier studies show that the positive effects of the VC industry as one of the main tools for economic growth and job creation are acknowledged by national authorities (e.g. OECD (1997), European Commission (1997) and Aernoudt (1999)).

As VC is sometimes hard to obtain from private sources, governments can help filling the so-called 'equity gap' in two ways. First, they can indirectly stimulate the private VC industry (OECD, 1997). Indirect support can be given through the creation of a good macro-economic framework, an improved institutional context, the development of favourable fiscal regimes and enhanced protection for VC companies and investors. The Dutch government, for instance, established in the early 1980ies a successful Guarantee Scheme where up to fifty percent of the potential losses of a VC participation was reimbursed to the investors, in case of bankruptcy of the participation. The creation of well-developed and liquid stock markets for early stage companies is another indirect factor stimulating the VC industry (Bygrave and Timmons, 1992; Lerner, 1994; Black and Gilson, '98; Aernoudt, 1999). The creation of the pan-European stock exchange for young growth companies EASDAQ [1] (European Association of Securities Dealers Automated Quotation) in 1996 and a more pronounced presence from the same year on of second-tier national stock exchanges on Euro.NM national divisions, were some of the European answers to the lack of well-functioning stock markets for that segment before the mid-nineties.

A second route European governments take to fill the equity-gap, is by setting up government-sponsored VC funds or by directly taking participations in small companies. For example, the OECD shows that in 1997, governments of OECD countries invested an estimated US$ 3 billion of money in small, innovative firms (OECD, 1997). This is a non-neglegible amount and therefore deserves special attention. One can raise the question why governments intervene directly, either by setting up government-sponsored VC funds or by direct investments in private companies. Is it appropriate to do

so ? Hence, does government cover a need that is not addressed by the private sector or does it crowd out the private sector in this way? In this study, we will only focus on the driving forces of government investment in the VC industry, and prefer not to study direct investments in companies or indirect interventions. The latter routes to stimulate entrepreneurship are beyond the scope of the paper.

The paper is organised as follows. First, the importance of the supply of government funds for the VC industry is shown for 10 European countries from 1989 to 1999, using the yearly statistics of the European Venture Capital Association. Thereafter, motives for supplying government funds to the VC industry are given, leading to the development of hypotheses. Variables, used to test the hypotheses, together with the methods of analysis are presented. The results of the analyses are discussed and the paper concludes with a discussion on the role of governments in the VC industry.

2. GOVERNMENT INVESTMENTS IN EUROPEAN VC INDUSTRIES: SOME EVIDENCE

Table I shows the supply of government funds to the VC industry in absolute amounts (Panel A) and as a percentage of total funds raised by the VC industry (Panel B) in a given country and a given year for a sample of 10 European countries from 1989 to 1999. Panel C shows the average percentage of the supply of government funds in the VC industry relative to a country's GDP over the period 1989-1999. Data are obtained from the yearly statistics of the European Venture Capital Association (EVCA).

insert table I, panel A, B and C here

Panel A indicates that the degree to which governments invest in VC funds varies widely over the observed countries. On the one hand, the Belgian, Finnish, Italian, Dutch and British governments directly supply a considerable amount of VC funds over all years, amounting to over 15 million euro in most country-years. In Belgium, this figure even climbs to an all-time high of nearly 244 million euro in 1999. Figures for France are smaller (< 15 million euro), but still represent a relative steady amount. In Ireland, Norway, Spain and Sweden on the contrary, governments do not invest in VC funds during one or more years; their involvement is more fluctuating than in the first group of countries (between 0 euro, for several country-years and 129 million euro in 1999 for Sweden). The Dutch government injected a more or less stable amount in VC funds until 1996; afterwards the stable pattern disappears. One can conclude from these figures that European governments intervene actively in the VC industry by supplying state funds to the VC industry, but that the level of involvement varies widely from year to year and over countries.

While the absolute amount of government funds supplied to the VC industry is high in Belgium, Finland, Italy, the Netherlands and the UK for all country-years, its relative importance compared to total VC funds raising (panel B) remains only high in Belgium and Finland (more than 35% [2]). In these countries, funds from government account, on average, for more than one third of the national fund raising activity. For Italy and the Netherlands, the relative importance is smaller; for most of the years it is smaller than 15%. In the UK, the relative importance is in all years smaller than 2%, due to the fact that there is a large private VC industry. Thus, although the absolute amount that governments supply to VC funds is high for nearly each observation, its importance for the national VC industry is quite different: from very important in Belgium and Finland to moderately important in the Netherlands and Italy and unimportant in the UK. In Norway, a surge in the supply of government funds to the VC industry appears from 1993 on: the percentage of funds raised by the VC industry, coming from governments, grew from zero in 1992 over 34,2% in 1993 to more than 57% in 1994, but declined steadily afterwards. The opposite is observed in Spain, where government provided more than 20% of total capital raised by the VC industry from 1989 to 1991, but this source of funds ceased dramatically from 1993 on.

Panel C shows the average percentage of the supply of government funds to the VC industry relative to a country's GDP over all observed years. This measure is important because it gives an indication on the relative importance of the supply of government funds to the VC industry compared to total economic activity. Evaluation of direct government VC investments to total VC investments gives a clear view of the importance of government investments in the VC industry, but does not reveal its relative importance in the overall economy. For example, direct government VC investments as a percentage of total VC investments may be low, but can be important compared to the national economic activity if the national VC industry is heavily developed.

Not surprisingly, the average figure is highest for Belgium (investment by government in the VC industry represent 0,040% of Belgian GDP), Finland (0,020%) and Norway (0,020%). In Ireland (0,007%), Italy (0,007%), the Netherlands (0,013%) and Sweden (0,010%), the supply of government funds is relatively more modest. France (0,001%), Spain (0,004%) and the U.K. (0,002%) have the lowest figures; the average supply of government funds, relative to total economic activity, is fairly limited there.

The large fluctuations over time of the supply of government funds to the VC industry in most countries and the large differences between countries of the level supply are surprising and call for a more intense study.

3. MOTIVES FOR DIRECT GOVERNMENT VC INVESTMENTS

Earlier research reviews the motivations of public authorities to finance firms (Schleifer, 1998) and more specifically the role of governemnt in the VC industry (Florida and Smith, 1993; Hancock and Wilcox, 1998; Leleux et al., 1998; Aernoudt, 1999; Lerner, 1999). The existence of an equity gap is perceived to be one of the main rationales for government intervention in the financing process. This equity gap is observed when the allocation process of capital and projects is suboptimal, leading to the fact that value creating projects may be denied financing due to market imperfections. In Europe, the match between capital and innovative projects is often hindered due to a risk averse investment culture, a lack of confidence in SMEs and a limited development of secondary capital markets (OECD, 1997; Aernoudt, 1999; Murray, 1999). Therefore, authorities can directly intervene by offering financing to young companies with high growth potential, or by setting up VC funds, completely or partially funded by government. There are however different views on the role of governments in the VC industry. While some bring forward motives in favour of direct supply of funds, opponents counter the arguments and are in favour of no involvement of governments in the VC industry (e.g. Florida and Smith, 1993) or call for a better regulated policy (Leleux et al., 1998; Lerner, 1999).

The OECD (1997) and Aernoudt (1999) stress the positive effects of the VC industry on economic growth and job creation. Therefore, proponents claim that government has a direct role to play in financial markets when small businesses have difficulties to obtain sufficient capital. By doing this, government actively supports economic growth through a full development of the VC industry. Moreover, Lerner (1999) highlights the importance of R&D spill-overs as a key rationale for government investment in the VC industry. Social returns of investments in innovative firms are often higher than private returns. As private investors do not capture full benefits of the investment, it may be suboptimal for them to invest. Finally, Lerner (1999) shows the certification role of government: firms receiving investments by SBIR (Small Business Inovation Research) programs in the US between 1983 and 1997 grew faster than non awardees and were able to attract more venture financing. If this is true when subsidising companies, it might also apply to companies, funded by government VC funds.

There are, however, also negative side-effects of direct government intervention. For example, it can be argued that investments by government in the VC industry may lead to a slower development or even suppression of the private VC industry (O'Shea, 1996; Leleux et al., 1998). This is the crowding-out effect, where private VC funding decreases and is substituted by government funds (e.g. Khanna and Sandler, 2000). Second, public VC may well fund the best projects by investing at below-market rates (Manigart et al., 2001), leaving the second best projects to private VC investors. In other

words, governments can actually prevent the creation of an active and flourishing private VC market and hence create cannibalism by investing in those companies which would also have found financing without public involvement (Lerner, 1999). Third, Florida and Smith (1993) argue that government investments and subsidies often grant a 'license to steal' to the entrepreneurs. For example, the SBIC (Small Bussiness Investment Company) program seldom controls what happens with the money after a company receives a grant. Therefore, adequate control and follow-up of companies receiving government VC funds is a necessity in order to avoid abuse. Fourth, the professionalism of public servants which assess VC investment opportunities is criticised. Their reward system is in most cases independent of the outcome of the investments and therefore is considered as an imperfect tool in the creation of an investment strategy (Leleux et al., 1998). In this line of reasoning, public servants should be rewarded as their counterparts in the private sector, i.e. based upon the performance of their investments. Fifth, Florida and Kenney (1988) argue that simply making VC finance available will not automatically generate the conditions under which entrepreneurship can flourish. Not only the supply side of capital is of a decisive importance, but also the demand side.

As no argument seems to be decisive, it can be said that the debate about the appropriateness of direct government VC investments is still open. Opinions are mixed while both proponents and opponents bring forward plausible arguments. Here, we study the determinants of the supply of government VC funds to the VC industry. The central research question focuses on the main drivers of European government policies towards direct VC investments *:*

"What drives the supply of funds by government in venture capital industries in Europe?"

First, the *overall economic situation* is expected to influence the degree to which governments supply funds to the VC industry (Acs and Audretsch, 1994). When the economic climate is negative, there will be fewer incentives for the private sector to invest in risky ventures, leading to a larger equity gap. National authorities therefore are expected to give stronger impulses to the VC industry when the economy is in a downturn, for example by supplying more funds.

Jeng and Wells (2000) argue that this relation can be reversed: as there are fewer start-ups in a macro-economic contraction (Acs and Audretsch, 1994), the demand for VC will decrease. In an economy in equilibrium, a lower demand should lead to a lower supply of VC, and as a consequence, the supply of VC by governments should decrease. However, if the aim of governments is to stimulate the economy, especially when the economy is in a bad shape, then governments are expected to stimulate the creation of companies at that time. Barriers to company creation, such as a shortage of VC, are to be fought. We therefore expect that governments will especially stimulate the economy by increasing the supply of capital when the economy is in a downturn. This leads to the first hypothesis:

Hypothesis 1: "A negative (resp. positive) economic climate leads to more (resp. less) supply of government funds to the VC industry."

Assuming governments should only intervene in areas where the private sector is deficient, it is expected that the supply of VC by governments will be higher when capital, raised from the private sector, is low and vice versa. When the supply of VC by private parties, such as financial institutions, institutional investors, companies or private individuals, is low, we expect governments to react to this situation and fill the gap left by the private sector. This reaction, however, will not occur on the spot: we expect a time lag between a low supply of private funds and a high supply of government funds. We therefore expect a negative relation between venture capital, raised from private sources and the supply of VC by governments in the year(s) thereafter:

Hypothesis 2: "A low (resp. high) supply of private VC leads to a higher (resp. less) supply of funds by governments to the VC industry in later years."

Remark that we assume a seeding effect and not a crowding-out effect (Leleux and Surlemont, 2000), given the direction of the causality. Indeed, we propose that governments *react* on a lack of private capital, not that the lack of private capital is caused by a high supply of government funds.

As the equity gap is likely to be highest for seed and start-up companies on the one hand, and for high technology companies on the other hand (due to the large information asymmetries and high business risk in these companies (Lerner, 1994)), we expect governments to react especially when there is a shortfall of investments of the VC industry in these companies. It is likely that the equity gap will be large for early stage companies, as EVCA-return statistics indicate that a higher risk is not compensated with higher returns for investors in early stage companies (EVCA, 2000). Investors in early stage deals realised an average IRR of 9,2%, during the period 1980-1997. This return is only slightly higher than for a diversified VC portfolio with early and later stage deals, which generated 8,7% on average. Buy-out funds realise an even higher average IRR of 12,6%, although these have a lower risk profile (EVCA , 2000). The combinations of these two characteristics, a higher risk profile combined with a lower return, makes early stage investments less interesting for investors. Governments therefore are expected to react by supplying funds to the VC industry when early stage and high technology investments are low. By doing so, governments may add value and support the development of a healthy VC industry (Leleux et al., 1998). This leads to following hypotheses:

Hypothesis 3: "Low (resp. high) amounts of seed and start-up VC investments lead to higher (resp. lower) supply of government funds to the VC industry in later years."

Hypothesis 4: "Low (resp. high) high-tech VC investments lead to higher (resp. lower) supply of government funds to the VC industry in later years."

4. DESCRIPTION OF THE DATA

Foregoing hypotheses are tested in 10 European countries with most VC activity [4]: Belgium, Finland, France, Ireland, Italy, the Netherlands, Norway, Spain, Sweden and the United Kingdom. The dependent variable of interest is the yearly amount of supply of government funds to the VC industry in a given country-year, relative to GDP. Data are taken from the annual statistics of the European Venture Capital Association (EVCA) from 1989 [3] until 1999. The dependent variable varies between 0% and 0,12% of GDP, with a mean value of 0,01%. Descriptive statistics of the dependent and independent variables are given in Table II.

insert table II here

A "good economic climate" is proxied by outputgap, GDP growth, long term interest rate, stock market return and number of IPOs. As well outputgap as GDP growth are frequently used as proxies of economic activity. Yearly national outputgap and GDP growth come from the OECD CD-Rom. Outputgap lies between -10,90% and +6,20% with a mean value of -0,74%. GDP growth varies from a minimum of - 5,40% to a maximum of 12,60%. The mean value is 3,76%.

The long term interest rate is also frequently used as a proxy for economic activity, as national authorities tend to decrease interest rate levels as a reaction on contracting economic activity. Therefore, a negative relationship between interest rates and supply of funds to the VC industry by governments is expected. Moreover, Bygrave (1992) argues that rising interest rates may increase the attractiveness for companies of financing with VC, as traditional financing sources become more expensive, thereby increasing the demand for VC. Both arguments lead to the same conclusion: a high interest rate level should lead to a decrease in the supply of government funds. National 10-year government bond yields are measures of long term interest rates and are taken from the database Datastream. The long term interest rate level reaches a minimum of 4,46% and a maximum of 13,70%, with an average of 8,23%. Because this variable includes future information, it is lagged one year.

Additionally, we included stock market returns and number of IPOs in a given country-year as proxies for the level of that part of economic activity that is especially relevant for the VC industry. Previous studies (Bygrave and Timmons, 1992; Bygrave and Muzyka, 1994; Black and Gilson, 1998; Jeng and

Wells, 2000) highlighted the correlation of stock market returns and the IPO activity on the one hand and the performance of the VC industry as a whole on the other hand. High numbers of IPOs create better exit opportunities for the VC investors and make the VC industry more attractive in general. High stock market returns and IPO activity should therefore lead to a high supply of private VC funds, and lower supply of government funds. Stock market return is calculated as the aggregate return of the national stock market on a year-to-year basis, and is obtained from the database Datastream. The return on the stock market on a year-to-year basis lies between -34,25% and +127,38%; average return equals 14,70%. The number of domestic IPOs is expressed relatively to total listed companies per country. Data are obtained from the Federation Internationale des Bourses de Valeurs. The variable reaches a minimum value of 0% and a maximum of 28,56%; the average is 6,24%. Both stock market return and number of IPOs are lagged one year.

The second hypothesis is tested by including VC sector variables. This enables to detect government reactions to changes in supply of VC by private sources, seed and start-up VC investments and high-tech VC investments. All figures are expressed relative to GDP in order to obtain a comparable set of figures over the different countries. The variable 'supply of non-government VC funds' is calculated from the EVCA statistics. The variable is lagged one year and varies between 0% and 1,23%, with a mean value of 0,13%. Seed and start-up VC investments and high tech[5] VC investments are expressed relative to GDP and lagged one year. Seed and start-up VC investments reach a minimum of 0% and a maximum of 0,07% of GDP and is 0,01% on average. High-tech VC investments vary between 0% and 0,17% of GDP, with an average of 0,03% of GDP.

insert table III here

Table III reports the correlation between all variables. The supply of government funds to the VC industry is significantly ($p = 0,003$) and negatively related to the long term interest rate, in line with hypothesis 1, and positively related (marginally significant, $p = 0,054$) to the level of high tech investments, contrary to hypothesis 4. No other statistically significant bivariate relations with the level of direct government VC investments are observed. The correlation between the independent variables remains within reasonable limits. The highest correlation is between supply of non-government VC funds and high tech VC investments.

5. PANEL DATA RESULTS

Panel data analyses are used as multivariate statistical tool as the dataset contains repeated observations (1989-1999) over the same units (countries). The availability of repeated observations on the same units allows us to specify and estimate more realistic models with panel data techniques than

a single cross-section would do (Baltagi, 1995). Between-country OLS regressions look for determinants of government supply of VC funds across the 10 countries in our dataset; within-country OLS regressions look for determinants of changes of government supply of VC funds within one country.

In a first model, the level of direct government VC investments is explained by macro-economic variables only: GDP growth, outputgap, long term interest rate, stock market return and number of IPOs. In a second model, the lagged VC sector variable 'supply of non-government VC funds relative to GDP' is added in order to test hypothesis 2. Finally, hypothesis 3 and 4 are tested by adding 'seed and start-up VC investments to GDP' and 'high-tech VC investments to GDP' to the model. Sector variables are lagged one year to capture causality. In a second set of analyses, the independent variables are averaged over the previous three years in order to create a longer time causal effect.

The between OLS regression (regression on means) explain the differences in supply of government funds to the VC industries between the different countries. This regression does not offer statistical significant relations between the level of supply of government funds and the explanatory variables and is therefore not reported here. One can conclude from this finding that supply of government VC funds to the VC industry is highly differentiated -as the descriptive analyses already indicated- and cannot be explained by the variables included in the model. Whether or not governments intervene directly in the VC sector is thus highly country-specific. This may be due to the fact that governments make a trade-off between direct and indirect measures. An in-depth study of the indirect measures might help to understand why some governments provide much funds, and others only few funds to the VC industry. This is , however, beyond the scope of this paper. A second explanation of the lack of significance in the between-countries regression is the erratic investment pattern over the years. If there is no stability in the time series, it is hard to find explanations for between-country differences.

insert table IV here

Within OLS regressions capture the changes in supply of government funds within a country over time and are reported in table IV. Results have been corrected for autocorrelation and heteroscedasticity problems. In the first model, the supply of government funds to the VC industry is estimated by using only the macro-economic variables. This model predicts 51,3% of the variance in the dependent variable. Most of the coefficients of the regression model are significant. The coefficient of the outputgap is significantly positive ($p = 0{,}002$), contrary to expectations. The level of GDP growth is negatively related to the supply of government funds, as expected, but the coefficient is only marginally significant. The coefficient of the lagged long term interest rate is significantly negative ($p = 0{,}010$), as expected. The lagged stock market return does not significantly influence the

supply of government funds to the VC industry. The lagged number of IPOs is significantly (p=0,042) negatively related to the level of direct government VC investments. Positive exit opportunities, measured by the level of IPOs lead to a significantly (p = 0,042) decreasing level of supply of government funds, as expected.

Support for hypothesis 1 is mixed. Although an increase in supply of funds by governments is, as expected, driven by a decrease in GDP growth, a decrease in interest rates and declining numbers of IPOs, it is positively related to the outputgap, contrary to the expectations. Following Jeng and Wells (2000), the positive relation between outputgap and supply of government funds to the VC industry could be explained by the argument that a good macro economic climate leads to a higher demand for VC funds. Capital raised by the VC industry with all investor parties – including governments – then increases. This, however, also indicates that governments do not offer sufficient capital to the VC industry in times of an economic downturn. Taking these findings into account, governments seem to match, at least partially, their investment strategy in the VC sector to the economic climate.

In order to address hypotheses 2, 3 and 4, table IV (panel B) shows the results of the second model that includes VC sector variables. The adjusted R^2 increases to 59,6%. The incorporation of the three sector variables substantially improves the explanatory power of the model. All signs of the macro-economic coefficients are the same as in model 1, with a significance level which remains comparable for most coefficients and hence indicates the robustness of the findings of the first model.

The variable 'supply of non-government VC funds' is, as hypothesized, significantly (p = 0,070) negatively related to the supply of funds by governments. This implies that decreasing supply of funds by non-government investors in year 0 results in rising investments by governments in year 1. Because causality is especially important in this matter and stationarity might drive the results, the model was re-ran with the average of the supply of funds of non-government sources over the last three years (and the average over the last three years of all VC sector variables). These models yield comparable results (not shown). Governments clearly adapt the level of their supply of funds to the level of supply of funds by other parties. Our result lend support to the seeding hypothesis, rather than to the crowding out hypothesis. Governments leave the initiative to the private sector and only come in when the private sector is deficient. Therefore, hypothesis 2 is supported.

The coefficient of seed and start-up VC investments is significantly positive (p = 0,020). Hypothesis 3, however, predicts a negative relationship. Low seed and start-up VC investments in year 0 are associated with a low supply of government funds in year 1, contrary to our expectations. This surprising finding might be explained that the data are not accurate enough. EVCA statistics do not report seed and start-up VC investments made by investor type. This restricts our analysis, as it is

impossible to determine whether or not changes in seed and start-up VC investments are caused by a reduction of investments by government VC funds or by private VC funds. More refined investment statistics would enable to study whether governments react on changes in investments partners of private VC funds in the seed or start-up stage.

Finally, the level of high-tech VC investments in year 0 is, as expected, negatively related to the level of supply of government funds to the VC industry in the following year, but the coefficient is not statistically significant. The same data problem as previously described might explain the lack of significance. With the data at hand, hypothesis 4 is not supported.

6. DISCUSSION AND CONCLUSIONS

The VC industry is important to foster high growth enterpreneurial firms. Therefore, governments set up programs to promote this type of financing, either indirectly by creating a favourable environment for a VC industry driven by private investments, and/or by directly supplying the funds to the VC industry to be invested in entrepreneurial companies. It is remarkable that the supply of governments funds differs that much over different countries and, within a country, over different years. This inspired us to study the driving forces of these fluctuations.

One of the main rationales of direct government intervention in the VC industry is to stimulate economic growth. We therefore expect that a good economic climate would lead to a lower supply of government funds to the VC industry. We find some evidence in favour of this argument : within a country, governments supply more funds to the VC industry when GDP growth is low and when long term interest rates are low, both macro-economic indicators of the overall economic climate. A higher output gap, however, also leads to a higher supply of government funds, contrary to expectations. It may well be that outputgap is a more long term indicator of economic activity, while GDP growth and interest rates are both spot indicators of the economic environment. This would suggest that governments especially react on short term economic indicators.

Governments react appropriately with respect to specific precursors of venture capital activity: returns on stock markets and number of IPOs. High stock market returns and a high number of IPOs lead to a favourable VC investment climate, as exit opportunities and therefore return prospects are good under these circumstances. This should trigger private investors and therefore decrease the need for direct supply of government funds. We find indeed that increasing stock markets returns (although not significantly) and number of IPOs are associated with lower government investments in the VC industry. This lends support to the hypothesis that governments act appropriately, by intervening directly in the VC industry when private players are less prone to play their role. This argument is

further supported by the fact that governments decrease their supply of funds to the VC industry when the supply of funds from non-government sources was abundant during the foregoing year(s).

A surprising finding is the fact that the more the VC industry invested in seed and start-up companies, the more funds are supplied by governments to the VC industry in later years, while governments do not seem to adapt their level of funding to the investments in high technology investments. One would indeed expect that governments would react to shortfalls in investments in those companies which are likely to have the greatest difficulties in finding appropriate levels of finance, namely early stage companies and high technology companies. However, Burgel and Murray (2000) found that British VC funds, investing small amounts in non-technology early stage companies realise disappointing returns to their shareholders, while funds investing in high technology early stage companies realise high returns. This might indicate that investing in high tech companies is an attractive and viable investment strategy for VC funds, hinting that the fact that governments do not react on changes in high tech investments is appropriate. In this line of reasoning, high tech investment activity should be left to the private sector.

In the same line of reasoning, however, it remains remarkable that governments react as they do on changes in investment levels in early stage companies. This calls for further study on this relationship. Unanswered questions in this respect are : who is investing in early stage companies : government VC funds or private VC funds ? Do these early stage companies invest in high tech companies or in non high tech companies ? Once these questions are answered, a clearer view on the appropriateness of government intervention in the VC industry will be gained.

There are further limitations to this study. First, we were unable to explain the differences in government involvement between different countries. This may be due to the fact that indirect government measures are left out of the scope of the study. It may well be that indirect measures are a substitute of direct measures. However, we found evidence that direct supply of government funds does not drive the private sector out of the VC industry. Moreover, although we adressed the causality problem with time lags, causality still remains a problem. It may well be that the relationships captured here are in fact reversed.

Concluding, we may state that governments seem to react quite appropriately to changes in the economic environment and in the supply of funds of private parties. It seems that governments are not crowding out the private VC industry, but seeding it. However, governments who supply a large amount of funds to the VC industry might wish to learn from countries where governments supply low amounts of funds. If countries are able to have a flourishing VC industry without a lot of government funds, an in-depth study of indirect measures might yield additional insights. It also

seems that governments adapt their level of supply of funds very quickly, as this level changes considerably over time. These changes are sometimes, but not always, driven by sound economic rationales. Therefore, a more considerate policy of changes in the direct supply of VC funds is needed.

Table I, Panel A: Supply of government funds to the VC industry (absolute amount – 1000 euro)

	Belgium	Finland	France	Ireland	Italy	Netherlands	Norway	Spain	Sweden	U.K.
1989	39.886	5.158	6.083	3.919	0	25.962	0	31.849	4.099	24.931
1990	44.747	6.104	11.074	6.606	41.559	23.810	0	19.778	64.000	19.053
1991	62.646	13.817	11.801	2.853	31.192	26.282	3.011	38.497	19.359	14.489
1992	n/a	9.530	9.896	0	56.385	28.740	0	4.049	701	15.401
1993	44.013	15.814	6.435	0	14.356	29.897	14.440	0	1.109	11.452
1994	44.608	18.413	11.645	0	53.904	23.148	36.535	0	0	34.144
1995	38.981	12.948	13.240	2.168	110.665	26.222	63.333	0	0	13.111
1996	73.670	20.477	11.267	968	74.222	28.037	47.258	0	133	11.507
1997	115.694	39.255	8.318	2.053	79.352	36.168	51.077	0	57.542	7.298
1998	118.802	25.445	0	2.725	74.547	53.040	19.826	24.715	0	13.825
1999	243.931	39.516	18.064	42.002	105.726	46.180	0	65.048	128.917	20.649

Table I, Panel B: Supply of government funds to the VC industry as a percentage of total funds raised (%)

	Belgium	Finland	France	Ireland	Italy	Netherlands	Norway	Spain	Sweden	U.K.
1989	50,6%	70,3%	0,7%	10,4%	0,0%	15,0%	0,0%	39,5%	10,8%	1,0%
1990	54,2%	36,3%	1,3%	19,5%	19,4%	10,0%	0,0%	23,3%	53,3%	1,0%
1991	60,1%	63,3%	1,2%	8,0%	6,1%	9,0%	6,4%	24,4%	40,2%	0,8%
1992	n/a	59,3%	1,0%	0,0%	11,0%	12,0%	0,0%	3,1%	1,4%	0,8%
1993	47,6%	79,7%	0,7%	0,0%	5,5%	14,4%	34,2%	0,0%	1,9%	0,7%
1994	41,6%	76,4%	1,1%	0,0%	19,7%	7,1%	57,8%	0,0%	0,0%	1,5%
1995	35,0%	41,9%	1,6%	11,2%	43,7%	5,6%	52,9%	0,0%	0,0%	0,5%
1996	67,6%	50,7%	1,3%	2,6%	14,6%	4,7%	56,7%	0,0%	0,0%	0,4%
1997	64,6%	35,4%	0,7%	6,0%	13,3%	4,8%	31,6%	0,0%	16,8%	0,2%
1998	45,9%	13,5%	0,0%	4,3%	8,0%	5,0%	11,9%	6,8%	0,0%	0,2%
1999	36,5%	15,9%	0,6%	40,0%	5,9%	2,7%	0,0%	9,0%	10,2%	0,2%

Table I, Panel C: Average supply of government funds to the VC industry as a percentage of GDP (1989-1999)

	Belgium	Finland	France	Ireland	Italy	Netherlands	Norway	Spain	Sweden	U.K.
mean	0,040%	0,020%	0,001%	0,007%	0,007%	0,013%	0,020%	0,004%	0,010%	0,002%

Source: Computed from EVCA, Statistical Yearbooks (1989-1999)

Table II: Descriptive statistics

	N	Minimum	Maximum	Mean	Standard deviation
Supply of government funds to the VC industry, relative to GDP	110	0,00%	0,12%	0,01%	0,01%
Outputgap	110	-10,90%	6,20%	-0,74%	2,87%
Real GDP growth	110	-5,40%	12,60%	3,76%	2,91%
Long term interest rate	110	4,46%	13,70%	8,23%	2,38%
Stock market return	110	-34,25%	127,38%	14,70%	25,21%
Number of domestic IPOs to total listed companies	110	0,00%	28,56%	6,24%	5,84%
Supply of non-government funds to GDP	110	0,00%	1,23%	0,13%	0,08%
Seed and start-up inv. to GDP	110	0,00%	0,07%	0,01%	0,01%
High-tech VC investments	110	0,00%	0,17%	0,03%	0,02%

Table III: Correlation matrix

	outputgap	GDP growth	Long term interest rate$_{(t-1)}$	Stock Market return$_{(t-1)}$	Number of domestic IPOs to total listed companies$_{(t-1)}$	Supply of non-government funds $_{(t-1)}$	Seed and start-up VC inv. to GDP $_{(t-1)}$	High tech inv. to GDP $_{(t= -1)}$
supply of government funds to the VC industry	0,08 (0,405)	-0,104 (0,281)	-0,281 (0,003) [b]	0,048 0,617	0,139 (0,147)	-0,027 (0,781)	0,048 (0,617)	0,184 (0,054) [*]
Outputgap	1,000 -	0,339 (0,000) [b]	0,177 (0,064) [a]	-0,278 (0,003) [b]	-0,053 (0,586)	0,179 (0,062) [a]	0,201 (0,035) [b]	0,223 (0,019) [b]
GDP growth	-	1,000 -	0,106 (0,270)	-0,182 (0,059) [a]	-0,025 (0,797)	-0,001 (0,991)	-0,079 (0,415)	-0,038 (0,694)
Long term interest rate$_{(t-1)}$	-	-	1,000 -	-0,475 (0,000) [b]	-0,370 (0,000) [b]	-0,329 (0,000) [b]	-0,299 (0,002) [b]	-0,478 (0,000) [b]
Stock Market return$_{(t-1)}$	-	-	-	1,000 -	0,205 (0,032) [b]	0,134 (0,163)	0,246 (0,010) [b]	0,135 (0,159)
Number of domestic IPOs to total listed companies$_{(t-1)}$	-	-	-	-	1,000	0,085 (0,376)	-0,018 (0,855)	0,049 (0,610)
Supply of non-government funds $_{(t-1)}$	-	-	-	-	-	1,000 -	0,324 (0,001) [b]	0,723 (0,000) [b]
Seed and start-up VC inv. to GDP $_{(t-1)}$	-	-	-	-	-	-	1,000 -	0,478 (0,000) [b]

Figures between brackets indicate the statistical significance :

[a] significant at the 90% confidence interval
[b] significant at the 95% confidence interval

Table IV, Panel data – within regressions (fixed effects)

Results of the panel regression, with dependent variable = supply of government funds to the VC industry. Model 1 only contains macro-economic variables, while model 2 also takes sector variables into account.

Variable	**MODEL 1** (Panel A) Coefficient	Significance	**MODEL 2** (Panel B) Coefficient	Significance
HYPOTHESIS 1				
(Constant)	0,054	0,000 [b]	0,034	0,017 [b]
Outputgap	0,231	0,002 [b]	0,163	0,022 [b]
GDP growth	-0,041	0,205	0,202	0,705
Long term interest rate$_{(t-1)}$	-0,416	0,010 [b]	-0,371	0,016 [b]
Stock market return $_{(t-1)}$	-0,003	0,758	-0,011	0,250
Number of (domestic) IPOs to total listed companies$_{(t-1)}$	-0,087	0,042 [b]	-0,069	0,078 [a]
HYPOTHESIS 2				
Supply of non-government funds $_{(t-1)}$ to GDP			-0,023	0,070 [a]
HYPOTHESIS 3				
Seed and start-up VC inv. to GDP			6,466	0,020 [b]
HYPOTHESIS 4				
High-tech VC inv. to GDP $_{(t-1)}$			-0,025	0,843
Number of observations	110		110	
Adjusted R^2	0,513		0,596	

[a] : significant at the 90% confidence interval

[b] : significant at the 95% confidence interval

NOTES

[1] This European Stock Exchange for growth companies recently was taken over by Nasdaq and changed its name to Nasdaq Europe.

[2] Except for Finland in 1998 and 1999; Finnish government intervened less through direct VC investments during the last two years

[3] Earlier figures are incomplete and as a consequence unreliable.

[4] Denmark and Germany do not report yearly figures about public VC investments and are therefore left out of the study, although they have a reasonably high level of VC activity.

5 High-tech investments: Communications, Computer related, Other electronics related, Biotech and Medical/Health related (EVCA yearbook, 2000)

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