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Explaining Cross-Country Variations in Venture Capital Investments: Theory and Empirical Evidence

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I. Introduction

The relative size of venture capital investments considerably differs across countries. Although early-stage investments, often used as a narrow approximation of venture capital investments, substantially increased in the last fifteen years, differences between the European markets and the U.S. market in terms of investments in firms' early stage are still substantial (Figure 1).[1] In 2001, only Sweden and Finland realized a level of early-stage investments, as per million of gross domestic product (GDP), that is comparable with the level in the United States. In 2001, the United States invested about one per million of its GDP as early-stage venture capital, while the United Kingdom and Germany invested less than 0.6 and France invested less than 0.4 million.

The purpose of this paper is to identify determinants which help explain variations in the relative size of venture capital investments across countries. To this end, I will use a general equilibrium model to identify a basic condition which must be fulfilled for venture capital markets to emerge. This condition states that venture capital markets emerge only if the increase in the performance of enterprises due to venture capitalists' active involvement in form of management support and monitoring ser-

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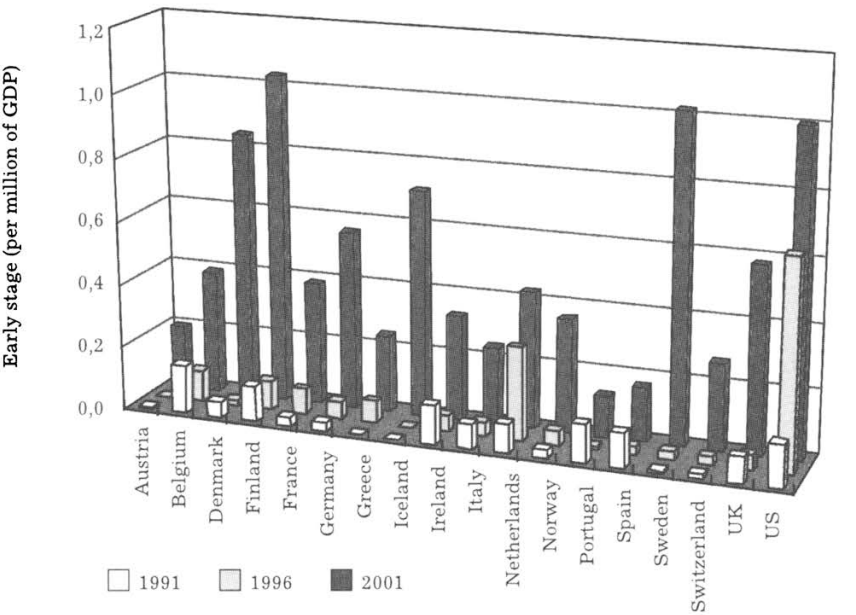
[1] In line with the American tradition, venture capital is understood as the offering by an experienced intermediary, the venture capitalist, of financial means to young high-technology enterprises in combination with management support for these enterprises.



Source: Schertler (2003a).

Figure 1: Early-stage investments in the United States and Europe (per million of GDP)

vices (i.e., the increase in the success probability of the enterprises) is larger than the increase in the enterprises' user costs of capital. This condition implies that the development of venture capital finance depends on the dominance of the banking market because bank finance determines a lower boundary of the user costs of capital. In addition, I will use my general equilibrium model to derive the level of venture capital investments in equilibrium. This equilibrium level depends on the venture capitalists' costs of management support and monitoring services and venture capitalists' costs of raising new funds from uninformed capital providers.

Thereafter, I will test the implications of my model by using dynamic panel techniques and a data set of 18 European countries for the period 1990 to 2001. Testing these model implications empirically is only indirectly possible, since a price for raising new funds or the costs of management support are not available. Therefore, I will use variables in the empirical model that I expect determine the price for raising new funds and

costs of management support and monitoring services. These variables inform about the structure of financial markets. Some of my measures of the structure of financial markets, such as the wealth of pension funds and banks' profitability, are insignificant. However, I find evidence that the growth of stock market capitalization has also a positive impact on the level of venture capital investments. In addition, I find evidence that the lending rate has a positive and significant impact on the level of venture capital investments when I use the early-stage investments as an endogenous variable.

This paper is divided into five sections. In the second section, I will develop a model that helps identify the basic condition for venture capital markets to emerge. In the third section, I will use this model to determine the steady-state level of venture capital investments. In the fourth section, I will empirically test the implications of my model regarding the determinants of venture capital investments which I will derive in the second and third section. In the fifth section, I will summarize the results of my theoretical and empirical analysis.

II. Basic Condition for Venture Capital Markets

My general equilibrium model, which I will develop in this and the next section, takes into account some of the systematic interdependencies between capital providers, venture capitalists, innovators, and consumers. In my model, consumers demand products whose development is risky. Venture capitalists can reduce these risks through management support and, thus, increase the expected profits from the development of these products. Products are supplied under monopolistic competition. In the steady state, free entry leads to expected profits which are equal to the wage rate in the economy. The expected profit function determines the number of entrepreneurs in the steady state. This number, in turn, determines the level of venture capital investments. Thus, in my model, the determinants of the number of entrepreneurs are also the determinants of the level of venture capital investments.

I derive the basic condition for venture capital markets to emerge by comparing an enterprise's costs of financing a start-up investment via venture capital and via an alternative source called bank credits. I assume that the main difference between these two forms of financing is the venture capitalist's management support, which is assumed to have a positive impact on the enterprise's success probability. Thus, compared

to bank credits, venture capital finance increases the enterprise's revenues. In the following, I describe first the production of the product and then the costs of the two financing forms.

1. Production of Products

The entrepreneur must make a start-up investment, I, to setup production. I assume that the entrepreneur has to raise capital in the financial market because she does not have the means to finance the start-up investment herself. While capital is used to setup production, labor is used to produce the product. Products are produced using labor at constant marginal costs after they have been successfully developed. The production technology is uncertain. Therefore, the entrepreneur has to repay an amount, R, which is higher than the start-up investment.

The probability of a product that will be developed successfully, which is determined by a random variable realized only after financing decisions have been taken and after the start-up investment, I, has been made, depends on the mode of financing. If the enterprise is financed by venture capital and if the venture capitalist provides management support to the entrepreneur, the success probability is given by ψ^{VC}. If the enterprise is financed by bank credits, this probability is given by ψ^{WVC}.

If the entrepreneur develops her product successfully, she receives positive revenues and repays the capital. If the entrepreneur does not develop her product successfully, her revenues are equal to zero, and she does not repay the capital. Using the probability that entrepreneurs will be successful, the expected profit, $\hat{\pi}_{\overline{m}}$, of the entrepreneur who wants to develop a product $\overline{m}$ is given by

$$\hat{\pi}_{\overline{m}} = \psi(p_{\overline{m}} - w)X_{\overline{m}} - \psi R \text{ with } \psi \in \{\psi^{VC}, \psi^{WVC}\}, \tag{1}$$

where $p_{\overline{m}}$ is the price of the product, w is the wage rate, and $X_{\overline{m}}$ is the quantity of the product.

According to equation (1), the expected profit of the entrepreneur is determined by the success probability, the price of the product, the demand for the product, and by the level of the repayment.

2. *The Mode of Financing*

Venture capitalists play a positive role in financing enterprises which bank creditors do not play. In particular, the venture capitalist's management support increases the probability, $\psi^{VC} > \psi^{WVC}$, that the entrepreneur's product will be developed successfully. This is because venture capitalists have a comparative advantage in the selection and monitoring of enterprises compared to other financial intermediaries.[2]

Assuming that venture capitalists add value to the enterprises is in line with recent empirical studies of the United States.[3] According to these studies, venture-capital-backed enterprises outperform non-venture-capital-backed ones even after the initial public offering (Brav and Gompers (1997)). Venture-capital-backed enterprises are likely to realize first-mover advantages because they bring their products to the market earlier than their non-venture-capital-backed counterparts (Hellmann and Puri (2000)). Moreover, the total costs of going public, including the underwriters' fee, seem to be lower for venture-capital-backed enterprises than for their non-venture-capital-backed counterparts (Megginson and Weiss (1991)). In addition, venture-capital-backed enterprises take out significantly more patents than other comparable enterprises (Kortum and Lerner (2000)).

When does the entrepreneur choose venture capital as the source of financing? In order to answer this question, I take three steps to derive equilibria on the financial market. First, I derive the steady-state levels of the repayment which are specified between the entrepreneur and a venture capitalist or a bank creditor. Second, I discuss under which conditions the entrepreneur chooses venture capital financing when venture capitalists have not yet built reputational capital. Third, I prove that a venture capitalist has incentives to provide management support to the entrepreneur once the venture capital repayment has been specified, i.e., venture capitalists have no incentives to engage in moral-hazard behavior.

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[2] *Amit* et al. (1998) have argued that venture capitalists have a comparative advantage in financing enterprises, since they specialize in particular stages and/or technologies.

[3] At the same time, results reported in the empirical literature indicate that it is not clear whether the higher performance of venture-capital-backed enterprises can be attributed to venture capitalists' management support, or whether it can be attributed to venture capitalists' ability to recognize good investment opportunities.

a) Repayment in the Steady State

What are the possible steady-state levels of the repayment? There are only two possible repayments in the steady state because all venture capitalists and all bank creditors are identical.

In case of venture capital financing, every venture capitalist's expected profit results from the difference between his expected revenue, which is given by the repayment, R^{VC}, multiplied by the probability that the enterprise will be successful, minus his costs. The venture capitalist's costs cover the enterprise's start-up investment, I, the compensation premium demanded by risk-averse capital providers, P^{VC}, and the costs for providing management support to the enterprise, C. Each venture capitalist wants to repay the compensation premium in order to encourage capital providers to offer capital for the start-up investments of entrepreneurs in the next period.[4] Thus, the venture capitalist expects a profit per enterprise which is given by

$$\hat{\pi}_{VC} = -I + \psi^{VC} R^{VC} - C - P^{VC}. \tag{2}$$

Venture capital finance is only offered if the venture capitalist's expected profit is at least equal to zero. Setting equation (2) equal to zero and solving for the repayment gives the lowest possible repayment demanded by the venture capitalist:

$$R^{VC} = (I + C + P^{VC})/\psi^{VC}. \tag{3}$$

Thus, the lowest possible repayment for venture capital financing depends positively on the costs of providing management support to an enterprise, the costs of raising new capital from capital providers, and on the effect the venture capitalist's involvement has on the success probability, i.e., on the size of the venture capitalist's value added.

In the case of credit financing, the bank's expected profit results from the difference between the expected revenue, which is given by the repayment, R^B, multiplied by the probability that the enterprise will be successful, ψ^{WVC}, minus the costs. The bank's costs cover the start-up investment, I, and the compensation premium demanded by risk-averse capital providers, P^B. As the venture capitalist, the bank wants to repay

[4] The compensation premium may depend on the degree of risk aversion of the capital providers. The higher the degree of risk aversion of the capital providers is, the higher the compensation premium might be.

the compensation premium in order to encourage capital providers to offer capital for the start-up investments of entrepreneurs in the next period. Thus, the bank expects a profit per enterprise that is given by

$$\hat{\pi}_B = -I + \psi^{WVC} R^B - P^B. \tag{4}$$

Assuming competition between banks, the repayment in case of credit financing is given by

$$R^B = (I + P^B)/\psi^{WVC}. \tag{5}$$

b) When Do Entrepreneurs Choose Venture Capital Financing?

The choice between bank credits and venture capital finance depends only on the level of the repayment because the investment in the enterprise and the specification of the repayment is made before the venture capitalists provide management support to the enterprises. This is because the level of the repayment, R, can be specified in a contract, while the venture capitalists' management support is not contractible. This assumption is reasonable given that it would be extremely difficult for third parties, such as courts, to verify the actual amount of management support provided and to determine whether this amount was adequate. Because venture capitalists cannot credibly commit to provide management support to the enterprises after the repayment is fixed, entrepreneurs always choose the lower repayment.

One might argue that entrepreneurs anticipate the value added by venture capitalists, so that the latter can demand a higher repayment without specifying the management support in advance. However, in the beginning of a venture capital market when venture capitalists have not yet built up reputational capital, entrepreneurs cannot distinguish between venture capitalists building reputational capital and those only interested in money-making.

Thus, I assume that entrepreneurs choose venture capital financing if the repayment for venture capital finance that takes the costs of venture capitalists' management support into account is lower than the costs for credit financing: $R^B > R^{VC}$.

Inserting equation (3) and (5) into this inequality and rearranging yields

$$\psi^{VC}(I + P^B) - (I + P^{VC} + C)\psi^{WVC} > 0. \tag{6}$$

This condition states that entrepreneurs choose venture capital finance only if the increase in the performance of the enterprise due to the venture capitalist's active involvement in form of management support, ψ^{VC}/ψ^{WVC}, is larger than the increase in the user costs of capital of the enterprise, $(I + P^{VC} + C)/(I + P^B)$.

Because entrepreneurs are identical, the development of all products is either financed by bank credits or by venture capital in equilibrium.

c) Separation Between Banks and Venture Capitalists

The following proposition provides a detailed description of whether a venture capitalist can increase his profits when he saves on management support, i. e., whether he has incentives to behave like a bank.

Proposition: When condition (6) is fulfilled, a venture capitalist has no incentive to behave like a bank, while when condition (6) is not fulfilled, each bank has no incentive to behave like a venture capitalist.

Proof: Consider a representative risk-neutral intermediary that maximizes his expected profit by deciding whether to support the enterprises he has chosen to finance. The intermediary's expected profit is given by

$$\hat{\pi} = -I - C(\psi) - P + \psi R \text{ with}$$

$$\psi \in \{\psi^{VC}, \psi^{WVC}\}, R \in \{R^{VC}, R^B\}, P \in \{P^{VC}, P^B\}, \text{ and } C(\psi) = \begin{cases} C & \text{if} \quad \psi = \psi^{VC} \\ 0 & \text{if} \quad \psi = \psi^{WVC} \end{cases}.$$

Because the repayment is already fixed when the intermediary decides on providing management support to the enterprise, he compares his expected profit if he provides management support to the enterprise, $\hat{\pi}(\psi^{VC})$, with his expected profit if he does not provide management support to the enterprise, $\hat{\pi}(\psi^{WVC})$.

Suppose first that the repayment of credit financing has been chosen. Then, as Table 1 summarizes, the intermediary's expected profit when providing management support to the enterprise, $\hat{\pi}(\psi^{VC})$, is lower than his expected profit when not providing support to the enterprise,

Table 1

The Value of Venture Capitalist's Expected Profit

	R^{VC}	R^{WVC}
ψ^{VC}	$\hat{\pi}_{VC} = -I + \psi^{VC}\frac{I+C+P^{VC}}{\psi^{VC}} - C - P^{VC} = 0$	$\hat{\pi}_{VC} = -I + \psi^{VC}\frac{I+P^{VC}}{\psi^{WVC}} - C - P^{B} < 0$ if $\psi^{VC}(I+P^{B}) - (I+P^{VC}+C)\psi^{WVC} < 0$
$>\psi^{WVC}$	$\hat{\pi}_{VC} = -I + \psi^{WVC}\frac{I+C+P^{VC}}{\psi^{VC}} - P^{B} < 0$ if $\psi^{VC}(I+P^{B}) - (I+P^{VC}+C)\psi^{WVC} > 0$	$\hat{\pi}_{VC} = -I + \psi^{WVC}\frac{I+P^{B}}{\psi^{WVC}} - P^{B} = 0$

$\hat{\pi}(\psi^{WVC})$, if $\psi^{VC}(I+P^{B}) - (I+P^{VC}+C)\psi^{WVC} < 0$. Therefore, when condition (6) is not satisfied, the repayment of bank finance is specified and banks have no incentive to behave like venture capitalists.

Suppose now that the repayment of venture capital financing, R^{VC}, has been specified between the intermediary and the entrepreneur. Then, the intermediary's expected profit when providing management support to the enterprise $\hat{\pi}(\psi^{VC})$ is higher than his expected profit when not providing support to the enterprise $\hat{\pi}(\psi^{WVC})$ if $\psi^{VC}(I+P^{B}) - (I+P^{VC}+C)\psi^{WVC} > 0$, which is again condition (6). Thus, venture capital finance emerges only if venture capitalists' value added exceeds the increase in the user costs of capital of the enterprise.

III. What Determines the Level of Venture Capital Investments?

By taking into account some of the systematic interdependencies between consumers, entrepreneurs developing products, venture capitalists, and capital providers, determinants of the level of venture capital investments across countries can be identified. In my model, the level of venture capital investments follows from the number of entrepreneurs that produce products. Hence, it is important to specify first the consumers' demand for products. In order to derive the level of venture capital investments, I assume that the venture capital market is competitive, so that the venture capitalist can demand only a repayment from the entrepreneur that drives his expected profits equal to zero.[5]

1. Consumer Behavior

In each period, a representative individual, who owns all resources in the economy, maximizes his consumption utility that is given by a love-of-variety function. The consumption-utility function contains a basic homogeneous product and an aggregate of products. The products are aggregated by means of a constant elasticity of substitution function (Dixit and Stiglitz (1977)).[6] The representative individual maximizes his consumption utility function subject to the budget constraint. As I will argue below, individuals do not have to save part of their income to finance domestic investment because the capital stock of the economy is constant in the steady state. The income, Y, consists of the labor and capital income.

Maximizing the consumption-utility function subject to the budget constraint with respect to the product quantities gives the Marshallian demand function for a particular product, $\overline{m}$, as a function of the respective product prices, the income of the individuals, and their income shares:

$$X_{\overline{m}} = \frac{Y p_{\overline{m}}^{\frac{1}{\rho-1}}}{\beta \sum_{m} p_{m}^{\frac{\rho}{\rho-1}}}, \text{ with } \beta = \beta_B \left[\frac{1}{\beta_T} + \frac{1}{\beta_B} \right], \tag{7}$$

where $0 < \beta_s < 1$, $s \in \{B, T\}$ denotes the income shares of the basic product and the aggregate of products, and $0 < \rho < 1$ denotes the degree of differentiation in the differentiated-product market for products.

2. Steady-State Number of Enterprises

In order to derive the steady-state number of enterprises, the entrepreneur's expected profit, given in equation (1), must be maximized by setting the profit-maximizing price of the product. Inserting the demand function, given in equation (7), and maximizing the expected profit leads to the following optimal product price $p_{\overline{m}}^{\star} = w/\rho$ (see also Romer 1986).

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[5] Assuming another form of competition in the venture capital market, which would be more realistic, would make the analysis more complicated without changing the main qualitative results.

[6] This approach to the aggregation of differentiated goods has also been used to analyze trade patterns (*Krugman* (1980) and *Helpman* (1981)) and to model endogenous growth (*Barro* and *Sala-i-Martin* (1995)).

Inserting the optimal product price, which is identical for all products, into the expected profit of the entrepreneur yields

$$\hat{\pi}_{\overline{m}} = \frac{\psi^{VC}(1-\rho)Y}{\beta N} - \psi^{VC}R^{VC}, \text{ if } \psi^{VC}(I+P^{B}) > (I+P^{VC}+C)\psi^{WVC}, \tag{8}$$

where N denotes the number of entrepreneurs who have successfully started their enterprises.

In order to determine the steady-state number of entrepreneurs, I first specify the individuals' capital and labor income available for consumption, Y. In the steady state, the income can be totally consumed because the capital stock of the economy is constant and the saving rate is equal to zero. The story behind this is as follows. The start-up investments are totally sunk after they have been implemented, and each enterprise is active for only one period. The enterprises have to repay the start-up investments, and they have to pay the compensation premium, P^{VC}. The compensation premium is part of the income and is, thus, consumed, while the start-up investments are repaid to be invested in the next period. Therefore, in the steady state, the individuals' capital income is given by the compensation premium per financed entrepreneur multiplied by the number of successfully financed entrepreneurs, N, divided by the success probability. The labor income is given by the wage rate multiplied by the number of workers, which results from the number of individuals in the economy, L, minus the number of entrepreneurs. In addition, the individuals' income contains the realized profits of successful entrepreneurs. Each entrepreneur receives a profit equal to $\pi_{\overline{m}}$. Thus, the income in the economy is given by $Y = w\left(L - N/\psi^{VC}\right) + P^{VC}N/\psi^{VC} + \pi_{\overline{m}}N$.

To determine the wage rate, I assume that the basic homogeneous product is produced using only labor input. For simplicity, I assume that each unit of labor results in one unit of the basic homogeneous product. The price of the basic homogeneous product is set equal to one so that the wage rate in the economy is equal to one.

In the steady state, free entry of enterprises drives the expected profits to the wage rate, since individuals will embark on a career as entrepreneurs only if they earn at least an amount equal to the wage rate of an employee. Upon setting equation (8) equal to the wage rate, which is equal to one, and inserting the individuals' income, gives the number of successful entrepreneurs in the steady state, N^{*}, as a function of the exogenous parameters of the model:[7]

$$(9) \quad N^* = \frac{\psi^{VC}(1-\rho)L}{(I+P^{VC}+C+1)\beta-(1-\rho)(P^{VC})}, \text{ if } \psi^{VC}(I+P^B) > (I+P^{VC}+C)\psi^{WVC}.$$

Thus, the venture capitalists' active involvement affects the steady-state number of entrepreneurs because venture capitalists' active involvement in the form of management support increases the probability of entrepreneurs being successful. The larger the effect of the venture capitalists' active involvement on the success probability is, the higher the number of entrepreneurs in the steady state.

3. The Level of Venture Capital Investments

If condition (6) is not fulfilled, the level of venture capital investments is equal to zero. If condition (6) is fulfilled, the level of venture capital investments results from the number of successful venture-capital-backed entrepreneurs multiplied by the start-up investment divided by the success probability and the number of individuals, L, used as a measure for the size of the economy. Thus, the level of venture capital investments relative to the size of the economy is given as

$$(10) \quad \frac{V^*}{L} = \begin{cases} 0 & \text{if } \psi^{VC}(I+P^B) \leq (I+P^{VC}+C)\psi^{WVC} \\ \frac{(1-\rho)I}{(I+P^{VC}+C+1)\beta-(1-\rho)P^{VC}} & \text{else} \end{cases}$$

Equation (10) implies that the level of venture capital investments relative to the economy's size depends on the importance of the banking market. When the banking market is dominant (when the banks' price for raising new funds P^B is low and the success probability without venture capital finance ψ^{WVC} is high), venture capital finance has difficulties to develop. This is the case because in a dominant banking market, banks have well-working mechanisms and established relationships to solve problems arising when information is asymmetrically distributed either between banks and entrepreneurs or between banks and capital providers.

As the sign of the partial derivative of the level of venture capital investments relative to the economy's size with respect to the compensation premium of capital providers indicates, the higher the compensation premium, the lower the level of venture capital investments is because $\beta > 1 > (1-\rho)$. Like the start-up investments and the venture capitalists'

[7] In the steady state with venture capital finance, is $\pi_{\overline{m}} = w/\psi^{VC}$.

costs of management support, the compensation premium is part of the fixed costs of the entrepreneurs. Increasing these fixed costs reduces the number of enterprises that is needed to fulfill the zero-profit condition in a differentiated product market. Thus, for a higher compensation premium, fewer entrepreneurs try to start an enterprise.

Moreover, the level of venture capital investments relative to the economy's size increases with the start-up investment. An increase in the start-up investment has two effects. First, each entrepreneur demands more capital, which ceteris paribus increases the venture capital demand. Second, an increase in the start-up investment increases the fixed costs of each enterprise and reduces the optimal number of enterprises demanding venture capital. In my model, as indicated by the partial derivative of equation (10) with respect to the start-up investment, the first effect is larger than the second one.

By contrast, the level of venture capital investments relative to the economy's size decreases with the costs of venture capitalists' management support and with the differentiation parameter. Venture capitalists' costs of management support increase the fixed costs of the enterprises The more the products can be substituted (the higher the parameter ρ) the lower the number of enterprises is that fulfils the zero-profit condition in the differentiated product market.

4. *The Functioning of Venture Capital Markets*

From equation (10), one can extract two types of explanations for variations in venture capital investment across countries. First, equation (10) implies that venture capital investments are zero (or comparatively low) if venture capital finance does not add sufficient value to the enterprises either because of high costs of management support, C, or because of a low impact on profitability of the enterprises, i.e., on the success probability ψ^{VC}. Thus, a venture capital market may not exist because the *internal functioning* of the market is unbalanced. Second, equation (10) implies that venture capital investments are zero (or comparatively low) if venture capitalists' costs for raising new funds are too high compared to the banks' capital costs. Thus, a venture capital market may not exist because the *external functioning* of the market is unbalanced. In the following, I discuss why the internal and external functioning of a venture capital market might be unbalanced and discuss links to be tested in the empirical part of this paper.

a) The Internal Functioning

In order for the internal functioning of a venture capital market to be balanced, venture capital finance must create value. In my model, this value depends on (i) the probability of success of an investment with and without venture capital finance, and, (ii) the costs for venture capitalists' management support. The lower the impact of the venture capitalists' management support on the success probability, the less likely the emergence of a venture capital market is. Moreover, the higher the costs of management support, the less likely the emergence of a venture capital market is.

Venture capital finance might not create value if venture capitalists lack technological experience. Recent empirical studies have found a positive correlation between venture capitalists' value added and venture capitalists' experience. Baker and Gompers (1999) have found evidence that the presence of experienced venture capitalists reduces the fraction of insiders on the board of directors of venture-capital-backed enterprises. Reducing the fraction of insiders can be interpreted as lowering the power of chief executive officers who are interested in a high fraction of insiders on the board in order to establish business policies that are beneficial for them. In an empirical study, Lerner (1994) has found evidence that experienced venture capitalists are more proficient in timing the initial public offerings of venture-capital-backed enterprises than their less experienced counterparts. In particular, enterprises backed by experienced venture capitalists are more likely to go public when their valuations are at the maximum than the enterprises backed by less experienced venture capitalists.

Venture capitalists may accumulate the experience necessary to make high-risk investments profitable during their activities as active financial intermediaries. Certainly, they typically start their career with some basic experience because they have often some experience in selling enterprises successfully on a stock market. But some specific sort of experience can be accumulated only as an active financial intermediary. One element of this experience may be the ability to recognize crisis situations in the venture-capital-backed enterprises early on, or to evaluate business plans and business ideas at lower costs than inexperienced venture capitalists.

Apart from the venture capitalists' technological experience, law tradition, and regulations in the corporate sector and in labor markets can

affect the costs of management support, C, as well as the value created by venture capitalists' active involvement. Generally, contract law should not prevent venture capitalists from having control rights, such as board and voting rights. Only if venture capitalists have control rights in the enterprises they may be capable of intervening in the enterprise's business policies, and, by doing so, they may be capable of increasing the expected profits of the enterprises. Regulations in the corporate sector determine the costs that arise when venture capitalists gather information on entrepreneurs in which they want to invest. For example, accounting standards determine transaction costs that arise when venture capitalists gather information. The better accounting standards are, the easier and cheaper it is to get information about a particular firm. Regulations of labor markets may affect the internal functioning of venture capital markets, since they determine the costs of venture capitalists' management support and monitoring services.

b) The External Functioning

In order to have a balanced external functioning of a venture capital market, venture capitalists must be able to raise capital at an appropriate rate, compared to the capital costs of banks. For some reasons, the price which venture capitalists have to pay might be higher than the price which banks have to pay. Banks have already established relationships to capital providers, while venture capitalists have not. Because banks have established relationships, problems of asymmetric information may play a minor role when banks raise capital for investments in enterprises. In contrast, asymmetric information between venture capitalists and capital providers may be substantial.

Large financial players can affect the price which venture capitalists have to pay for capital, since large players have different investment strategies, especially with respect to investment risks. As has been argued by Mayer et al. (2004), institutions such as pension funds are likely to encourage early-stage investments more than other investors do. Only a few European countries have large pension funds which, as do U.S. pension funds, seek investment opportunities with a promising risk-return relationship.

The price for capital that venture capitalists have to pay for raising new funds depends on several pieces of legislation and regulations, especially regarding shareholder rights. The price which venture capitalists

have to pay for capital can be expected to be lower in those countries in which shareholders are better protected than creditors. In addition, the price for raising capital is likely to be affected by the tax system[8] since it can favor particular forms of investments. For example, capital providers have lower incentives to invest in venture capital funds and higher incentives to invest in bonds when losses made with venture capital investments are not tax deductible.

c) Towards an Empirical Model

When explaining cross-country variations in venture capital investments empirically, one has to overcome the problem that venture capitalists' prices for raising new funds and venture capitalists' costs of providing management support and monitoring services are not directly observable. Therefore, I will use instrumental variables in the empirical model of whom I expect that they determine the price for raising new funds and costs of management support and monitoring services.

I expect that the price for raising new funds is likely to be lower in an economy with a liquid stock market than in an economy without a liquid stock market for at least three reasons. First, by successfully exiting from venture-capital-backed enterprises via an initial public offering, venture capitalists build a reputation that they can use to raise capital from capital providers at more favorable conditions. Thus, in terms of the theoretical model, the existence of a stock market reduces P^{VC}. Second, with initial public offerings of venture-capital-backed enterprises, venture capitalists can signal their experience to the market, and this can reduce transaction costs in the relationship between venture capitalists and entrepreneurs. Third, as Black and Gilson (1998) have argued, liquid stock markets offer venture capitalists and entrepreneurs who want to start high-technology enterprises the opportunity to enter into an implicit contract over control. Because an initial public offering gives the entrepreneur the opportunity to re-acquire control at least partly (since the entrepreneur can obtain a leading management position in the listed enterprise), the entrepreneur has lower incentives for opportunistic behavior. Thus, in terms of the theoretical model, the presence of a stock market reduces C.

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[8] *Keuschnigg* and *Nielsen* (2003) have shown theoretically that a tax on capital income reduces venture capital demand because it reduces the number of entrepreneurs in equilibrium.

Moreover, I expect that the price that venture capitalists have to pay for raising capital from uninformed capital providers is determined by the structure of the financial market. Of particular interest is the availability of pension funds, since pension funds are likely to be less risk-averse than banks and, therefore, are more likely to invest in risky enterprises. Thus, high levels of pension funds are expected to lead to higher levels of venture capital investments. In addition, following a strand of the literature that analyzes the effects of the financial structure on the efficiency of capital allocation (Levine and Zervos (1998), Beck and Levine (2002)), I expect that the importance of banks relative to the importance of stock markets matter for the price of raising new funds and, thus, for the level of venture capital investments.

IV. Empirical Analysis

1. Recent Literature

There are four studies that analyze cross-country variations in venture capital investments. Jeng and Wells (2000), which is the most popular study, have used a data set of 21 countries for the years 1993 to 1995 and static panel data techniques. Schertler (2003b) has used a panel data set of 14 Western European countries for the years 1989 to 2000 and dynamic panel data techniques. Da Rin et al. (2003) have used a data set of 17 European countries for the years 1987 to 2001 and static panel data techniques. Leleux and Surlemont (2003) have used a data set of 15 European countries over the period 1990 to 1996 and Granger causality test.

In line with my theoretical considerations regarding the impact of financial markets, Jeng and Wells (2000) have found evidence that the wealth of pension funds has a significantly positive impact on new funds raised. In addition, they have found evidence that the market value of initial public offerings has a significantly positive impact on early- and expansion-stage investments but no impact on early-stage investments. Moreover, Schertler (2003b) documents that venture capital investments depend positively on the capitalization of stock markets, and on the human capital endowment of an economy (approximated by research and development employees). Furthermore, Da Rin et al. (2003) have found evidence that the share of private equity invested in high-technology enterprises is positively affected by the existence of a stock market for innovative enterprises and by research and development expenditures.

Regarding the impact of labor markets, which is ignored in the theoretical model,[9] Jeng and Wells (2000) have found evidence that labor market rigidities[10] have a significantly negative impact on early-stage investments, but not on early- and expansion-stage investments. By contrast, Schertler (2003b) has found a positive impact of labor market rigidities on venture capital investments. She explains the positive coefficient as being the result of different capital-labor-ratios: enterprises operating in economies with rigid labor markets demand more capital per employee than their counterparts operating in flexible labor markets. Besides these papers analysing the determinants of venture capital investments, there is a growing body of papers addressing the impact of venture capital investments on labor market performance (Wasmer and Weil (2000), Fehn and Fuchs (2003), Belke et al. (2002)). Wasmer and Weil (2000) have found a significant link between the unemployment rate and venture capital investments. Fehn and Fuchs (2003) have used disaggregated data, and have found evidence that venture capital investments affect the structure of labor demand. Belke et al. (2002) have found a significantly negative link between the change in unemployment and venture capital investments, and a significantly positive one between employment and venture capital investments.

Not in line with my theoretical considerations is the negative and significant impact of accounting standards on early- and expansion-stage investments found by Jeng and Wells (2000). In their paper, Jeng and Wells have argued that an insignificant coefficient could be explained by the fact that empirical proxies used for accounting standards are those of public firms and not of privately held firms. However, they do not offer an explanation for the significantly negative coefficient.

In a related paper, Leleux and Surlemont (2003) have analyzed the impact of government funding of venture capital investments. They have used the Granger causality test to check whether public funds seed the industry or whether they crowd out private funds. Results of the Gran-

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9 The link between labor markets and investments is not clear in the theoretical literature. On the one hand, strong labor market institutions may lead to a substitution effect between capital and labor ending up with higher capital-labor ratios (*Layard* et al. (1991)). On the other hand, hold-up problems between enterprises and labor market institutions such as labor unions may reduce investment incentives (*Grout* (1984)).

10 *Jeng* and *Wells* (2000) have used two measures of labor market rigidities: the average tenure of employees with some or completed tertiary education and the percent of labor force with a tenure greater than 10 years.

ger causality test support neither the seed nor the crowing out hypotheses. Leleux and Surlemont (2003) have argued that public venture capital funds seem to be the consequence of developments in the venture capital industry.

So far, no study has addressed whether the dominance of the banking system affects the level of venture capital investments. The intention of this paper is to close this gap.

2. *Methodology*

In order to test my hypotheses derived in the Section 3.4c, I use dynamic panel data techniques because, inter alia, venture capital investments have developed very dynamically in the last ten years. By estimating a dynamic model, the effects of reputation building and experience accumulation can be captured. In particular, venture capitalists accumulate experience in order to successfully select, monitor, and support and, thus, to add value to young high-technology enterprises. They accumulate experience by being involved in the management of young high-technology enterprises. Reputation, i.e., a track record of successfully financing young high-technology enterprises, is needed in order to raise capital from capital providers who a priori have little information about the profitability of venture capital investments.

My dynamic panel model features, besides exogenous variables, a lagged endogenous variable and country-specific effects:

$$VC_{it} = VC_{it-1}\delta + X_{it}\beta + \vartheta_i + \varepsilon_{it}, \tag{11}$$

where X_{it} denotes the matrix of exogenous variables, ϑ_i denotes the country-specific effects, ε_{it} denotes the disturbance vector, and δ and β denote coefficients to be estimated.

Country-specific effects have to be removed from equation (11) because it can be expected that they are correlated with the lagged endogenous variable. They can be removed by calculating first differences. Anderson and Hsiao (1982) proposed this approach first. This procedure not only removes the county-specific effects but also all variables that are time-invariant. Therefore, I do not consider regulatory variables such as the accounting standards and anti-director rights reported by La Porta et al. (2000).

Removing the country-specific effects by first differencing leads to a correlation between the lagged endogenous variable and the disturbance vector. Arellano and Bond (1991) have argued that using generalized method of moments (GMM) and lags as instruments can produce a consistent estimator if the disturbance vector is serially uncorrelated. Valid instruments in this model are the endogenous variables lagged two or more periods. Only if disturbances are uncorrelated, and if the instruments are valid, is estimation consistent. Therefore, I test whether there is second-order correlation in the residuals, and I perform a Sargan test for over-identifying restrictions to check the validity of instruments (Arellano and Bond (1991)).

For unbalanced panels that have a time dimension smaller than twenty periods and a small number of cross-sections, Judson and Owen (1999) have recommended a one-step GMM estimator. In particular, Judson and Owen (1999) have found that the computational efficiency of the estimator can be increased without substantially reducing effectiveness by using only a subset of available lagged values as instruments. Therefore, I use the one-step GMM estimator and a subset of available lags of the endogenous variable as instruments.

Because I cannot rule out that the variables capturing the financial market structure and the labor market structure depend on past venture capital investments (Wasmer and Weil (2000), Da Rin et al. (2003)),[11] I use instruments for these variables in order to obtain consistent parameter estimates. In particular, I assume that these variables are predetermined and I use two lags of these variables as instruments similarly to the way I use the endogenous variable lagged two or more periods to instrument the lagged endogenous variable.

3. Description of the Data Set

I use a panel data set of 16 European countries for the time period 1990 to 2001. These countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

I use two measures of venture capital investments: investments in enterprises' early stage (seed and start-up) of development as a narrow de-

[11] For example, labor market performance can be the result of venture capital finance, since venture capital investments most often create employment (*Belke* et al. (2002)) in the form of high-qualified jobs (*Engel* (2003)).

finition and investments in enterprises' early- and expansion-stages of development as a broader definition of venture capital investments. I scale these variables by gross domestic product (GDP). In the seed stage, the initial business concept is formed and prototypes of new products are developed and compared with competing products in the market. In the start-up stage, production is set up and an initial marketing campaign is launched, the market reaction to which is carefully analyzed. Compared to other stages of development, such as the expansion-stage, the seed and start-up stage are very risky stages. In the expansion-stage, enterprises require large amounts of external funding because the cash flow often does not yet generate enough liquidity for the internal financing of the enterprises' growth.

In order to test the impact of the banking industry on venture capital investments, I assume that bank finance and venture capital finance coexist, while in the theoretical model, I use either bank finance or venture capital finance. I use the lending rate and a measure of banks' profitability to capture the importance of the banking industry. The lending rate gives the price of an alternative financing form for enterprises. I expect that, ceteris paribus, the higher the lending rate is, the higher venture capital investments are. Banks' profitability is measured as banks' profits divided by banks' assets. I expect that the higher banks' profitability, the more market power banks have and, thus, the lower venture capital investments are.

In order to test the impact of the structure of financial markets on venture capital investments, which affects the price of venture capitalists when raising new funds and venture capitalists' costs of management support, I use several measures. In particular, I use pension funds scaled by GDP, either the growth of the stock market capitalization, or the capitalization of stock markets scaled by GDP, or the number of listed companies scaled by the population, and bank assets divided by stock market capitalization to capture the relative importance of banks as compared to stock markets.

In order to control differences in labor market regulations, I use an index of protection against dismissal for regular and temporary employment provided by the OECD (1999). Two values are available over the observation period: one describes the strictness in the late 1980s, while the other describes the strictness in the late 1990s. The value of the late 1980s is used for the years 1990–1993, while the value of the late 1990s is used for the years 1994–2001.

Table 2

Data Definitions and Sources

Variable	Description	Source
Venture capital investments	Venture capital investments are measured either as investments in early stage (government and private sector funded) or investments in early and expansion stage (government and private sector funded) scaled by gross domestic product.	EVCA (various issues).
Dominance of banks	The dominance of banks is captured by the lending rate and banks' profitability measured as banks' profits over banks' assets. The available data in the bank profitability statistics differ between countries. For some countries, assets and profits are reported for only commercial banks, while for other countries assets and profits of only all banks are reported.	OECD bank profitability (2003), IFS CD Rom (2003).
Financial market	To capture the structure of financial markets, I use stock market capitalization (end-of-period levels) as a percentage of GDP, the number of firms listed as percent of population (*100), the growth rate of stock market capitalization, pension funds as a percentage of GDP, and bank assets as a percentage of stock market capitalization. Pension funds are set equal to zero for France and Greece. For both countries, detailed figures of pension funds are not available.	Emerging stock markets factbook (1993, 2002), OECD Initial Investors (2004), OECD bank profitability (2003).
Labor market	Labor market rigidity is captured by strictness of protection against dismissals of regular and temporary employment.	OECD (1999), Table 2.5.

In addition, I control differences in the level of funds offered by governments. For this purpose, I include a variable measuring the relative importance of public funding defined as funds offered by public authorities as a percentage of overall funding. Since public funding itself might be endogenous regarding early-stage investments, I use lagged public funding.

Table 3 presents descriptive statistics of the endogenous and exogenous variables of my unbalanced panel. The number of observations for

Table 3

Descriptive Statistics

	Mean	Std. Dev.	Min	Max
a. Endogenous variables				
Early-stage investments (% of GDP)	0.019	0.0266	0.000	0.108
Early- and expansion-stage investments (% of GDP)	0.069	0.666	0.014	0.393
b. Exogenous variables				
Lending rate	9.91	5.07	3.34	29.45
Banks' profitability	0.71	0.71	–3.04	3.09
Growth of stock market capitalization	3.83	0.83	2.23	5.80
Stock market capitalization (% of GDP)	64.58	57.56	9.35	331.43
Number of listed companies (% of population)	0.002	0.001	0.000	0.005
Pension funds (% of GDP)	22.33	34.51	0	119.30
Labor market index	2.39	1.01	0.5	4.1
Public venture capital (% of private equity)	7.95	14.08	0.00	95.36
Growth of GDP	28.85	2.41	24.08	35.40

the endogenous variables is 187, while the number of observations for the exogenous variables is between 146 and 187. The volumes of capital managed by pension funds are only available for the years from 1993 through 2001 and not for all countries (see Table 2 for a description of the data sources).

On average, over all periods and all countries, venture capital investments in enterprises' early-stage of development are about 0.019 percent of GDP. Venture capital investments in enterprises' early and expansion stage are about 0.069 percent of GDP over all countries and all periods considered. Thus, expansion-stage investments are twice as high as early-stage investments. As the minimum and maximum values indicate,

differences in early- and expansion-stage investments across countries and/or time are substantial. While Greece has early-stage investments as low as 0.00 percent of GDP, Ireland has early-stage investments as high as 0.108 percent of GDP. Both, early-stage investments and early- and expansion-stage investments as a percentage of GDP increased in all countries during the observation period.

The countries also differ substantially with respect to the exogenous variables. Greece has had the highest lending rate in my sample, while Switzerland and Ireland, among others, have had comparatively low rates. With respect to stock markets, Portugal and Austria have had very low levels of market capitalization, while Finland, the United Kingdom, and Switzerland have had high levels of market capitalization and a high number of listed companies. Pension funds have been almost non-existent in Greece, France, and Austria, while pension funds in the Netherlands and Switzerland have had substantial amounts to manage. Banks' profitability has shown no clear pattern over time and across countries. Finland and Belgium have had very high percentages of funds coming from public authorities (sometimes above 70 percent), while Denmark and Greece have had very low percentages.

4. Estimation Results

Table 4 and 5 present the results of one-step GMM estimations using the early-stage investments and the early- and expansion-stage investments as a percentage of GDP as endogenous variables. As indicated by the p-values of m(2), disturbances lack second-order autocorrelation, which is necessary for GMM estimates to be consistent. The p-values of the Sargan tests indicate that the null hypothesis cannot be rejected. Under the null hypothesis, the model is correctly specified and the instruments are uncorrelated with the disturbances. Thus, both test results indicate that the estimations produce consistent parameter estimates.

The lagged endogenous variables have positive and highly significant coefficients in all specifications. This may suggest that experience accumulation and reputation building take place in venture capital markets.

The results suggest that the dominance of banks do play a significant role when using early-stage investments, but not when using early- and expansion-stage investments as endogenous variable. I find evidence that the lending rate has a significantly positive influence on early-stage investments (Table 4). Thus, in countries where bank finance is expensive,

Table 4: **Explaining Early-Stage Investments**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged endogenous variable	0.29*** (4.22)	0.36*** (6.47)	0.21** (2.50)	0.36*** (5.97)	0.35*** (6.55)	0.32*** (4.35)	0.36*** (4.48)
Public venture capital	0.00 (0.82)	−0.00 (0.31)	−0.00 (0.16)	−0.00 (0.27)	−0.00 (0.28)	0.00 (0.86)	0.00 (0.84)
Lending rate	0.25*** (3.87)	0.20*** (3.93)	0.20* (1.71)	0.22*** (2.95)	0.21*** (3.61)	0.18** (2.59)	0.11** (2.14)
Growth of stock market capitalization	0.94** (2.57)	1.04*** (3.09)	0.03 (0.03)	1.12** (2.39)	1.46** (2.21)		
Labor market indicator	0.33 (0.80)	−0.07 (0.20)	0.31 (0.57)	−0.17 (0.49)	−0.08 (0.28)	0.08 (0.20)	0.08 (0.25)
Banks' profitability		0.09 (0.53)					
Pension funds (% of GDP)			0.00 (0.04)				
Growth of GDP				−0.34 (0.19)			
Bank assets over stock market capitalization					0.00 (1.00)		
Stock market capitalization (% of GDP)						0.00 (0.64)	
Number of listed companies (% of population)							0.29 (1.01)
Dummy for 1999 and 2000	2.54*** (3.89)	2.50*** (3.91)	2.38*** (3.58)	2.49*** (3.84)	2.43*** (3.74)	2.68*** (3.91)	2.76*** (4.42)
Constant	0.28*** (3.94)	0.18*** (3.77)	0.48*** (2.74)	0.20** (2.19)	0.17*** (3.35)	0.28*** (3.79)	0.23*** (5.07)
m(1) (p-value)	0.00	0.00	0.01	0.00	0.00	0.00	0.00
m(2) (p-value)	0.51	0.39	0.78	0.42	0.45	0.41	0.28
Sargan test (p-value)	0.42	0.83	0.86	0.85	0.84	0.61	0.29
No. of observations	163	163	97	163	163	163	164
No. of countries	16	16	15	16	16	16	16

Note: Dependent variable is venture capital investments in enterprises' early stage as a percentage of GDP (*100). For the endogenous variable I use three lags as instruments. All variables are assumed to be predetermined variables. I used two lagged values as instruments.

***, **, * denotes significant at the 1, 5 and 10 percent level. t-values are given under the coefficients.

Table 5: **Explaining Early- and Expansion-Stage Investments**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Lagged endogenous variable	0.39*** (7.50)	0.40*** (6.10)	0.22** (2.38)	0.40*** (5.82)	0.39*** (6.39)	0.38*** (6.19)	0.36*** (6.93)
Public venture capital	–0.02* (1.86)	–0.02* (1.90)	–0.02 (1.52)	–0.02* (1.94)	–0.02* (1.84)	–0.02* (1.74)	–0.01 (1.20)
Lending rate	0.15 (0.79)	0.22 (1.32)	0.32 (0.96)	0.19 (1.00)	0.23 (1.34)	0.17 (0.99)	0.12 (0.62)
Growth of stock market capitalization	0.79 (1.12)	0.62 (1.26)	–1.12 (0.61)	0.59 (0.98)	1.40 (1.21)		
Labor market indicator	0.18 (0.18)	–0.56 (0.66)	0.70 (0.74)	–0.53 (0.62)	–0.59 (0.76)	–0.50 (0.55)	–0.67 (0.78)
Banks' profitability		0.19 (0.61)					
Pension funds (% of GDP)			0.06 (0.75)				
Growth of GDP				–2.23 (0.68)			
Bank assets over stock market capitalization					0.00 (0.78)		
Stock market capitalization (% of GDP)						0.01 (0.44)	
Number of listed companies (% of population)							0.52 (0.81)
Dummy for 1999 and 2000	6.67*** (5.00)	6.78*** (5.19)	6.61*** (4.49)	6.80*** (5.17)	6.64*** (5.11)	6.78*** (5.21)	6.88*** (5.21)
Constant	0.37*** (2.73)	0.37*** (2.83)	1.02** (2.46)	0.48** (2.39)	0.36*** (2.70)	0.39*** (2.72)	0.38*** (3.17)
m(1) (p-value)	0.00	0.00	0.02	0.00	0.00	0.00	0.01
m(2) (p-value)	0.76	0.93	0.75	0.88	0.99	0.85	0.74
Sargan test (p-value)	0.90	0.93	0.96	0.93	0.93	0.52	0.62
No. of observations	163	163	97	163	163	163	164
No. of countries	16	16	15	16	16	16	16

Note: Dependent variable is venture capital investments in enterprises' early- and expansion-stage as a percentage of GDP (*100). For the endogenous variable I use three lags as instruments. All variables are assumed to be predetermined variables. I used two lagged values as instruments.

***, **, * denotes significant at the 1, 5 and 10 percent level. t-values are given under the coefficients.

early-stage investments may develop more easily than in countries in which bank finance is cheap. However, I do not find a significant link between the lending rate and early- and expansion-stage venture capital (Table 5). In addition to the lending rate, I use banks' profitability to capture how the market power of banks determines the way in which enterprises' investments are financed. However, banks' profitability has neither a significant impact on early-stage investments nor on early- and expansion-stage investments.

The results suggest that the structure of the financial markets plays no significant role for venture capital investments on the aggregated level. In the case of early-stage investments, I find evidence that the growth of stock market capitalization has a significantly positive impact (Table 4), while in the case of the early- and expansion-stage investments it has not (Table 5). Two other measures of stock market development, the number of listed companies and the capitalization of stock markets, also do not have a significant impact on venture capital investments. In addition, I employ a relative measure of the importance of banks and stock market capitalization, which is, however, insignificant in both specifications.

Pension funds, another important variable describing the structure of financial markets, have neither a significant impact on early-stage investments nor on early- and expansion-stage investments. One reason for this insignificance might be that pension funds do not have to invest domestically, so that domestic availability of pension fund capital is not correlated with particular forms of investments. However, Gompers, and Lerner (1998), using aggregated data for the United States, have found evidence that pension funds have a positive impact over time. In addition, Jeng and Wells (2000) have found evidence that the wealth of private pension funds divided by GDP has a significant positive impact on new funds raised for venture capital when using within-estimations but not when using between-estimations. Because of these results, Jeng and Wells have argued that the wealth of private pension funds is a significant determinant of venture capital over time but not across countries.

Regarding the role of labor markets and public venture capital for the development of venture capital investments, I do not find a significant link between venture capital investments and either the labor market indicator or the public venture capital variable. This might be the result of a high multicollinearity between these two variables. Therefore, I estimated the model again and included either the labor market indicator or

the public venture capital variable (results are not reported). In the case of the public venture capital variable, I do not find a significant impact on early-stage investments. In the case of the labor market indicator, I find a significantly positive impact on early-stage investments. This is to some extent surprising. Schertler (2003b) explains the positive coefficient as being the result of different capital-labor-ratios: enterprises operating in economies with rigid labor markets demand more capital per employee than their counterparts operating in flexible labor markets.

In addition to the variables already mentioned, I include a dummy variable which is equal to one for the years 1999 and 2000. This dummy variable is highly significant in all specifications, indicating the boom in venture capital investments during the overvaluation in shares of enterprises which operate in the information and communication industry. Moreover, I include GDP growth to control for cyclical fluctuations (used also by Wasmer and Weil (2000)). However, the variable is insignificant and has little impact on the coefficients of the other variables.

V. Summary

Using a general equilibrium model, I have identified, in a first step, a basic condition that must be fulfilled for venture capital markets to emerge. This condition states that venture capital markets emerge only if the value created by venture capitalists exceeds the increase in the user costs of capital. The value added is given by the increase in the success probability of entrepreneurs due to venture capitalists' active involvement in management support. The increase in the user costs of capital results from the costs of providing management support and from raising new funds from uninformed capital providers. Using this basic condition, I have argued that when banks are dominant in financing enterprises, venture capital finance has difficulties to develop.

In a second step, I have used my general equilibrium model to identify several determinants of the level of venture capital investments in order to explain cross-country variations in venture capital investments. In my model, the level of venture capital investments relative to the size of the economy depends on the price which venture capitalists have to pay for raising capital from capital providers, the costs of venture capitalists' management support, and on the competition intensity in the market in which the venture-capital-backed enterprise operates. The higher the

price for raising new funds and the costs of venture capitalists' management support, the lower the equilibrium level of venture capital investments is.

In the empirical part of the paper, I have tested the insights of my model. Because neither the price for raising new funds nor the costs of management support are directly observable, I have specified variables that can be expected to be highly correlated with the unobservable variables. I have argued that the structure of financial markets is important, since it determines the price which venture capitalists have to pay for raising new funds and the cost of providing management support. The structure of the financial market is captured in terms of the existence of liquid stock markets, the size of the banking industry as compared to the stock markets, and the importance of pension funds.

For the empirical analysis, I have used a panel data set of European countries for the period 1990 to 2001. I have used either the early-stage or the early- and expansion-stage venture capital as a percentage of GDP as endogenous variable. I have found mixed evidence. In particular, the lending rate, which I have included to capture the role of banks, has a significantly positive impact on early-stage investments, while it has no impact on early- and expansion-stage investments. Moreover, banks' profitability, another measure to capture the role of banks, is insignificant in all model specifications. Regarding the structure of the financial market, I have found evidence that the growth of stock market capitalization affects early-stage investments significantly positively, while it does not affect early- and expansion-stage investments. My other variables related to the structure of the financial market, such as the importance of pension funds, are not significant.

These results deepen our understanding of what explains cross-country variations in venture capital investments. However, there are still open questions. Among these are the question concerning the link between venture capital investments and business cycle volatility. Analysing this link may also deepen our understanding of the link between labor markets and venture capital investments because one can expect that venture capital investments react more sensitively to business cycle upswings when the labor market is flexible than when it is inflexible. It is left to future research to address these questions.

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Summary

Explaining Cross-Country Variations in Venture Capital Investments: Theory and Empirical Evidence

This paper investigates why venture capital investments substantially vary across countries. Using a general equilibrium model, I show that the development of venture capital finance depends on the dominance of the banking market because bank finance determines a lower boundary of firms' user costs of capital. Moreover, this model shows that the level of venture capital investments is affected by the venture capitalists' costs of management support and monitoring services and the price for raising new funds from uninformed capital providers. Using dynamic panel techniques and a data set of 16 European countries, I test the implications of the model. I find, inter alia, that the lending rate has a positive and significant impact on early-stage investments. (JEL G24, O16, O41)

Zusammenfassung

Zur Erklärung von Länderunterschieden in den Venture-Capital-Investitionen: Theorie und empirische Evidenz

Dieser Artikel untersucht Unterschiede in den Venture-Capital-Investitionen zwischen Ländern. Innerhalb eines allgemeinen Gleichgewichtsmodells zeige ich zunächst, dass die Entwicklung der Finanzierungsform Venture Capital von der Dominanz des Bankensektors abhängt, da Kreditfinanzierung die Basis der Kapi-

talkosten aus Unternehmenssicht festlegt. Darüber hinaus zeigt das Modell, dass das Niveau der Venture-Capital-Investitionen von den Kosten der Managementunterstützung durch den Venture-Capital-Geber sowie von den Kosten der Kapitalaufnahme für Venture-Capital-Geber bestimmt wird. Unter Verwendung eines dynamischen Panelschätzers und eines Datensatzes bestehend aus 16 europäischen Ländern überprüfe ich die Implikationen des Modells. Ich finde unter anderem Evidenz, dass die Venture-Capital-Investitionen positiv vom Darlehenszinssatz abhängen.

Résumé

Comment expliquer les différences nationales des investissements de venture capital: évidence théorique et empirique

Cet article examine pourquoi les investissements de venture capital (capital-risque) varient substantiellement d'un pays à l'autre. A l'aide d'un modèle d'équilibre général, l'auteur montre tout d'abord que le développement du financement de venture capital dépend de la dominance du secteur bancaire, car le financement du crédit détermine la base des coûts de capital du point de vue de l'entreprise. En outre, le modèle montre que le niveau des investissements de venture capital est déterminé par les coûts du soutien du management par le venture capitaliste ainsi que par les coûts de l'emprunt pour le venture capitaliste. En utilisant la technique de panel dynamique et une base de données de 16 pays européens, l'auteur examine les implications du modèle. Il trouve entre autre l'évidence suivante: le taux d'emprunt a un impact positif et significatif sur les investissements au départ.