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Under What Conditions Do Venture Capital Markets Emerge?

by

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Abstract

Venture capital activity differs considerably across countries. Venture capital markets are highly developed in few countries, while these markets are almost nonexistent in many other countries. This paper examines the conditions that have to be fulfilled for liquid venture capital markets to emerge. Using a general equilibrium model, two necessary conditions are identified. First, value added by venture capitalists' active involvement must be high compared to the costs of management support. Second, the number of high-technology enterprises demanding venture capital must exceed a critical level. The paper discusses how differences in financial and innovation systems affect these two conditions.

Keywords: Management support, high-technology enterprises, venture capital finance

JEL classification: G24, O16, O41

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1 Introduction

Venture capital activity differs considerably across countries. Only few countries have highly developed venture capital markets, such as the United States, while in many other countries, these markets are almost nonexistent. Recent literature has suggested that the differences in venture capital activity can be explained by differences in the financial market structure (Black and Gilson 1998), differences in corporate governance systems and innovation systems (Becker and Hellmann 2000). However, the recent literature has not identified basic conditions necessary for venture capital markets to emerge efficiently.

The purpose of this paper is to investigate under what basic conditions venture capital markets emerge. Using a general equilibrium model, it is shown that venture capital markets emerge only if the value-added by venture capitalists' active involvement in form of management support is high compared to the costs of supporting the management teams of high-technology enterprises. Moreover, the model shows that there is a second condition for a venture capital market to emerge: the demand for venture capital by young high-technology enterprises must exceed a critical level because innovative ideas are indivisible. It is argued that this critical level is even higher if venture capitalists' specialization on particular fields of technologies is taken into account. After deriving these two necessary conditions, the paper discusses the impact of various financial market structures and innovation systems.

This paper divides into five sections. In the second section, I give an overview of the main ingredients of the model. In the third section, I determine the steady state values analytically and I derive under what conditions venture capital markets emerge. In the fourth section, I discuss the impact of some additional determinants on the emergence of venture capital markets. Section five summarizes the main results.

2 Overview of the Model

The model takes into account the systematic interdependencies between outside investors, venture capitalists, banks, innovators, and consumers (Figure 1). The consumers demand high-technology products in addition to

traditional products. The development of traditional products can be financed by bank credits. The development of high-technology products is risky. Venture capitalists can reduce these risks through management support and, thus, increase the expected profits of high-technology product developments.[1]

In order to produce a traditional or high-technology product, an entrepreneur must make a start-up investment for the development of the respective product. This start-up investment is used for research and development activities if a high-technology product should be developed, and for organizing the business if a traditional product is developed. The entrepreneur has to raise capital in the financial market because she does not have the means to finance the start-up investment herself. After successfully establishing the enterprise, both traditional and high-technology products are produced using only labour at constant marginal costs. A homogeneous basic product is also produced using only labour input to determine the wage rate in the economy.

The probability of a successful development of high-technology products, which is determined by a random variable realized only after financing decisions have been taken and the start-up investment has been made, depends on venture capitalists' active involvement. Venture capitalists influence the probability of a successful development because they have a comparative advantage in financing high-technology products. This comparative advantage is based on the venture capitalists' stage- and

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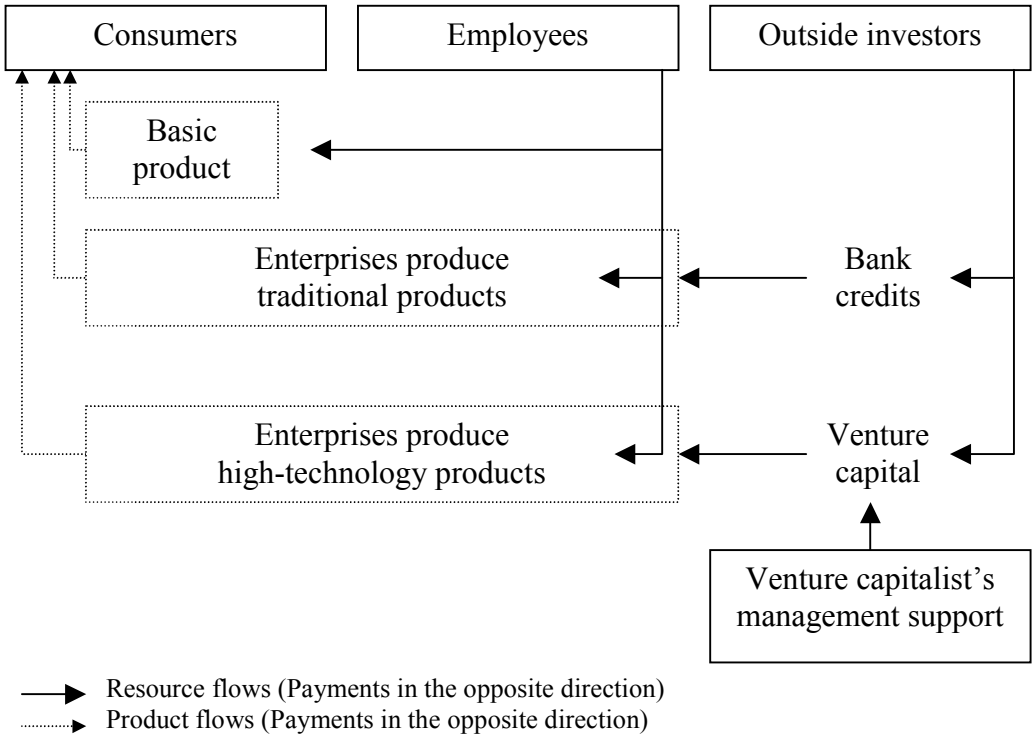
1 In the US, venture-capital-backing has a positive impact on the profitability of enterprises as indicated by several empirical studies For example, Brav and Gompers (1997) find that venture-capital-backed enterprises outperform non-venture-capital-backed ones even after the initial public offering (IPO). In the sample of Silicon Valley high-technology start-ups analysed by Hellmann and Puri (2000), venture-capital-backed enterprises are likely to realize first mover advantages because they bring their products earlier to the market than their non-venture-capital-backed counterparts. Moreover, evidence found by Megginson and Weiss (1991) suggests that the total costs of going public including the underwriters' fee are lower for venture-capital-backed enterprises than for their non-venture-capital-backed counterparts. In addition, in the sample by Kortum and Lerner (2000), venture-capital-backed enterprises take out significantly more patents than other comparable enterprises.

technology-specific knowledge and experience that they need to support the management teams of the high-technology enterprises.

Traditional and high-technology products are supplied under monopolistic competition. In the steady state, free entry leads to zero profits in the market for traditional products and high-technology products: traditional and high-technology products are sold at average costs. The zero-profit conditions are used to determine the number of traditional and high-technology enterprises in the steady state. The number of traditional enterprises determines the volume of bank credits, while the number of high-technology enterprises determines the volume of venture capital.

Figure 1: Overview of the model



In each period, the individuals, who own the resources in the economy, maximize their consumption utility that is given by a love of variety function. The consumption utility function contains the basic homogeneous product, an aggregate of traditional products as well as an aggregate of high-technology products. The individuals maximize their consumption utility under the restriction of their budget constraint, i.e., in the optimum their income is equal to their consumption expenditures. The income is

given by the wage income and capital income because individuals demand, as risk-averse outside investors, a risk premium for capital invested in high-technology enterprises. The risk-less rate of interest is equal to zero. The consumption expenditures are given by the sum of product quantities multiplied by the respective product prices.

In the steady state, the individuals' income 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 invested, and each enterprise is active for only one period. The enterprises do not have to pay interests but they have to repay the start-up investment, and enterprises producing high-technology products additionally have to pay a risk premium. The risk premium is part of the income and is thus consumed, while the start-up investments are repaid to the risk-averse outside investors. In the next period, the outside investors offer this capital to the next generation of entrepreneurs for start-up investments. Therefore, in the steady state, the individuals' income is constant, and the saving rate of the economy is equal to zero.

3 Conditions for Liquid Venture Capital Markets

Consumer Behaviour

A representative individual maximizes the following consumption utility function that consists of the basic homogeneous product, an aggregate of traditional products and an aggregate of high-technology products. The traditional and high-technology products are aggregated with a constant elasticity function (Dixit and Stiglitz 1977). The consumption utility function is given by:

$$[1] \quad U = X_B^{\beta_B}\left(\sum_m X_{mi}^{\rho_i}\right)^{\frac{\beta_T}{\rho_i}}\left(\sum_n X_{nt}^{\rho_t}\right)^{\frac{\beta_T}{\rho_t}},$$

where

β_s with $s \in \{B,T\}$ and $0 < \beta_s < 1$ denotes the income shares of the basic product and the aggregate of traditional products,

$X_{\bar{n}t}$ denotes the quantity of a particular traditional product,

$X_{\bar{m}i}$ denotes the quantity of a particular high-technology product,

X_B denotes the quantity of the basic homogeneous product,

ρ_j with $0 < \rho_j < 1$, $j \in \{i, t\}$ denotes the degree of differentiation in the monopolistic market for traditional and high-technology products, respectively. The elasticity of substitution between any two products is identical. The elasticity of substitution increases with the parameter ρ_j. If the parameter ρ_j would be equal to one (which I rule out here) the products were perfect substitutes.

The representative individual maximizes the consumption utility function [1] under the following budget constraint:

[2] $$p_B X_B + \sum_m p_{mi} X_{mi} + \sum_n p_{nt} X_{nt} = Y,$$

p_B denotes the price of the basic homogeneous product,

$p_{\bar{n}t}$ denotes the price of a particular traditional product,

$p_{\bar{m}i}$ denotes the price of a particular high-technology product,

Y denotes the income of the individuals.

Maximizing the consumption utility under the budget constraint with respect to the product quantities and inserting the individuals' income gives the Marshallian demand function for a particular traditional product $\bar{n}$ as a function of the prices for traditional products, the wage rate, the number of individuals, and the income shares. Since traditional and high-technology products have the same income share β_T, the Marshallian demand functions do not depend on the price index of the respective other product group supplied under monopolistic competition. The Marshallian demand functions for a high-technology product $\bar{m}$ and for a traditional product $\bar{n}$ are then given by:

[3] $$X_{\bar{m}i} = \frac{Y p_{\bar{m}i}^{\frac{1}{\rho_i - 1}}}{\beta \sum_n p_{\bar{m}i}^{\frac{\rho_i}{\rho_i - 1}}} \quad \text{and} \quad X_{\bar{n}t} = \frac{Y p_{\bar{n}t}^{\frac{1}{\rho_t - 1}}}{\beta \sum_n p_{nt}^{\frac{\rho_t}{\rho_t - 1}}}, \text{ with } \beta = \beta_B \left[\frac{1}{\beta_T} + \frac{2}{\beta_B} \right].$$

Venture Capitalists' Role

Let me now turn to the role of the venture capitalists in financing high-technology entrepreneurs before discussing the profit maximization problem of a high-technology entrepreneur. The development of high-technology products is uncertain. Entrepreneurs who want to develop a high-technology product are successful only with the probability ψ_i. Therefore, the start-up investment I_i is lost with the probability $1-\psi_i$. Because of this uncertainty, enterprises producing high-technology products have to repay an amount R that is higher than the start-up investment, while enterprises producing traditional products only have to repay the start-up investment since this investment is not uncertain.

The venture capitalist's management support increases the probability of a successful development of the entrepreneur's high-technology product to $\psi_i^{VC} > \psi_i$. Supporting the entrepreneur is not costless for the venture capitalist. In case he supports an entrepreneur, the venture capitalist has to carry costs that amount to C.

Each venture capitalist maximizes his expected profits under the restriction that the risk-averse outside investors also offer capital for the start-up investments of high-technology entrepreneurs in the next period. Because these investments are risky, the risk-averse outside investors demand a risk premium P per high-technology entrepreneur that depends on the degree of risk aversion of the outside investors. The higher the degree of risk aversion of the outside investors is, the higher the risk premium must be.

Consider a representative risk-neutral venture capitalist. This venture capitalist will support a high-technology entrepreneur only if his expected profit with management support exceeds his expected costs without management support. If the venture capitalist supports the high-technology entrepreneur, his expected profit is given by:

[4] $\hat{\pi}_{VC} = -I_i + \psi_i^{VC} R - C - P$.

If he does not support the high-technology entrepreneur, his expected profit is given by:

[5] $\hat{\pi}_{VC} = -I_i + \psi_i R - P$.

In the steady state, competition between venture capitalists will drive venture capitalist's expected profit to zero. Moreover, since venture capitalists are assumed to be identical, they do not differ with respect to their experience accumulated in the past and they do not differ with respect to their reputation, all venture capitalists do or do not support high-technology entrepreneurs in the steady state.

The venture capitalist and a high-technology entrepreneur specify the level of the repayment R 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 support provided and to determine whether this amount was adequate. As a result of non-contractibility, the contractually specified repayment must provide incentives for management support.

There are two possible levels for the repayment in the steady state. If the venture capitalist does not support the entrepreneur, this repayment must be equal to $R^{WVC} = (I_i + P)/\psi_i$ because of the zero-profit condition of the venture capitalist's expected profits. If the venture capitalist supports the high-technology entrepreneur, the repayment must be equal to $R^{VC} = (I_i + P + C)/\psi_i^{VC}$. The investment strategy of the venture capitalist in the steady state depends on the size of the effect of his active involvement and on the costs of management support.

Does the venture capitalist have incentives to support the high-technology entrepreneur if the repayment without management support has been contractually specified? Inserting the repayment without management support R^{WVC} into the venture capitalist's expected profit function [4] leads to $\hat{\pi}_{VC} = -(I_i + P + C) + \psi_i^{VC}(P + I_i)/\psi_i$ which can be smaller or larger than zero depending on the values of the variables. Only if

[6] $\psi_i^{VC}(I_i + P) - (I_i + P + C)\psi_i > 0$,

the venture capitalist would support the high-technology entrepreneur even if the repayment in which the costs for management support is not considered has been specified in the contract.

Does the venture capitalist actually support the high-technology entrepreneur if the repayment with management support has been contractually specified? Inserting the repayment with management support R^{VC} in the venture capitalist's expected profit [4] leads to $\hat{\pi}_{VC} = \psi_i \left(I_i + P + C\right) / \psi_i^{VC} - \left(P + I_i\right)$ which is only smaller than zero if condition [6] holds.

Thus, if condition [6] holds, the venture capitalist supports the high-technology entrepreneur independent of whether the repayment with or without management support is contractually specified. If the repayment with management support is contractually specified, the venture capitalist has an expected profit that is equal to zero, while if the repayment without management support is contractually specified, his expected profit is positive. However, if the condition is not fulfilled, a venture capital market on which financial means are offered in combination with management support will never develop.

Which one of the repayments will be specified? In this simple model of venture capital finance, the high-technology entrepreneur will always choose the contract with the lowest repayment because the venture capitalist has no additional mechanism beside the repayment that he can use to commit himself to support the high-technology entrepreneur after the repayment has been specified and because of the competition between venture capitalists. Setting the repayment with management support $R^{VC} = \left(I_i + P + C\right) / \psi_i^{VC}$ smaller than the repayment without management support $R^{WVC} = \left(I_i + P\right) / \psi_i$ leads to condition [6]. Thus, if condition [6] holds the venture capitalist supports the high-technology entrepreneur and has an expected profit that is equal to zero.

To summarize the venture capitalists' behaviour: in the steady state, the venture capitalists do not only offer the financial means for the start-up investments of high-technology entrepreneurs but also management support which increases the profitability of high-technology enterprises. In exchange for the start-up investment I_i and their management support, the venture capitalists demand a repayment $R^{VC} = \left(I_i + P + C\right) / \psi_i^{VC}$. The repayment is adjusted for the lower probability of high-technology entrepreneurs to fail which results from the venture capitalists' active

involvement and for the venture capitalists' costs which arise because of management support.

Inequality [6] gives the first condition that must be fulfilled for a liquid venture capital market to emerge. Only if inequality [6] is fulfilled a liquid venture capital market will emerge since then the expected profit of a high-technology entrepreneur is higher with than without venture capital and the venture capitalist's management support. Put it differently, these markets will develop only if the gain in the success probability through the venture capitalist's management support is substantial compared to the costs of the management support.

Entrepreneur behaviour

Let me now turn to the profit maximization of a high-technology entrepreneur. An entrepreneur who wants to start her own high-technology enterprise, i.e., an enterprise that produces a high-technology product, maximizes her profit and takes the Marshallian demand function [3] as given. If the high-technology entrepreneur develops her product successfully, she receives positive revenues and repays the venture capitalist. If the high-technology entrepreneur does not develop her product successfully, her revenues are equal to zero and she repays nothing to the venture capitalist. The expected profit of the entrepreneur who wants to develop a high-technology product $\overline{m}$ is then given by:

$$[7] \quad \hat{\pi}_{\overline{m}i} = \begin{cases} 0 & \text{if unsuccessful} \\ (p_{\overline{m}i} - w)X_{\overline{m}i} - R^{VC} & \text{if successful} \end{cases}.$$

Since the venture capitalist supports the high-technology entrepreneur, the high-technology entrepreneur is successful with probability ψ_i^{VC}. Therefore, the expected profit can be written as:

$$[8] \quad \hat{\pi}_{\overline{m}i} = \psi_i^{VC}(p_{\overline{m}i} - w)X_{\overline{m}i} - \psi_i^{VC}R^{VC}.$$

The entrepreneur who wants to develop a high-technology product maximizes the expected profit of the enterprise by setting the profit-maximizing product price. As usual in this type of models, the entrepreneur does not consider the impact of her price setting behaviour on the product

price index in the Marshallian demand function (see, for example, Romer 1986). For the optimal product price, it follows:

[9] $$p^*_{\overline{m}i} = \frac{1}{\rho_i} w.$$

Hence, the entrepreneur producing a high-technology product sells her product at a constant mark-up over the wage rate. This mark-up decreases with the degree of substitution. In the case of perfect substitutes, i.e., $\rho_i = 1$, the mark-up would be equal to zero, while in the case of complementary products, i.e., $\rho_i \to 0$, the mark-up would be infinite.

Using this optimal product price, which is identical for all high-technology products, we can write the expected profit of the high-technology entrepreneurs as a function of the number of high-technology enterprises N_i, i.e., of the number of high-technology entrepreneurs that are successful. This yields:

[10] $$\hat{\pi}_{\overline{m}i} = \frac{\psi_i^{VC}(1-\rho_i)Y}{\beta N_i} - \psi_i^{VC} R^{VC}.$$

The profit depends positively on the wage rate, the income of the individuals, and the degree of differentiation and negatively on the number of high-technology enterprises and the level of the repayment. The higher the wage rate or the income of the individuals is, the higher the demand for a particular high-technology product is, and thus, the higher the product quantity a high-technology enterprise can sell. The higher the degree of differentiation, i.e., the lower the parameter ρ_i, between high-technology products, the higher the mark-up per product unit is. Moreover, the higher the number of high-technology enterprises, the more intensive the competition is, and, thus, the lower the profit is.

The individuals' income in the steady state is given by the wage rate multiplied by the number of individuals plus the risk premium per financed high-technology entrepreneur multiplied by the number of high-technology entrepreneurs $Y = wL + N^*_{Fi} P$. The steady state number of high-technology entrepreneurs is given by the number of high-technology enterprises divided by the probability to be successful $N^*_{Fi} = N^*_i / \psi_i^{VC}$.

The wage rate is determined in the production of the basic homogeneous product. The basic homogeneous product is produced using only labour. In particular, one unit labour is transformed into one unit of the basic homogeneous product. Therefore, the wage rate is equal to the price of the basic homogeneous product, which is set equal to one.

In the steady state, free entry of enterprises producing high-technology products drives the expected profits in this market to zero. Setting [10] equal to zero, and inserting the individuals' income gives the number of enterprises in the market for high-technology products as a function of the exogenous parameters of the model:

$$[11]\quad N_i^* = \frac{\psi_i^{VC}(1-\rho_i)L}{(I_i+P+C)\beta-(1-\rho_i)P}.$$

Thus, the venture capitalists' active involvement affects the steady state number of enterprises producing high-technology products because their active involvement in the form of management support increases the probability of high-technology entrepreneurs to be successful. The larger the effect of the venture capitalists' active involvement on the probability to be successful is, the higher the number of enterprises producing high-technology products in the steady state.

Free entry in the market for traditional products leads to the following steady state number of traditional enterprises:

$$[12]\quad N_t^* = \frac{(1-\rho_t)\left(L+N_i^* P/\psi_i^{VC}\right)}{\beta I_t}.$$

The demand for venture capital results from the number of high-technology entrepreneurs. The number of venture-capital-backed high-technology entrepreneurs is higher than the number of enterprises producing high-technology products because not all high-technology entrepreneurs are successful. The venture capital demand results from the number of venture-capital-backed high-technology entrepreneurs multiplied by the start-up investment:

$$[13]\quad V_d^* = N_{Fi}^* I_i = \frac{N_i^* I_i}{\psi_i^{VC}} = \frac{I_i L(1-\rho_i)}{(I_i+P+C)\beta-P(1-\rho_i)}.$$

As the partial derivative of the venture capital demand with respect to the risk premium indicates, the higher the risk premium, the lower the venture capital demand is because $\beta > 1 > (1 - \rho_i)$. Like the start-up investments and the venture capitalists' costs for management support, the risk premium is part of the fixed costs of the high-technology enterprises. Increasing these fixed costs reduces the number of high-technology enterprises that is needed to fulfil the zero-profit condition in this monopolistic market. Thus, for a higher risk premium, fewer high-technology entrepreneurs try to start a high-technology enterprise.

Moreover, the venture capital demand increases with the start-up investment. An increase in the start-up investment has two effects. First, each high-technology 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 high-technology enterprise and, thus, reduces the optimal number of high-technology enterprises and, therefore, the number of high-technology entrepreneurs demanding venture capital. In this model, as indicated by the partial derivative of equation [13] with respect to the start-up investment, the first effect is larger than the second one.

The venture capital demand increases with the size of the economy (with L) because the larger the economy is, the more high-technology products are demanded. By contrast, the venture capital demand decreases with the costs of venture capitalists' management support, which increase the fixed costs of the high-technology enterprises, and with the differentiation parameter because the more the high-technology products can be substituted (the higher the parameter ρ_i), the lower the number of high-technology enterprises is that fulfils the zero-profit condition in this monopolistic market.

The second condition for the emergence of liquid venture capital markets results from the number of high-technology enterprises in the steady state. Venture capital markets will develop only if the demand for venture capital is sufficiently high, i.e., if the optimal number of high-technology enterprises given by equation [11] is at least equal to one. This is because the number of high-technology enterprises is integer constraint and less than one high-technology enterprise cannot be started. Using equation [11],

one can derive a condition under which the agents of the economy, i.e., the high-technology entrepreneurs and the venture capitalists, have incentives to establish a market for venture capital.

Setting equation [11] larger and equal to one and solving for the number of individuals results in:

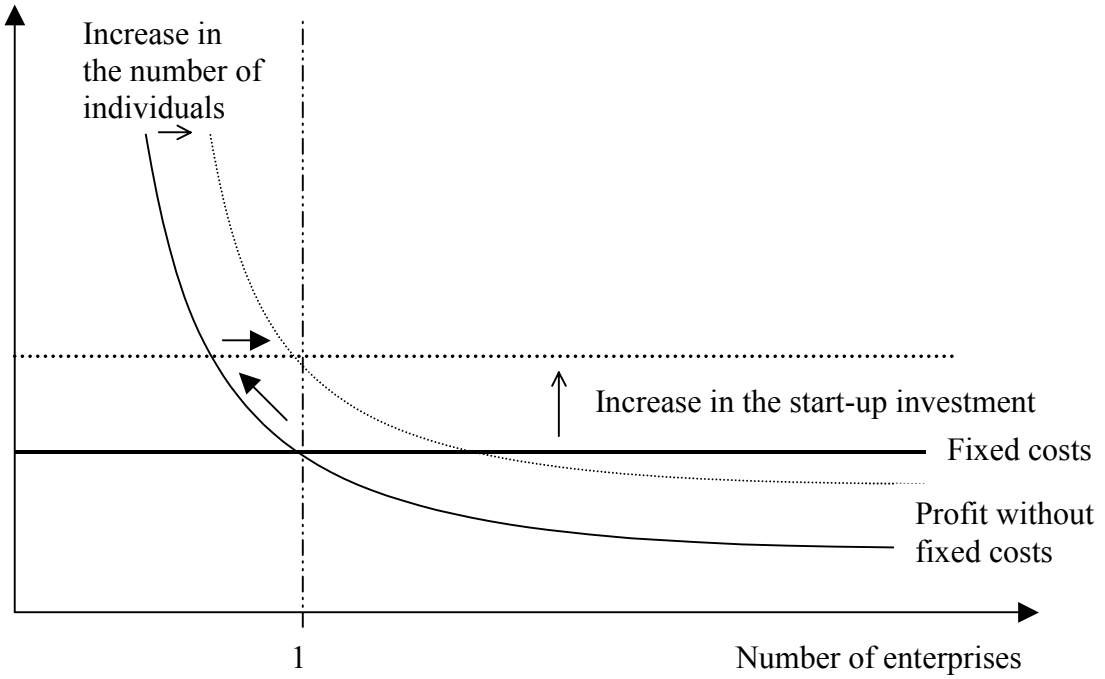
$$[19] \quad L \geq \frac{(I_i + P + C)\beta - (1 - \rho_i)P}{\psi_i^{VC}(1 - \rho_i)}.$$

Thus, only if the number of individuals is sufficiently large (the right-hand side of this inequality is positive because $\beta_2 > 1 > (1 - \rho_i)$), a venture capital market will develop.

Assuming that [19] holds with equality, one can analyse how the parameters on the right-hand side affect the number of individuals in the economy that is necessary for the genesis of venture capital markets. The partial derivative indicates that the higher the start-up investment, the costs of the venture capitalists to support the management, or the risk premium for the outside investors is, the higher the number of individuals for the genesis of venture capital markets must be. Figure 2 explains the reason for the positive relationship.

The two solid lines in Figure 2 depict the profit without fixed costs and the fixed costs of a high-technology enterprise. For a venture capital market to develop, the intersection of these two lines must result in a number of high-technology enterprises that is at least equal to one. An increase in the start-up investment ceteris paribus reduces the number of high-technology enterprises from one to less than one because the higher the start-up investment is, the lower the number of enterprises in the monopolistic market must be that drives the profits of the high-technology enterprises to zero. Without changing the profit of the high-technology enterprise, a venture capital market would never develop because the optimal number of high-technology enterprises (which results from the intersection of the profit without fixed costs and the fixed costs) is smaller than one. In order to increase the number of high-technology enterprises, the profit without fixed costs of the high-technology enterprise must be increased, and this can be done with an increase in the number of individuals.

Figure 2: Revenue and fixed costs of high-technology enterprises



What about a change in the income shares used for the basic homogeneous good β_B or for traditional and high-technology products β_T? Remember that $\beta = \beta_B / \beta_T + 2$. An increase in the income share that is used for traditional and high-technology products β_T reduces the number of individuals required for the genesis of venture capital markets. The reason for this is that the higher the income share β_T, the higher the profit without fixed costs of the enterprises producing high-technology products is and, thus, the lower the number of individuals must be.

The higher the parameter which specifies the degree of differentiation between high-technology products ρ_i, the higher the number of individuals must be to fulfil the condition which ensures the genesis of venture capital markets. The degree of differentiation affects the profit of the high-technology enterprises. The better high-technology products can be substituted, the lower the profits of the high-technology enterprises are. This effect ceteris paribus lowers the optimal number of high-technology enterprises.

4 Additional Determinants

The model presented above captures the behaviour of the main agents acting on venture capital markets, such as high-technology entrepreneurs, venture capitalists, and outside investors supplying their capital to venture capital funds. However, the model does not consider explicitly some important aspects that affect the genesis of venture capital markets. The two most important aspects seem to be the determinants of a sufficient venture capital demand by young high-technology enterprises, and stock markets for shares of young high-technology enterprises.[2] These aspects are to be discussed in the following.

Venture capital markets will emerge only if venture capital demand is sufficiently large. Factors affecting the level of the venture capital demand are the innovation climate, the willingness and economic incentives of the individuals to share control,[3] and the price for management support and monitoring of the venture capitalists.

Whether an economy has a sufficient innovation potential for a liquid venture capital market depends in turn on a multitude of determinants which are certainly not of static nature and which are to some extent interdependent. Let me give two examples. First, the innovation potential for a liquid venture capital market depends on the innovation system: The more in-house the research and development activities are, the less likely the development of a venture capital market is. However, the less developed financial markets are, the more likely are in-house research and

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2 Moreover, policy-induced barriers embedded in tax law and regulations of factor and good markets affect substantially the genesis of venture capital markets because they inflate the user costs of venture capital (Schertler and Stolpe 2000). These policy-induced barriers affect the venture capital demand, the venture capital supply or the volume of experienced venture capitalists. For example, labour markets can be regulated in such a way that individuals have low incentives to become high-technology entrepreneurs or active involved financial intermediaries. Tax laws can undermine the supply of venture capital by outside investors if risk-less assets are more favourable than investments in risky assets.

3 Mayer (2001) argues that the structure of institutions and the activities in the high-technology sector are related. Europe has opted for high levels of investor protection and this is not stimulating the growth of high-technology enterprises.

development activities. Second, the innovation potential depends on the number of individuals generating ideas. This number in turn is affected by the design of the university system: the more creativeness and individualism a university system initiates, the higher the number of individuals with high-technology ideas might be.

The price for management support and monitoring of venture capitalists can be prohibitively high so that the demand is too low for a venture capital market to develop. The price for management support and monitoring is prohibitive if regulations prevent venture capitalists to be actively involved in the enterprises they finance. Only if venture capitalists have exclusive control rights in the enterprises, they are capable of intervening in the business politics and by doing so they are capable of increasing the expected profit of the enterprises and, thus, of their participations.

I have argued above that the demand for venture capital must exceed a minimum level because high-technology ideas are indivisible. This restriction is weak compared to the one required for endogenous specialization of the venture capitalists. To put it differently, the demand for venture capital and, thus, the number of high-technology enterprises must be so high that venture capitalists can endogenously focus their investments on particular stages of enterprises' development and/or on particular technology areas. Amit et al. (1998) argue that due to specialization, venture capitalists have a comparative advantage in the selection and monitoring of high-technology enterprises compared to other financial intermediaries. Therefore, if the technology sector as a whole is too small, or if high-technology ideas are dispersed over a wide range of technology fields so that venture capitalists cannot specialize and cannot accumulate technology-specific experience, one cannot expect a liquid venture capital market to develop.

The second aspect that affects the genesis of a liquid venture capital market is stock markets for shares of young high-technology enterprises. Financial systems are distinguished in bank-based and stock market-based systems.[4]

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4 For a comparison of different financial systems see Allen and Gale (1995), Demirgüc-Kunt and Levine (1999), Allen and Gale (2000), Carlin and Mayer (2000).

For example, in Germany, large banks are the major players, while, in the US, shareholders play an important role. Therefore, the German system is often called a bank-based system, while the US system is called stock market-based. Both systems have advantages as well as disadvantages. However, the bank-based systems seem to have more disadvantages with respect to financing high-technology enterprises especially because the control mechanisms of banks do not work well in the case of high-technology enterprises. High-technology enterprises that invest a large share of their capital into research and development activities cannot offer collateral. Thus, collateral is not at bank's disposal as a selection mechanism. Additionally, bank managers are less likely to have the experience to select the most promising high-technology enterprises. Offering a single price for all qualities of high-technology enterprises without active selection would lead to a market failure similar to the one presented by Akerlof (1970) for the car market and Stiglitz and Weiss (1981) for credit markets.

Black and Gilson (1998, 1999) argue that a liquid stock market offers venture capitalists and high-technology entrepreneurs the opportunity to enter into an implicit contract over control. Since an IPO gives the entrepreneur the opportunity to re-acquire control at least partly, the entrepreneur has lower incentives for opportunistic behaviour. Moreover, if entrepreneurs have the opportunity to re-acquire control, they are more interested in venture capital finance. In terms of the model presented above this means that a liquid stock market can increase the demand for venture capital because it lowers the transaction costs of high-technology entrepreneurs.

In addition, the presence of liquid stock markets for shares of high-technology enterprises can support the development of an appropriate skill composition necessary for venture capital markets to develop. Liquid stock markets have a positive impact on the number of individuals in an economy who have some basic experience. Entrepreneurs who sell their enterprises on a stock market for fast-growing enterprises have hands-on experience in managing an enterprise, they have a comprehensive knowledge about a particular technology area, and they have a basic experience about how to go public. These entrepreneurs seem to be natural candidates for becoming

venture capitalists who offer management support in addition to financial means.

However, Becker and Hellmann (2000) argue that the existence of a liquid stock market[5] is a necessary but not a sufficient condition for the development of venture capital markets.[6] For a venture capital market to develop, appropriate corporate governance structures must be developed that protect outside investors and shareholders sufficiently. Complementary changes in corporate governance and entrepreneurship can be necessary especially if the financial system is bank-based.

New theories on corporate governance in general emphasize the important role of complementarities between various instruments such as payment systems, owner structure, and capital structure (Heinrich 2002). The corporate governance structures of venture capital markets are complex because of the relationship between outside investors and venture capitalists, on the one hand, and because of the relationship between venture capitalists and high-technology entrepreneurs, on the other. In both relationships, corporate governance instruments are used to solve substantial incentive problems (Schertler 2001). It seems that corporate governance instruments used in the relationship between venture capitalists and entrepreneurs are also complementary to the ones used in the relationship between venture capitalists and outside investors.

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5 However, for a venture capital market to develop, the liquid stock market has not to be a domestic one as the success of the Israeli venture capital market suggests (Rock 2001, 2002). The exit of Israeli venture-capital-backed enterprises is on the NASDAQ. But it must be questioned whether this exit strategy is also possible in a similar way for enterprises from other countries. This does not seem to be the case because the investor community views Israeli venture-capital-backed enterprises going public as regular, Silicon Valley technology enterprises (Rock 2002).

6 Becker and Hellmann (2000) study the failure of the German WFG. They find evidence that the leading German banks, which were the founders of the WFG, were more interested in their reputation and in enterprises already financed than in the selection of new enterprises.

VI Summary

The model that has been used to analyse under what conditions venture capital markets emerge has captured the main agents that are active in these markets: venture capitalists, entrepreneurs, and outside investors. Venture capitalists invest management support in addition to financial means in high-technology enterprises. Venture capitalists' management support increases the probability of entrepreneurs to be successful and, thus, the expected profitability of the high-technology enterprises. Venture capitalists do not invest their own financial resources; they have to raise capital from outside investors. Outside investors supply capital at a constant risk premium to venture capital funds.

With this model, two conditions have been identified which must be fulfilled for a venture capital market to emerge. These two conditions can explain why venture capital activity differs substantially across countries. First, venture capital markets emerge only if the value-added by venture capitalists' active involvement in form of management support is high compared to the costs of this management support. To put it differently, only if venture capitalists can add value that cannot be generated by entrepreneurs themselves, venture capital finance will emerge. Second, the demand for venture capital by young high-technology enterprises must exceed a critical level. This critical level is determined by the indivisibility of innovative ideas and by the specialization of venture capitalists on particular fields of technologies.

Moreover, it has been argued, that the emergence of liquid venture capital markets depends on innovation and financial systems. The lower the innovation potential of an economy, or the lower the willingness of entrepreneurs to share control, the lower the demand for venture capital will be. Moreover, transaction costs determine venture capital activities: governance structures and contract law may have a significant impact. For example, the demand of venture capital could be extraordinarily low if regulations do not allow venture capitalists and high-technology entrepreneurs to sign contracts that allow venture capitalists to take on an active role in high-technology enterprises.

Liquid stock markets for shares of fast-growing enterprises affect venture capital activity through three channels. First, they allow venture capitalists and entrepreneurs to enter into implicit contracts over control. This increases the demand for venture capital. Second, venture capitalists can build reputation for financing high-technology enterprises successfully through using stock markets as an exit channel for their participations. Third, liquid stock markets can have a positive impact on the number of individuals who have experience to support young high-technology enterprises.

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