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CAPITAL MARKET INSTITUTIONS AND VENTURE CAPITAL: DO THEY AFFECT UNEMPLOYMENT AND LABOUR DEMAND?

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CAPITAL MARKET INSTITUTIONS AND VENTURE CAPITAL: DO THEY AFFECT UNEMPLOYMENT AND LABOUR DEMAND?

Abstract

This paper analyses the influence of the capital market on the labour market. Especially the impact of start-up financing on the structure of unemployment is of interest. We use a cross-country panel data analysis to examine how venture capital investment influences disaggre-gate unemployment. As we expected, venture capital investment has different influences on sectoral-, educational- and occupational-specific unemployment. We suggest, on the basis of the regression results that venture capital investment is a catalyst of structural change and has contributed to the faster growing internet and new economy sector in countries like the U.S. that have a well-developed venture capital market.

JEL Code: E22, E24, E44, G24, G32.

Keywords: Labor markets, venture capital, employment, new economy, panel analysis.

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1. Introduction

During the last twenty years the US has had an impressive labour market performance compared with other developed economies like those of Continental Europe. A great part of this better performance can be attributed to US labour market institutions that can deal better with shocks and the structural change from a Tayloristic to a holistic organisation model. However, to fully explain the better performance of the US labour market, we must look at complementary markets that also influence the situation on the labour market. One possible market that influences the situation of the labour market is the financial market, as Schumpeter (1911) once emphasised. An obvious difference between the US and Continental Europe is the stock-market-based capital market in the US and the bank-based capital market in continental Europe. This results in different financing possibilities for start-ups and expansion projects depending on the financial market type. In the US, venture capital (VC) financing is the dominant financing type for start-ups (Freear and Wetzel, 1990), whereas in Continental Europe debt financing is still the dominant financing type (Edwards and Fischer, 1994). From the 1950s to the 1980s the Continental European bank-based capital market seemed to work very well and was a comparative institutional advantage for these countries. But since the 1990s some doubts have arisen inter alia because of the dominance of US companies in the Internet sector and the ability of the US to better adapt to the needs of the structural change and to benefit from it. One possible explanation for this development is the conjecture that a bank-based capital market is appropriate for a catching-up economy but not for developed countries operating at the innovative frontier (Carlin and Mayer, 1999, Acemoglu et al., 2002).

Therefore we conjecture that some of the structural problems of Continental European economies is the lacking market orientation of the bank-based Continental European capital markets which cannot deal as well as a stock-market-based capital market with the risk and uncertainty at the "innovative frontier". A result of this effect should be that countries with bank-based capital markets have a comparative disadvantage in financing projects and start-ups close to the innovative frontier. The evolution and development of new industries such as the new economy or biotech industry should therefore take place to a greater extent in stock-market-based countries with well-functioning VC markets. Additionally we expect that the labour-saving technical progress that accompanies structural change will shift labour demand more in favour of high-skilled persons in stock-market-based countries compared to bank-based countries.

This paper examines whether these conjectures indeed hold and whether there is some evidence at the macroeconomic level for a relationship between the financial system of a country, especially the VC market as a financing tool for entrepreneurs, and the labour market performance. For doing so, section 2 presents a theoretical model and derives the influence of different start-up financing types on the unemployment level. Section 3 presents a regression analysis which examines the influence of the capital and labour market on the unemployment rate over the post-war period. Section 4 presents the result of a cross country analysis examining the relationship between VC investment and the structure of unemployment. The last section provides some concluding remarks based on our results.

2. Capital Market Imperfections and Unemployment

The theoretical model employed in this section has been developed by Wasmer and Weil (2000). This model relates the labour market performance to the situation on the financial market for entrepreneurs. It serves as a theoretical underpinning for the ensuing empirical analysis. The advantage of this model is that it also produces some macroeconomic predictions concerning the relationship between the capital market and the labour market. These predictions are obtained by using the profit-maximising Bellman equations of each of the participating market players. The model distinguishes three different groups of homogeneous actors:

- Entrepreneurs (F) who can set up a firm but have neither savings nor access to the capital market without a financial intermediary,
- Financiers, henceforth banks (B), who finance start-ups and act as financial intermediaries, and
- Workers who work in start-ups of entrepreneurs at a one-to-one ratio with entrepreneurs.

The life cycle of a start-up has four phases:

- The search on the financial market with pecuniary costs k for the bank and non-pecuniary costs c for the entrepreneur.
- After a match on the financial market has occurred, the entrepreneur-bank partners search on the labour market a worker at a cost γ, which is borrowed from the bank.

- After a successful search on the labour market, the start-up begins production. The profit of the start-up is shared according to negotiations between the entrepreneur and the bank. Indeed, the profit sharing agreement is a kind of equity financing and no debt loan, although we speak of banks.

- The start-up will be liquidated with an exogenous probability of ρ. The involved entrepreneur, bank and worker each begin a new search on the relevant markets after the liquidation of the firm.

The situation on the financial market is characterised by the ratio of entrepreneurs and banks $\phi=F/B$. This ratio determines the probability of a match between an entrepreneur and a bank, the duration of the search and hence the expected search cost for an entrepreneur or a bank. A higher value of ϕ accompanies higher expected search costs for entrepreneurs and lower expected search costs for banks. The ratio of entrepreneurs per bank is now higher, so that the existing entrepreneurs have a lower probability of finding a bank, whereas they have a higher probability of finding an entrepreneur and a project to finance. The situation on the labour market is characterised by the ratio of vacancies and unemployed workers $\theta=V/U$. The number of vacancies is determined by the situation on the financial market and the probability for an entrepreneur-bank match. The ratio θ determines the probability of a match, the expected search duration for each party and hence the expected search cost for the entrepreneur-bank partnership. A higher value of θ means a lower probability for the entrepreneur-bank partnership to find a worker and therefore increases the expected search cost for this party. In contrast, the expected search duration for the worker shortens because of the higher number of vacancies per unemployed worker.

Figure 1: Equilibrium situation in ϕ,θ-plane

Source: Wasmer and Weil (2000).

In Figure 1 we depict the situation on the capital and labour market. Since the situation on the capital market determines the situation on the labour market, we only have to consider the behaviour and profit-maximising Bellman equations of the entrepreneurs and the banks and therefore their isoprofit curves EE and BB. These isoprofit curves include all points in ϕ,θ-plane that have the same value. If there is perfect competition, i.e. no other alternatives for financing or for selling an idea for a start-up, the isoprofit curves are zero profit curves. Otherwise the value of these curves would be equal to the non-negative value of available alternatives.

The isoprofit curve FF is downward sloped because a looser capital market for entrepreneurs must be compensated by a tighter situation on the labour market for firms. Beginning at point A, a tightening situation on the labour market leads to movement to point B, which is characterised by a higher ratio of vacancies per unemployed worker. The expected search duration for the firm increases as well as the search costs. This cost increase must now be compensated by decreasing expected search costs for entrepreneurs on the capital market. Lower expected search costs lead to a shorter search duration for the entrepreneur and therefore a lower ratio

of entrepreneurs per bank, so that we move to point C, which lies on the same isoprofit curve as A. Similarly, the isoprofit curve BB is upward sloped because a looser capital market for banks must be compensated by a tighter labour market for firms. Beginning in point D, a tightening on the labour market for firms leads to higher expected search cost on the labour market and therefore to a move to point E, which is characterised by a higher ratio of vacancies per unemployed worker. This cost increase of firms reduces the profit of banks via the profit sharing contract and is compensated by lower expected search costs for banks on the capital market. The search duration of banks decreases when the ratio of entrepreneurs per bank, and therefore ϕ, increases. This leads to a move from point E to F, which lies on the same isoprofit curve as point D. For given financing alternatives for banks and a market for selling start-up ideas, we will get two isoprofit curves whose value depends on the residual price on the shadow markets. The isoprofit curves will intersect at the equilibrium point G. G determines the equilibrium situation on the financial as well as the labour market. If we fix the number of workers and standardise it to one, we will get U as the share of unemployed workers and therefore as the unemployment rate. With no frictions on the capital market, we get the Pissarides' (1990) equilibrium with θ=V/U and a deformed isoprofit curve for banks that shifts to the right. The deformed BB' curve is inelastic for any changes of θ and identical with the θ-axis till θ^p . Then it is infinitely elastic for a change of θ.

In the next step, we implement the consequences of some empirical facts about venture capital investment compared with debt loan financing in our model. We use this comparison to derive theoretically a comparative advantage of stock-market-based capital markets to bank-based capital markets under certain circumstances.

First of all, there is a broad literature which derives a comparative advantage of venture-capital-backed companies with respect to their growth rates (see, for instance, Lerner, 1996). A possible reason for this advantage could be the fact that venture-backed companies are more innovative than non-venture backed companies (Kortum and Lerner, 1998). Although Engel and Keilbach deny this for Germany (Engel and Keilbach, 2002), Engel (2001) derives a higher growth rate of venture capital backed companies in Germany that could be attributed to the superior managerial advice of VC companies (Keuschnigg and Nielsen, 2000). Another positive aspect of the managerial advice of VC companies is the higher survival rate of venture-capital-backed start-ups (Keuschnigg and Nielsen, 2000). The advice of VC companies should help start-ups avoid making managerial mistakes that could threaten their existence.

Figure 2: VC and higher earnings

Source: Wasmer and Weil (2000).

Both effects, the higher growth rate and the higher survival rate, lead to higher expected profits of start-ups. In Figure 2 we depict the consequences of higher profits on the equilibrium situation. The higher expected profits result from an improved return situation and shift the FF curve to the right to FF'. A higher expected profit attracts more entrepreneurs. If we take point H and hold the number of banks constant, a higher number of entrepreneurs will lead to an increase of ϕ and to a shift of the FF curve to the point I. The new isoprofit curve of the entrepreneurs is FF', which lies to the right of FF. The point of intersection of the FF' curve and the θ-axis is the Pissarides' equilibrium without credit market frictions θ^{pp}. θ^{pp} has shifted to the right because of the improved return situation, a higher marginal product of labour and hence a higher labour demand because of a fixed exogenous wage rate. The BB curve shifts, because of the improved earnings situation, to the right. Improved profits attract more banks, which is why the BB curve shifts from point J to point K. The higher number of banks lowers ϕ because of a constant number of entrepreneurs. The new BB'' curve lies to right of BB. The new equilibrium with capital and labour market frictions is in point L with ϕ^* (the capital

market equilibrium does not depend on the earnings) and θ^{**}. The new labour market equilibrium θ^{**} implies a lower unemployment rate.[1]

In the next step we discuss how far VC financing has a comparative advantage over credit financing with regard to costs. A possible cost advantage could result from the superior information basis of a VC company. VC companies advise start-ups and monitor them more closely than creditors. This managerial support of start-ups allows the VC company to gain some information about which skills are important for the success of a start-up and how best to evaluate these skills. A creditor who is not involved in the operation of his client does not have the possibility of gaining this information. This would now enable the VC company to focus its screening activity on the relevant factors and therefore to lower screening costs. Another effect could be that the VC company can preselect the group of entrepreneurs because of some special skills of the entrepreneur before the screening procedure. The remaining screening group would be of a higher quality. This possible performance improvement should be attributed to the screening procedure and therefore be a cost improvement because the overall earnings of a firm do not change. Only the expected profit of the capital provider increases due to the preselection process during which the most promising entrepreneurs are picked out of the overall group of entrepreneurs.

The symmetrical risk sharing and success participation of VC companies and their start-ups without an upper limit could be also a possible cost advantage of VC companies. Ordinary credit financing does not benefit from firm's success once it exceeds the loan value. Contrarily, a VC company benefits from the additional value created. As long as the survival rate of start-ups is high, the asymmetric risk sharing does not lead to a severe disadvantage of credit financing. The stable, long-term relationship between the creditor and its debtor could even be a comparative advantage (Allen and Gale, 1999). This comparative advantage of credit financing to equity financing disappears with the development of an economy (Boyd and Smith, 1998, Acemoglu et al., 2002) and becomes even a disadvantage when the projects are R&D intense with more uncertain future prospects (Huang and Xu, 1999)[2]. Because of this disadvantage of credit financing in funding innovation-based projects, the creditor has to charge a higher risk premium and therefore higher capital costs than a VC company. The non-fixed payment obligations of the entrepreneur additionally reduce the risk incentive problem of debt financing and create a comparative advantage of VC financing. A costly monitoring of

[1] An analytical proof is given by Wasmer and Weil (2000), p.16.

[2] We assume hereby that market based systems go along with a lower bank concentration.

the entrepreneur to avoid a misallocation of funds in too risky projects is, in contrast to credit financing, not necessary or only to a lower degree, and so the costs of a VC company decrease.

Figure 3: Cost Advantage of a VC Company

Source: Wasmer and Weil (2000).

The consequences of the above derived results are depicted in Figure 3. The costs of a VC company compared to a creditor would be reduced and the BB curve would be shifted from point M to point N. For a given number of entrepreneurs, there will be more banks, ϕ decreases and BB shifts to the right to B^+. In the new equilibrium point O, ϕ decreases and θ increases, so that the unemployment rate is reduced due to the larger value θ^+, which is accompanied by a reduced unemployment rate.

In the next two sections we test the above derived results for their empirical relevance. Before we examine the influence of venture capital financing on the unemployment rate in Chapter 4, we examine the influence of the institutional setting on the capital market on the unemployment rate over a 40 year period.

3. Long-Term Influence of Capital Markets

Depending on the development stage of an economy, different kinds of capital markets should have a comparative institutional advantage. We expect bank-based capital markets to be advantageous for the duration of the catching-up process. Imitative investments in already available technologies should impose lower monitoring costs for banks, so that bank-based capital markets foster the growth of investment-based industries. In contrast, stock-market-based capital markets should have a comparative advantage in funding innovation-based projects at a later stage of economic development (Boyd and Smith, 1998, Acemoglu et al., 2002). Due to the fact that capital markets are related to the legal origin of a country, a switch from one system to another is not easily and quickly possible but rather requires a substantial transition period (La Porta et al., 1998). We therefore examine the extent to which the legal origin of a country has been advantageous for a country and whether there has been a breaking point of the influence when a country has finished its catching-up process and operates close to the innovative frontier. For this purpose we use a data set of developed countries employed by Blanchard and Wolfers (1999), which is supplemented by some additional data of financial markets taken from La Porta et al. (1998) and the OECD (Leahy et al., 2001). The data set consists of eight five-year periods, beginning in 1960 and ending in 1999.

The regression method implied is a FGLS estimation with a White HCCM. The estimation equation is the following:

$$u_{it} = c + D_t + \sum_j X_{ijt} b_{tj} + \sum_m Z_{im} f_m + g_{it} h + e_{it}, \qquad (1)$$

whereby u_{it} is the average unemployment rate during the five year period. C is a constant term and D_t is a matrix of time dummy vectors which tests for an increase of the unemployment rate over time. X_{ijt} is the value of the country-specific value of the labour market institution j in country i for the period t. Z_{im} is the value of the country-specific institutional setting of the labour market for country i. It consists of a dummy variable for the legal origin as well as the values for creditor and shareholder rights in a country. The capital market matrix Z_{im} is time invariant because of the above-mentioned, very long transition period of a capital market setting. g_{it} is the average annual growth rate of the GDP of country i for period t and shall control for cyclical effects on the unemployment rate.

The exogenous regression variables are the following[3]:

[3] They are explained in detail in the appendix.

- Labour market institutions
  - Active Labour Market Expenditures as percentage of GDP (ALMPHAT),
  - Benefit Duration (BENEFIT),
  - Replacement Rate (RR),
  - Union Density (UDEN), the co-ordination level of contract negotiation (CO-ORD),
  - Employment Protection (EMPRO),
  - Tax Wedge (WEDGE) and
  - Union Contract Coverage (UNION),
- Capital market settings:
  - Three country dummies for legal origin relative to common law,
    - German law origin (GERMAN),
    - French law origin (FRENCH) and
    - Scandinavian law origin (SCAND),
  - creditor rights and
  - shareholder rights.

All variables are standardised in a way that a higher value corresponds with a more generous setting of the institution.

Table 1: Influence of the legal origin on the unemployment rate

Time period	1960-1999		1960-1979		1985-1999	
Variable	Coeffi-cient	Prob.	Coeffi-cient	Prob.	Coeffi-cient	Prob.
SHARE	0.006598	0.1101	0.003627	0.1084	0.002011	0.7617
CREDIT	-0.004505	0.0995	-0.005412	0.0074	-0.005553	0.321
GERMAN	-0.027204	0.139	-0.03545	0.0026	-0.081035	0.1142
FRENCH	-0.018618	0.2566	-0.032993	0.0075	-0.067504	0.1036
SCAND	-0.012696	0.5576	-0.042353	0.0032	-0.021858	0.6901

In Table 1 we present the estimation results for the capital market settings for different time periods. Due to the fact that the influence of the capital market on the unemployment rate is of special interest, we refer to the appendix for the estimation results of all variables implied.

The legal origin of a country is used in this regression to distinguish between a bank-based and a stock-market-based capital market. Countries with German, Scandinavian and French

legal origins have a bank-based capital market, whereas the reference group (common law origin) has a stock-market-based capital market. For the whole period from 1960 to 1999 the legal origin had no statistically significant influence[4] on the unemployment rate. But when we consider only the period from 1960 to 1980, we get the result that the Continental European countries had a statistically significant (at least countries with Scandinavian and German legal origin) lower expected unemployment rate for the period from 1960 to 1980, which we interpret as an indication for a comparative institutional advantage of bank-based capital markets over this time period. The bank-based capital markets of those countries seemed to help the continental European countries in their catching-up process after World War II and reduced the unemployment rate of these countries relative to the common law countries.

The different development stages of economies are considered in this regression by including the average real GDP growth rate, so that this effect cannot be the cause for country differences of the unemployment rate, as well as the labour market setting which is also included in this regression. In a second step, we run a regression for the 1985-1999 period to check whether a comparative institutional advantage of German and Scandinavian law countries still exists. For this period we get a positive statistically significant influence of the dummy variable for German and Scandinavian Law countries, which is consistent with our conjecture that the comparative advantage of the capital market setting of these countries has disappeared and has even become a comparative disadvantage with the approach to the innovative frontier. The influence of the French law country dummy is still statistically insignificant and has not changed its sign, so that we can not conclude that the institutional setting of French law countries has become disadvantageous. To further investigate the influence of the capital market on the labour market after 1985, we examine in the next section the influence of venture capital financing on the disaggregate structure of the unemployment level, because this financing tool is of special interest for start-ups and for fostering the process of structural change.

4. Influence of VC-Investment on the Structure of Labour Demand

As mentioned in Section 2, there are some facts that suggest that VC financing has a comparative advantage in financing innovation-based projects compared to ordinary debt financing. If this conjecture is true, we would expect that the labour demand for innovation-based industries will be higher in countries with a better functioning venture capital market. To test

[4] We test for a significance level of 5%.

for the validity of this conjecture, we make three separate FGLS estimations that examine the influence of venture capital investment[5] and of early stage investment[6] on the change of the unemployment level according to industry classification, occupation and educational attainment. For this purpose we use a data set[7] of 20 developed countries for a 14 year period from 1986 to 1999. Unfortunately, we did not have the disaggregate unemployment data before 1992, so that we use VC investment as a lagged variable for a seven year period to observe the long term influence on the unemployment rate. The advantage of such a method is that we do not place on the VC investment any restrictions on the expected influence, as some dynamical estimation equations with lagged dependent variables do. We were in addition thereby able to avoid severe autocorrelation problems occurring in estimation equations with lagged dependent variables (Belke, Fehn and Foster, 2002). The estimation implied is a FGLS estimation with a White HCCM and the following equation:

$$\Delta u_{it} = \alpha + \beta\, VC_{it-k} + \gamma \Delta GDP_{it-l} + \delta_j X_{jit} + \varepsilon_{it}, \qquad (2)$$

whereby Δu_{it} is the standardised change of the unemployment level, α is a constant term with common effects. VC_{it-k} is the VC investment level relative to GDP for t to t-7 and X_{jit} are the labour market institutional settings which should test for different changes of unemployment with respect to different labour market settings. ΔGDP_{it} is the real GDP growth rate and ε_{it} is a country specific error term. We additionally include a trend variable because of the measurement of the unemployment variable as a level variable and possibly occurring demographic effects. We use the above-mentioned estimation specification because we expect that the VC investment level and the real GDP growth rate affect the change of the unemployment level. Country-specific level differences of the unemployment level should be removed by using the standardised change of the unemployment level. The influence of a changing institutional setting on the labour market is considered by the country specific labour market variables which are measured by their level rather than by their change due to low variation over time. We additionally use the level of labour market institutions because the level of these institutions and their values influence the change of the unemployment level.

[5] Including seed, start-up and expansion investment.

[6] Including seed and start-up investment.

[7] The data set implied uses for the change of the unemployment level data from the online database of the ILO and from the European social statistics. The VC investment data is taken from Belke, Fehn and Foster (2002) as well as the real GDP growth rate and the labour market institutional settings. The data sources are explained in detail in the appendix.

As the first of three regressions, we present the results of the estimation for the influence of VC and early stage investment on the change of the unemployment level according to industry specification. We expect that those industries that are innovation-based should benefit most from VC investment and early stage investment. Due to the fact that start-ups should be more financially constrained in financing innovation-based projects than already existing firms which have a significant amount of free cash flows or other inventories of significant value (Hubbard, 1997), early stage investment should have a substantial effect on unemployment. Especially innovative, high-tech industries like the telecom sector or new economy should be the beneficiaries of higher investment levels.

Table 2: VC investment and unemployment according to industry classification

	UNEMPISCI-1 Agri-culture	UNEMPISCI-2 Mining	UNEMPISCI-3 manu-facturing	UNEMPISCI-4 electri-city	UNEMPISCI-5 building	UNEMPISCI-6 retail	UNEMPISCI-7 Traffic, telecom	UNEMPISCI-8 Insur-ance, banking	UNEMPISCI-9 Public ad., others
Cumulative influence of VC investment at a significance level of 1%	0.210	0.469	0.000	-0.164	0.014	0.000	-0.239	-0.023	0.084
Cumulative influence of early stage investment at a significance level of 1%	1.264	0.147	-0.267	1.063	0.528	0.000	0.000	0.090	0.501

In Table 2 we present the regression results for the influence on the change of the unemployment level according to industry classification. We focus on the cumulative influence of VC and start-up investment on the change of the unemployment level at a significance level of 1%[8]. Early stage investment has a negative influence on the unemployment level for the manufacturing sector. A possible explanation for this fact is that VC has backed start up projects that could not have been realised with ordinary credit financing. Especially the investment-intensive manufacturing sector seems to need early stage financing to fund projects in a more volatile economic environment. Contrary to expectations, the influence of early stage investment is insignificant for the traffic and telecom sector. A reason for this could be that only after a long period does investment in start-ups create a perceptible positive influence on the labour market, which is not observed in the short and mid-term (here, seven years). The other industrial sectors are losers of early stage investment, which is not surprising because these sectors do not benefit from structural change. When we examine the influence of VC

[8] For a detailed estimation output we refer to the appendix.

investment, we observe that it has a negative influence on the unemployment level of the telecom sector, financial services and the electricity sector. VC investment has the expected effect on the unemployment level of the telecom sector and creates a significant amount of additional labour demand in contrast to early stage investment. The same is true for the financial services sector. The old economy sectors are disadvantaged by accelerated structural change and experience higher unemployment levels.

In the next step, we examine the influence of VC and early stage on the unemployment level according to occupation. We suggest that the beneficiaries of VC and early stage investment should be the high-skilled persons, because they profit most from a labour saving structural change (Berthold, 2000). Among the groups of engineers, scientists and managers, the high-skilled persons should be represented to a considerable degree so that we expect that these groups benefit most from a higher investment level.

Table 3: VC investment and unemployment according to occupation

	UNEMP ISCO-1 Management	UNEMP ISCO-2 Scientists	UNEMP ISCO-3 engineers	UNEMP ISCO-4 Office worker	UNEMP ISCO-5 Service personnel	UNEMP ISCO-6 Skilled workers, farmers	UNEMP ISCO-7 Factory workers, others
Cumulative influence of VC investment at a significance level of 1%	0.089	-0.088	-0.183	0.000	0.000	-0.012	0.109
Cumulative influence of early stage investment at a significance level of 1%	0.317	1.348	-0.353	-0.461	-0.090	0.578	0.435

The regression results in Table 3 show the influence of VC and early stage investment on the change of the unemployment level at a significance level of 1%. The results of early stage investment are consistent for the group of engineers with the conjectures mentioned above. The influence on the unemployment level of the group of managers and scientists is positive and inconsistent with our expectations. A possible explanation could be that a higher rate of early stage investment induces the existing companies to reduce their managerial and R&D staff, and therefore labour demand decreases for these two groups. This lower labour demand cannot be compensated by the additional labour demand of start-ups in the short and mid-term because these companies do usually not have an R&D department or a complex managerial system at the beginning of their life cycle so that the overall unemployment level increases. A higher early stage investment level decreases the unemployment level of office workers which

indicates that this group of workers is complementary to entrepreneurs. The other groups of workers do not benefit from early stage investment, which is not surprising when we take into account that these groups consist mainly of low-skilled people that should be at a disadvantage in structural change that is accelerated by early stage investment. The regression results concerning the influence of the VC investment level on the unemployment rate are consistent with the conjectures above for the groups of scientists and engineers. Only the influence on the unemployment level of managers contradicts our expectations. Smaller administrative departments and hence a higher unemployment level of managers could be an effect of an active participation and monitoring of VC companies that avoid a too complex administration. The influence on the unemployment rate on skilled workers is also negative, which indicates that not only high-skilled workers with a university degree benefit from an accelerated structural change but also skilled workers. The influence on the other occupational groups are either insignificant or increase the unemployment level which is consistent with our expectations.

In the third regression we estimated the influence of VC and early investment on the change of the unemployment level according to educational attainment. This is the core of our hypothesis concerning the effect of VC investment on structural change. We suggest that VC and early stage investment should reduce unemployment among high-skilled workers and increase unemployment among low-skilled workers. VC investment should enhance structural change and the accompanying labour saving technical progress. This would reduce labour demand of low-skilled workers and hence increase the unemployment level. Simultaneously labour demand for high-skilled workers should grow and the unemployment level of this group should decrease because of VC investment.

Table 4: VC investment and unemployment according to educational attainment

	UNEMP Lower than university degree	UNEMP University degree and higher
Cumulative influence of VC investment at a significance level of 1%	0.142	-0.325
Cumulative influence of early stage investment at a significance level of 1%	0.000	-1.066

The results in Table 4 confirm these hypotheses concerning the effect VC investment on the structure of labour demand according to educational attainment. Early stage investment does not affect the unemployment level of low-skilled workers but has a significant negative influence on the unemployment level of high-skilled workers. Compared to VC investment, the influence of early stage investment is three times larger on the unemployment rate so that early stage investment can be regarded as a better tool to promote structural change. But nevertheless does VC investment also act a catalyst for structural change and the implied labour saving technical progress with adverse effects on labour demand for low-skilled workers and positive effects on labour demand for high-skilled workers.

5. Conclusions

The regression results of the long term influence of the capital market indicate that there has been a structural break in the influence of the institutional setting on the capital market on the labour market. We suggest that this structural break is caused by different stages of economic development and a changing comparative institutional advantage concerning the appropriateness of capital markets in funding innovation-based or investment-based projects. The regression results of the disaggregate unemployment estimations give clear evidence that VC investment and early stage investment have effects on the structure of labour demand and hence on unemployment. Although we get different results for the influence of VC and early stage investment on the unemployment level according to industry classification, probably because of a too aggregate distinction between industry sectors, we can conclude, because of the results of the influence of VC and early stage investment on the unemployment level according to occupation, that there are different effects on the structure of labour demand. Groups with high-skilled people seem to benefit from VC investment and at least one of these groups from early stage investment. Other groups do not benefit from VC and early stage investment except the group of office workers and skilled workers. The last regression, which distinguishes explicitly between high-skilled workers and low-skilled workers, substantiates our hypothesis that high-skilled workers benefit most from VC and early stage investment activity. These results confirm the suggestion that VC and early stage investment acts as catalysts of structural change.

In order to benefit from the job creation side of VC investment, policy makers should try, irrespective of the legal origin of their capital markets, to implement a market for VC financing especially when we consider the problems of current debt financing. A possible way to

improve the efficiency and liquidity of the VC market is the establishment of pension funds as VC providers which could be achieved by switching to a significant extent from pay-as-you-go to funded pension systems. Another focus should lie on the improvement of existing IPO markets as exit channels for VC providers. Especially better accounting standards and an improved corporate governance system are necessary to create transparency and trust after numerous accounting scandals like Enron. The liquidity and efficiency of a secondary stock market is crucial for the efficiency of a VC market so that policy makers should focus on the revival of stock markets segments like the NASDAQ or the German "Neuer Markt".

Nevertheless, it is also essential that labour market and welfare state reforms along with reforms of the education sector are undertaken by policy makers. Workers have only two possibilities to react to the challenge created by structural change: They can either become better or cheaper. A welfare state should therefore not obstruct workers from qualifying and from switching their occupation or industry sector by setting a reservation wage which is too high. Generous welfare payments should be reconsidered and cut back, if they are not incentive compatible. Wage negotiations should be decentralised so that they do not hinder workers from negotiating wages which are in line with the economic situation at the firm level and so that they do not prevent the establishment of a low wage sector. Tax credit systems like the EITC in the US can help to absorb the adverse income effects on low-skilled workers of such reforms and provide incentives for work and qualification on the job. Qualification on the job is usually more effective in this respect than active labour market programs which often ignore market needs and foster long term unemployment via carrousel effects.

Policy makers should concentrate government activities and expenditure on improving work incentives and possibilities to qualify. Improving the education system inter alia via reducing its underfunding in many European countries and via strengthening the incentives to perform well for teachers and professors are key issues in this respect. Furthermore, a general and perceptible tax rate decrease and a cutback of progressive income taxation would strengthen incentives to build up human capital and would foster entrepreneurial dynamism due to higher after tax income and profits.

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Appendix

Table 5: Explanation of classification by sectors, occupation and educational attainment

Classification by industry sector	
ISCI-1	Agriculture
ISCI-2	Mining
ISCI-3	Manufaturing
ISCI-4	Electricity, gas, water
ISCI-5	Construction
ISCI-6	Retail and food
ISCI-7	Traffic, telecommunication
ISCI-8	Financial services
ISCI-9	Public administration, others
Classification by occupation	
ISCO-1	Managers
ISCO-2	Scientists
ISCO-3	Engineers
ISCO-4	Office workers
ISCO-5	Service personnel
ISCO-6	Skilled workers, farmers
ISCO-7	Unskilled workers, others
Classification by educational attainment	
ISCED-1	Lower than university degree
ISCED-2	University degree and higher

Table 6: Description of the labour market and capital market variables

Macroeconomic time series	
Average real GDP change (Growth)	Source: Blanchard and Wolfers, 1999, Data and Appendix.
Real gross domestic product (GDP)	Source: OECD Main Economic Indicators
Employment by occupation (EISCO)	Source: ILO Web Database and European social statistics, several volumes, 1993-1999.
Employment by industry sector (EISCI)	Source: ILO Web Database and European social statistics, several volumes, 1993-1999.
Unemployment by occupation (UISCO)	Source: ILO Web Database and European social statistics, several volumes, 1993-1999.
Unemployment by industry sector (UISCI)	Source: ILO Web Database and European social statistics, several volumes, 1993-1999.
Unemployment by educational attainment (UISCED)	Source: ILO Web Database.
Institutional labour market variables	
Benefit replacement ratio	(RR1) Average replacement rate over the first year of an unemployment spell. Source: Blanchard and Wolfers (1999), pp. 11 ff. and data appendix. Three realisations per country (for 1986-89, 1990-94 and 1995-99). Indicator displays more variability than RRATE.
Benefit duration (BENEFIT)	Duration of unemployment benefits (years, 4 years meaning indefinite). Source: Layard and Nickell (1997), pp. 11 ff., and complementary data delivered by S. Nickell.
Union coordination index (UNCORD)	Union co-ordination in wage bargaining. Index with 3 = high, 2 =middle, 1 = low. Source: Layard and Nickell (1997), Table 3, and complementary data delivered by S. Nickell.
Employment protection index (EMPRO)	Country ranking with 20 as the most strictly regulated. Source: Layard and

	Nickell (1997), p. 6, Table 2, and complementary data delivered by S. Nickell.
Tax wedge (T)	Total tax wedge (in %). Sum of the payroll tax rate, the income tax rate and the consumption tax rate. Average rates derived from national income and tax data. Source: Layard and Nickell (1997), p.4, Table 1, and complementary data delivered by S. Nickell.
Venture capital investment time series	
Venture capital investment (VC)	Seed, start-up and expansion (both government and private sector funded) as per mil of average GDP. Source: Data calculated from Asian Venture Capital Journal (2000), Baygan, Freudenberg (2000), European Venture Capital Association (2000), National Venture Capital Association (2000), Jeng, Wells (2000)
Early stage venture capital investment (INVEARLY)	Seed and startup (both government and private sector funded) as per mil of average GDP. Source: Data calculated from Asian Venture Capital Journal (2000), Baygan, Freudenberg (2000), European Venture Capital Association (2000), National Venture Capital Association (2000), Jeng, Wells (2000)
Institutional capital market variables	
Creditor rights (CREDITRIGHT)	Index of the legal systems protection of creditors in case of a firm's liqidation or reorganization. Range: 0 to 4, 4 is the highest level of creditor protection. Source: La Porta et al. (1998), p. 1136, Table 4.
Legal Origin (GERMAN, FRENCH, SCAND)	Dummy for German, French or Scandinavian Legal origin, Source: La porta et. al, 1998, Table 3.
Creditor rights OECD (CREDIT)	Measure of creditor rights with a mean value of 0 and a standard deviation of 1,Source: Leahy et al, p.37.
Shareholder rights (SHARE)	Measure of shareholder rights with a mean value of 0 and a standard deviation of 1,Source: Leahy et al, p.37.

Table 7: Estimation Output - Dependent Variable: Unemployment rate[9]

Time period	1960-1999		1960-1979		1985-1999	
Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
ALMPHAT	0.00126	0.0001	0.001028	0.0015	0.001423	0.0067
BENEFIT	0.00179	0.566	-0.007199	0.0236	0.011217	0.0335
COORD	0.02223	0.0001	0.002588	0.5193	0.033104	0.0003
UNION	0.014838	0.1146	0.012026	0.1912	0.008494	0.5197
UDEN	0.000585	0.0404	0.000594	0.0145	0.000578	0.2059
RRATE	0.000793	0.0008	0.000543	0.0137	0.000835	0.0328
T	0.001243	0.0003	0.001309	0.0007	0.001394	0.0122
EMPRO	0.003111	0.0057	0.000128	0.8837	0.004687	0.0009
GROWTH	-0.287973	0.1614	0.065438	0.7431	-0.192505	0.4962
SHARE	0.005573	0.2139	0.005032	0.1627	0.009288	0.1515
CREDIT	-0.000238	0.9414	-0.00456	0.0906	0.000369	0.957
GERMAN	-0.017953	0.3225	-0.034477	0.0101	0.005627	0.8447
FRENCH	-0.023386	0.181	-0.021405	0.1344	-0.00373	0.8904
SCAND	-0.007404	0.7435	-0.059798	0.002	0.045268	0.1734

[9] The influence of constant terms and dummies for time periods are not depicted.

Table 8: Estimation Output - Dependent Variable: change of the unemployment level according to occupation

	ISCO1		ISCO2		ISCO3		ISCO4		ISCO5		ISCO6		ISCO7	
INVEARLY	0.0331	0.6314	0.1719	0.0045	0.0469	0.2495	-0.0157	0.8552	0.0046	0.9116	0.0681	0.0058	-0.0114	0.7646
INVEARLY(-1)	0.3173	0.0402	-0.3998	0.0037	-0.1185	0.2497	0.1746	0.3010	0.1536	0.0630	-0.0535	0.4160	0.3770	0.0000
INVEARLY(-2)	-0.0949	0.5844	0.0356	0.8155	0.3419	0.0126	0.2506	0.3485	0.3068	0.0066	0.1320	0.1522	-0.3510	0.0043
INVEARLY(-3)	-0.2838	0.2543	0.1827	0.3664	0.2180	0.2701	0.0070	0.9770	-0.3617	0.0785	-0.0582	0.6856	0.4093	0.0115
INVEARLY(-4)	0.1557	0.6716	-0.4781	0.1711	-0.2105	0.4778	0.1643	0.5468	-0.2504	0.3095	0.2022	0.3028	-0.0909	0.7137
INVEARLY(-5)	0.1482	0.6799	0.8753	0.0226	-0.1769	0.4787	-0.4615	0.0446	0.3154	0.0939	-0.1431	0.3417	-0.1367	0.5901
INVEARLY(-6)	0.1845	0.4510	0.7004	0.0300	0.3563	0.1592	-0.0310	0.9005	0.2773	0.1564	0.5102	0.0022	-0.1668	0.3780
INVEARLY(-7)	0.0921	0.6630	-0.2152	0.3839	-0.6951	0.0027	-0.0633	0.7291	-0.3970	0.0120	-0.2734	0.0839	-0.1975	0.2180
C	0.1061	0.5240	0.0568	0.8711	0.4267	0.0112	0.0286	0.9602	0.2953	0.0031	0.2367	0.2511	0.2596	0.0162
RR1	-0.0041	0.0028	-0.0009	0.5940	0.0027	0.0962	-0.0011	0.6258	-0.0004	0.8023	0.0001	0.9346	0.0000	0.9820
RR25	-0.0033	0.0206	-0.0032	0.2745	-0.0043	0.0016	-0.0024	0.6436	-0.0034	0.0032	-0.0021	0.4041	-0.0004	0.7345
RRATE	0.0034	0.1063	0.0069	0.0447	-0.0023	0.4184	-0.0007	0.6994	-0.0003	0.8559	0.0016	0.4862	-0.0027	0.0905
BENEFIT	0.0068	0.7553	-0.0425	0.1548	0.0340	0.1383	0.0527	0.1504	0.0242	0.1760	-0.0171	0.5863	0.0552	0.0041
UNCORD	0.0704	0.2709	-0.1101	0.3348	0.0989	0.1785	0.1359	0.0013	0.0819	0.1234	0.0047	0.9283	0.1114	0.0230
NEWEP	0.0241	0.7234	0.1156	0.2402	-0.0856	0.2421	-0.0384	0.3102	-0.0144	0.6110	-0.0384	0.5986	-0.0059	0.8610
T	0.0013	0.4974	-0.0060	0.1639	-0.0004	0.8327	0.0039	0.7524	-0.0012	0.3366	-0.0017	0.3044	-0.0022	0.2345
CREDITRIGHT	-0.0046	0.8338	0.0526	0.0618	0.0300	0.1505	-0.0291	0.5205	0.0031	0.8634	0.0382	0.2787	-0.0438	0.0428
SHARERIGHT	-0.0135	0.6586	-0.0219	0.6098	-0.0414	0.1020	0.0077	0.8402	-0.0130	0.2340	-0.0463	0.1710	0.0206	0.2178
D(GDPR)	0.0153	0.0306	0.0225	0.0048	0.0087	0.3014	-0.0019	0.8330	0.0016	0.8546	0.0089	0.3032	-0.0328	0.0000
D(GDPR(-1))	-0.0159	0.0213	-0.0118	0.0677	-0.0128	0.0327	-0.0168	0.0066	-0.0079	0.0874	0.0021	0.7622	-0.0121	0.1220
TREND	-0.0329	0.0021	-0.0103	0.5066	-0.0376	0.0008	-0.0350	0.0000	-0.0307	0.0000	-0.0163	0.0387	-0.0216	0.0346
R-squared	0.4835		0.4225		0.4959		0.5214		0.7571		0.3689		0.7166	
Durbin-Watson	2.4974		2.0300		2.4458		1.9157		1.7821		2.4140		1.9389	

Table 9: Estimation Output - Dependent Variable: change of the unemployment level according to occupation

	ISCO1		ISCO2		ISCO3		ISCO4		ISCO5		ISCO6		ISCO7	
VC	-0.0061	0.6896	0.0638	0.0150	0.0055	0.6855	-0.0040	0.8270	-0.0184	0.1902	0.0143	0.1015	-0.0068	0.6476
VC(-1)	0.1476	0.0000	-0.0111	0.7827	0.0590	0.1445	0.0267	0.5454	0.0602	0.1866	0.0623	0.0030	0.1089	0.0089
VC(-2)	-0.0419	0.0763	0.0444	0.4869	0.0507	0.3271	0.0965	0.1090	0.0757	0.1530	0.0787	0.0045	-0.0009	0.9814
VC(-3)	-0.0876	0.0023	0.0559	0.1155	-0.0901	0.0749	-0.0472	0.2520	-0.0557	0.3274	-0.1533	0.0000	-0.0379	0.4881
VC(-4)	0.1758	0.0000	0.0093	0.8682	0.1633	0.0008	0.0195	0.6549	-0.0472	0.2338	0.0560	0.0338	0.0023	0.9656
VC(-5)	-0.1469	0.0000	-0.2923	0.0000	-0.1820	0.0017	-0.1240	0.0207	-0.0663	0.0809	0.0318	0.2343	-0.0428	0.4205
VC(-6)	0.0248	0.5359	0.2048	0.0000	0.0517	0.3694	0.0280	0.3822	0.0584	0.2297	0.0481	0.0458	-0.0506	0.4858
VC(-7)	-0.0518	0.1641	-0.0517	0.2413	-0.1640	0.0030	0.0123	0.6630	-0.0313	0.3505	0.0492	0.0199	-0.0709	0.1486
C	0.1889	0.1405	0.1467	0.6338	0.4316	0.0024	0.0465	0.9399	0.2340	0.0233	0.1890	0.1871	0.2817	0.0197
RR1	-0.0031	0.0012	0.0006	0.6318	0.0027	0.0253	-0.0007	0.6800	-0.0002	0.8777	0.0012	0.3124	0.0007	0.5163
RR25	-0.0034	0.0028	-0.0015	0.5958	-0.0057	0.0001	-0.0032	0.5545	-0.0034	0.0566	-0.0028	0.2758	-0.0032	0.0780
RRATE	0.0032	0.0907	0.0043	0.1191	-0.0025	0.3281	0.0012	0.5123	-0.0003	0.8677	0.0014	0.4625	-0.0026	0.1232
BENEFIT	0.0157	0.5057	-0.0050	0.8901	0.0381	0.0551	0.0249	0.4385	0.0250	0.2357	-0.0104	0.7299	0.0593	0.0062
UNCORD	0.0361	0.4904	-0.0634	0.5134	0.1049	0.1343	0.0587	0.3094	0.0656	0.2351	0.0039	0.9343	0.1119	0.0351
NEWEP	-0.0055	0.9116	0.1008	0.1910	-0.1207	0.0665	-0.0188	0.5996	-0.0227	0.5155	-0.0397	0.4781	-0.0495	0.2387
T	0.0030	0.0984	-0.0042	0.3873	0.0009	0.6207	0.0020	0.8750	-0.0001	0.9637	0.0000	0.9930	-0.0009	0.6410
CREDITRIGHT	0.0009	0.9694	0.0435	0.1967	0.0334	0.0716	-0.0111	0.7876	0.0011	0.9602	0.0115	0.7254	-0.0251	0.3228
SHARERIGHT	-0.0269	0.1895	0.0069	0.8496	-0.0527	0.0145	-0.0112	0.7708	-0.0139	0.2814	-0.0470	0.0337	-0.0029	0.8756
D(GDPR)	0.0131	0.0567	0.0157	0.0118	0.0092	0.2990	0.0032	0.6586	-0.0009	0.9374	0.0049	0.4625	-0.0196	0.0825
D(GDPR(-1))	-0.0149	0.0124	-0.0272	0.0027	-0.0150	0.0349	-0.0119	0.0125	-0.0066	0.2556	-0.0046	0.4661	-0.0130	0.1634
TREND	-0.0368	0.0000	-0.0362	0.0001	-0.0318	0.0000	-0.0211	0.0005	-0.0237	0.0001	-0.0203	0.0003	-0.0189	0.0447
R-squared	0.6385		0.5844		0.5231		0.4872		0.6502		0.5297		0.6459	
Durbin-Watson	2.5589		2.0336		2.5566		1.7538		1.7003		2.4882		1.8662	

Table 10: Estimation Output - Dependent Variable: change of the unemployment level according to educational attainment

	ISCED1		ISCED2				ISCED1		ISCED2	
INVEARLY	0.0514	0.2569	0.2753	0.0000		VC	-0.0324	0.0367	0.0627	0.0004
INVEARLY(-1)	0.2464	0.0224	0.0955	0.2113		VC(-1)	0.1425	0.0063	0.0095	0.7199
INVEARLY(-2)	0.0887	0.5666	-0.5236	0.0001		VC(-2)	0.1056	0.0133	-0.0804	0.0000
INVEARLY(-3)	-0.4332	0.1034	-0.5188	0.0000		VC(-3)	0.0061	0.8843	-0.0427	0.0775
INVEARLY(-4)	0.3134	0.0861	0.4758	0.0001		VC(-4)	-0.0569	0.2491	-0.0969	0.0041
INVEARLY(-5)	0.5600	0.0431	-1.8253	0.0000		VC(-5)	-0.0084	0.9092	-0.2098	0.0006
INVEARLY(-6)	-0.0005	0.9991	2.0023	0.0000		VC(-6)	0.1206	0.1769	0.2736	0.0601
INVEARLY(-7)	-0.0019	0.9949	-0.9516	0.0001		VC(-7)	-0.1018	0.0545	0.1184	0.5992
C	0.3579	0.2313	0.3876	0.7466		C	0.6233	0.0053	0.1582	0.9274
RR1	-0.0023	0.1958	0.0042	0.6537		RR1	-0.0022	0.1135	-0.0004	0.9702
RR25	-0.0016	0.5139	0.0007	0.9472		RR25	-0.0019	0.3782	0.0020	0.9063
RRATE	0.0023	0.4190	-0.0009	0.9667		RRATE	0.0011	0.5366	0.0036	0.9061
BENEFIT	-0.0492	0.1161	-0.0776	0.3171		BENEFIT	-0.0297	0.2080	-0.0537	0.0058
UNCORD	-0.0167	0.8067	-0.1471	0.4501		UNCORD	0.0132	0.7020	-0.0528	0.1741
NEWEP	0.0839	0.0067	0.1374	0.4325		NEWEP	0.0748	0.0215	0.1288	0.5138
T	-0.0024	0.6641	-0.0064	0.0053		T	-0.0046	0.3091	-0.0042	0.0012
CREDITRIGHT	0.0780	0.0187	0.0598	0.0005		CREDITRIGHT	0.0448	0.1343	-0.0164	0.9184
SHARERIGHT	-0.0168	0.3419	-0.0194	0.8078		SHARERIGHT	-0.0270	0.0899	-0.0004	0.9959
D(GDPR)	0.0140	0.0179	0.0131	0.0258		D(GDPR)	0.0164	0.0447	0.0137	0.3681
D(GDPR(-1))	-0.0119	0.0023	-0.0037	0.4498		D(GDPR(-1))	-0.0081	0.0607	-0.0162	0.0853
TREND	-0.0450	0.0005	-0.0064	0.7948		TREND	-0.0521	0.0000	-0.0165	0.2798
R-squared	0.6714		0.5885			R-squared	0.7217		0.6205	
Durbin-Watson	2.1641		2.4754			Durbin-Watson	2.2205		2.5164	

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