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Institutions and Structural Unemployment: Do Capital-Market Imperfections Matter?

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Keywords: labor markets, unemployment, new economy, panel analysis, venture capital

JEL classification: E22, E24, E44, G24, G32

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I. Introduction*

Continental European countries have by and large not been able to successfully address the unemployment issue. This is the case even though there is a widespread consensus that most of continental European unemployment is of structural nature in the sense that merely injecting additional goods demand into the economies will quickly run into supply-side bottlenecks and will face swift punishment by international financial markets (OECD, 1998).[1] Thus, wage pressure and inflation can pick up easily necessitating a return to a restrictive demand policy which would in turn let unemployment rise again. Given that unemployment in continental Europe generally displays asymmetric persistence, the level of unemployment could very well be even higher after such an experiment. Expansionary demand policy without a strong backing by supply-side reforms therefore makes little sense.

Furthermore, rigid labor markets along with generous welfare states are usually blamed to be the core institutions which prevent a better employment performance.[2] However, political-economy considerations make clear that deregulating labor markets and reforming welfare states is a daunting political task (Saint-Paul, 1998). This is the case because the distributional effects of such measures are in Europe generally perceived to be unfair and because they would hurt entrenched insiders which are usually the pivotal group in elections.[3] While labor-market and welfare-state reforms should stay high up on the agenda for economic policy, it is therefore important to check whether there exist alternative, possibly complementary routes for fighting structural unemployment.[4]

A prime difference between continental Europe and the U.S. is the much higher rate of job creation in the U.S. which is not restricted to low-paid service-sector jobs and can thus hardly

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[1] This paper deals with the question whether capital-market imperfections exacerbate structural unemployment and not with the also interesting issue how they affect cyclical fluctuations.

[2] See Layard, Nickell, and Jackman (1991), Lindbeck (1996), Fehn (1997), Caballero and Hammour (1998), and Blanchard and Wolfers (1999).

[3] This general perception notwithstanding, it is not at all clear whether such a policy would indeed favor capital at the expense of labor in the long run. The appropriation model of Caballero and Hammour (1998) along with recent empirical evidence in favor a long-run elasticity of substitution between capital and labor which exceeds the threshold value of one (Berthold, Fehn, and Thode 2000) demonstrate that the labor share as well as real wages in efficiency units could in fact rise in the long run.

[4] The importance of the complementarity of reforms has in particular been stressed by Coe and Snower (1997).

be fully accounted for by more flexible labor markets and a more restrictive welfare-state regime (McKinsey, 1994; Acemoglu, 1999). The U.S. neither fits the simple notion of creating more employment on essentially a given capital stock by reducing real wages, i.e., moving downward on a given labor demand curve, nor does the widening of the wage distribution which helped low-qualified workers to get a regular job seem to be the whole story (Nickell and Bell, 1995). The U.S. is also much better at creating average and high-paid jobs. This stylized fact should be also related to factors other than more flexible labor markets and a more restrictive welfare state, such as investment, innovation and establishing new firms.[5] Interestingly, all these factors are closely linked to the functioning of capital markets, where institutional differences between the U.S. and continental Europe are about as stark as on labor markets and between welfare state regimes. Nonetheless, leading publications on continental European unemployment give close to no consideration to these factors and to the striking differences in institional structures on capital markets.[6]

The real effects of imperfect capital markets have of course received quite a bit of attention in the literature in recent years.[7] However, the focus was either on how they affect business cycles and financial crises or on their effects on economic growth. Hence, the time dimension has been either short run or long run. What is largely missing is an investigation of their real effects in the medium run, which is the appropriate time perspective for European unemployment (Blanchard, 1997). This is surprising because economic intuition suggests that there are a number of channels through which imperfect capital markets might aggravate structural unemployment. The present paper attempts to fill this gap.

To this end, the paper is organized as follows. The second chapter points out intuitively the links between the institutional structure on capital markets and labor-market performance. The third chapter presents the structure of a macroeconomic model relating unemployment to imperfect labor and capital markets. It captures the key effect that imperfect capital markets exacerbate structural unemployment that is created by malfunctioning labor markets. The fourth chapter presents a cross-country panel analysis to estimate the relative importance of differences in institutional structures on labor and capital markets in explaining different national labor-market performances. Finally, the fifth chapter presents conclusions for economic policy.

[5] Another very important form of investment in this respect is of course human capital formation. However, as investment into human capital has very peculiar problems, it is abstracted from in this paper.
[6] Primary examples are Layard and Nickell, and Jackman (1991), and Blanchard (1997).
[7] See e.g. Greenwald and Stiglitz (1993), Kiyotaki and Moore (1997), King and Levine (1993), Levine and Zervos (1998), and Carlin and Mayer (1999).

II. How do capital-market institutions affect structural unemployment?

The institutional structure of capital markets varies considerably between the Anglo-Saxon countries such as the U.S. and the UK and continental Europe. While the stock market along with a booming venture capital market play a central role in the former countries, the latter countries can be crudely characterized as being bank based (Edwards and Fischer, 1994). Firms in continental Europe rely to a much larger degree on debt financing via banks and there are still extensive cross shareholdings between banks and especially large firms.[8] This and proxy voting causes control of firms to rest largely with banks rather than with the public as shareholders at large or institutional investors such as pension funds. The capitalization of the stock market relative to GDP and the size of the venture capital market are much lower in continental European countries compared to Anglo-Saxon countries.[9] Hence, firms in Anglo-Saxon countries enjoy considerably better access to risk-bearing capital which, however, is sometimes deemed to be impatient compared to credits from closely associated banks (Hall and Soskice, 1999).

While this has been the common way of grouping institutional structures on capital markets for quite some time, recent research has shown that another fruitful, but after all related approach consists in distinguishing countries according to the degree to which laws and their enforcement effectively protect the providers of equity and debt capital from ex-post appropriation by firms, i.e., by management and workers.[10] Four groups of countries emerge according to their legal heritage: French, Scandinavian and German civil law countries and the Anglo-Saxon common law countries. It is important to note that such countries as Japan, South Korea, and Taiwan are grouped among the German civil law countries. Generally, Anglo-Saxon common law countries provide the best effective protection of financiers with the notable exception that countries where the legislation on capital markets stems from German civil law display the strictest protection of creditors. Hence, Anglo-saxon countries have institutional structures for financing firms which are superior in both respects compared to French and Scandinavian countries, but compared to German countries they tend to have a comparative institutional advantage only in equity and venture capital financing and not in debt financing where the reverse holds (Carlin and Mayer, 1999).

[8] This might change in particular in Germany with the tax reform that has just been passed allowing corporate firms to sell stakes in other firms without paying capital gains taxes anymore.
[9] See Black and Gilson (1998), and Carlin and Mayer (1999).
[10] See La Porta et al. (1997), (1998), (1999a), and (1999b).

The open research question concerns the real effects of such differences in particular with respect to the situation on the labor market in the medium run. The renowned Modigliani-Miller irrelevance theorem states that the financial structure of firms should have no real effects under perfect capital markets (Modigliani and Miller, 1958). However, a wide array of empirical and theoretical contributions have shown by now that the Modigliani-Miller theorem is unlikely to hold and that financing decisions and even more so institutional structures on capital markets have real repercussions in the way that they affect business cycles, financial crises, and economic growth. From a theoretical perspective, deviations from the Modigliani-Miller theorem can be justified by capital-market imperfections, in particular by theories of asymmetric information, of control and of commitment (Carlin and Mayer, 1999). Institutional factors are the prime candidate for explaining intercountry differences. Yet, it remains to be seen whether the level of and changes in the structural rate of unemployment are also affected by differences in institutional structures on capital markets.

The key microeconomic problems on capital markets are moral hazard and adverse selection which are due to asymmetric information between the investor and the financier. These phenomena can give rise not only to credit and equity rationing but also to inefficient liquidations of financially constrained firms with sound fundamentals.[11] Standard microsolutions like posting collateral or writing sophisticated, possibly state-contingent contracts are usually either not feasible or only alleviate but do not solve the problem (Stiglitz and Weiss, 1992). Banks and stock markets are two institutions which are designed to lower the arising inefficiencies by providing monitoring, selection, and control services. Nonetheless, capital-market imperfections and liquidity constraints are empirically important phenomena as can be seen, e.g., by investment into fixed capital depending positively on cash flow even after controlling for investment opportunities.[12]

The stylized consequence of rationing on the capital market is a wedge between the marginal productivity of investment, be it new or continuation investment, and the interest rate (Hubbard, 1998). Hence, the larger this wedge becomes, the greater is the negative effect on investment into fixed capital, into R&D, into innovations, and into new firms. Furthermore, inefficient liquidations of fundamentally sound firms become more likely as it becomes more difficult for such firms to acquire financing of continuation investments in times of distress. All these five types of investment are linked to the efficiency of the capital market and they

[11] See Blanchard (1999), Caballero and Hammour (1999), and Hellmann and Stiglitz (2000).
[12] See e.g. Hubbard (1998), Gilchrist and Himmelberg (1995), and Fazzari, Hubbard, and Petersen (1988).

are furthermore important determinants of labor demand. A low overall effective protection of financiers against ex-post appropriation by workers and management, such as is the case in French and Scandinavian law countries relative to Anglo-Saxon countries, makes financiers more reluctant to enter into joint projects. It can thus be expected to increase total rationing on the capital market and to exert a negative effect on labor demand and on job creation.

However, when comparing the German law countries with the Anglo-Saxon countries things become more complicated. Investment into fixed capital can in principle lower unemployment by raising the marginal productivity of labor if growth of real wage costs lags behind. Since fixed capital can usually serve quite well as collateral, this kind of investment is also the one among the five types of investment which is most easily financed by incurring debt. It is therefore not surprising that German law countries such as Germany itself or Japan display comparatively high rates of fixed capital investment (Carlin and Mayer, 1999). It is however questionable whether fixed capital investment of in particular large, established firms is a promising route for achieving employment growth in highly developed OECD countries nowadays. First, a large part of this kind of investment takes place in the industrial sector where at best only very limited employment growth can be expected due to the general patterns of structural change. Second, this type of investment takes place in already existing firms, where entrenchend insiders particularly in the highly regulated continental European labor markets are in a good position to convert a rising marginal productivity of labor into wage increases for themselves rather than into employment gains (Lindbeck, 1996). Fixed capital investment was an important component of employment growth in the catch-up phase after the war when radical innovations by the leading industrial nations could basically be mimicked. But the more a country moves to the frontier of economic development, the less simple investment into fixed capital suffices for achieving employment growth. This fits well with the observation that countries such as Germany and Japan seem to have benefited from its institutional setup on the capital market for a long time, but that this has become more doubtful in the course of the last twenty years.

Key aspects for achieving employment growth in highly developed countries and thus in later stages of economic development appear to be the ability to finance R&D, to orchestrate radical product innovations, and to establish new firms. This is in particular true if employment growth is not only to take place in the form of low-paid service sector jobs. The type of investment rather than its pure level appears to make a difference for the effects on employment. Incremental or process innovations in industries where the main technological

breakthroughs essentially occurred either at the end of last century or during the first half of this century are hardly avenues for achieving major employment gains anymore. Expanding employment in the production of largely standardized industrial products is difficult partially due to globalization and rapidly advancing labor-saving technological progress in this area. Rather, employment growth is more easily achieved in the service sector or in the production of new and niche products which are often technologically advanced. A particularly important source of employment growth in the 1990s have been investments in information technology. However, investments in information technology largely produce intangible assets which cannot serve as collateral so that countries which have trouble in adequately financing such high-risk ventures by means of equity or venture capital have an inherent disadvantage in obtaining employment growth in the thriving information-technology sector compared to the Anglo-Saxon countries.

A large flow of newly created firms affects employment positively through a number of channels. First, new firms enhance competition on the goods market which reduces markups thus raising labor demand. Furthermore, new firms facilitate structural change and in particular the transition to the service sector, so that countries which foster the creation of new firms should have less problems in managing the transition to a more service- and information-technology-based economy. Finally, as new firms do not have insiders yet, a large flow of new firms undermines the bargaining power of insiders on the labor market thus producing more real wage restraint. This effect is reinforced by the rise in the real wage elasticity of labor demand which a vibrant market for founding new firms brings about (Krueger and Pischke, 1997). A higher short-run real wage elasticity of labor demand shifts the utility-maximizing decision of unions in face of the trade off between real wages and employment, which exists due to a downward-sloped labor demand curve in the short to medium run, toward more employment.[13] The incentive of workers to join unions therefore falls because the premium that unions achieve over the market-clearing real wage decreases.

This assessment is reinforced by the observation that more deregulated labor markets with weaker unions, less generous unemployment benefits, and lower firing costs tend to be accompanied by an elaborate protection of shareholders and well-developed venture-capital

[13] In the long run after capital has fully adjusted to any shock, labor demand is anyway either flat or even slightly upward sloping, so that the trade off between real wages and employment disappears (Caballero and Hammour, 1998; Berthold, Fehn, and Thode, 2000). However, such long-run considerations are less relevant for political organizations like unions than short-run effects of wage hikes.

markets across countries and vice versa.[14] At least two possible explanations exist for this connection. First, governments might have struck a more or less explicit politico-economic deal with insiders on labor and capital markets in corporatist countries against the interest of financiers to curtail competition on both markets. Second, the more workers are also capitalists themselves by being invested directly or via pension funds in the stock market, the greater is their own interest in a high yield on capital and the lower is their incentive to fight at all costs for maintaining rigid labor markets.

Having pointed out that R&D, product innovations, and new firms are likely to be major determinants of an economy's success in terms of employment nowadays, it is important to realize that these are all high-risk activities where problems of asymmetric information loom large and where the project itself usually does not constitute viable collateral.[15] It is also the case that the failure rate among such projects will generally be high while the few successful ones are likely to produce large profits for a considerable time span. R&D, product innovations, and new firms are therefore particularly dependent on a well-functioning capital market. First, the institutional structure on the capital market must be suitable for handling problems of asymmetric information. Second, it must be able to provide funding to highly risky projects without receiving much in the way of collateral. Third, as it is highly uncertain which projects will be successful it must be able to sort and provide financing to a very large number of projects, and there must also be the possibility to abandon projects quickly once their failure becomes apparent. Fourth, the capital market must provide a suitable environment for financiers to convert successful projects into cash for themselves, e.g., by going public. It must prevent workers and management from breaching the ex-ante agreed upon terms of trade by arbitrarily reducing ex post payments to financiers.

These conditions are arguably more likely to be fulfilled on stock-market and venture-capital based capital markets with a high effective legal protection of equity holders and venture capitalists in contrast to bank-based capital markets where debt financing is predominant.[16] Equity holders and venture capitalists participate fully in the profits of successful projects so that they are more willing than providers of debt capital to finance highly risky projects. It is furthermore easier in stock-market based capital markets to go public and the number of projects that are initially financed is larger. Empirically, there is indeed a positive relationship between innovation activity and founding new firms on the one hand and in particular the

[14] See Pagano and Volpin (1999), and Fehn and Meier (2000).
[15] See Guiso (1997), Brown (1997), and Weigand and Audretsch (1999).
[16] See Black and Gilson (1998), La Porta et al. (1999a), Fehn (2000), and OECD (2000).

availability of venture capital on the other hand.[17] Hence, a well-developed effective legal protection of shareholders and a thriving venture capital market might have become more important over time for achieving a high level of employment.[18]

III. Imperfect labor and capital markets in a macromodel

The purpose of this section is to present the structure of a simple macromodel which formally captures the gist of the above argument, namely that capital market imperfections exacerbate structural unemployment which is caused by labor-market rigidities.[19] The model is based on the idea that employment is only possible if entrepreneurs, workers, and financiers enter into joint production units and that contractual relationships between entrepreneurs and workers as well as between entrepreneurs and financiers are all but perfect. In particular, both relationships usually require some relationship-specific investment and are therefore open to the well-known hold-up problem, i.e., workers as well as management may wield the power to at least partially appropriate capital ex post, assuming that capital undergoes the greatest transformation and becomes most relationship-specific once invested. In other words, if capital is largely sunk after being invested and if the legal environment does not put great emphasis on protecting capital from ex-post appropriation by workers and management, rational financiers will already ex ante erect a high threshold value for the profitability of projects they are asked to finance. This is the case because they know that management and workers will ex post try to renegotiate payments to production factors to their detriment. For that part of the capital which is sunk and not collateralized, financiers will ex post only receive part of the accruing rents which the project produces. The size of the payments hinges on the ex post relative bargaining power of production factors and, of course, on the size of the rents, but not on the opportunity costs of this part of the capital which is sunk.

The model economy is composed of three sets of agents: Entrepreneurs, workers, and financiers. The discount rate r is assumed to be the same for all three types of agents and is

[17] See OECD (1996), and Kortum and Lerner (1998), and Hellmann and Puri (1999).

[18] Acemoglu (2000) presents a model which shows formally that economies with better functioning financial markets can be expected to display a superior employment performance in times of rapid structural change. Such economies are able to finance the creation of new firms via the external capital market, e.e., via venture capital, whereas firms in the other economies with less well functioning financial markets have to rely mostly on self financing. Hence, job creation will lag behind as the process of structural change is impeded from the creation side.

[19] The presented macromodel is based on Caballero and Hammour (1998) and especially (1999). We do not want to pretend that we add anything to their models. The sole purpose of this section is to briefly show how two of the transmission channels of the previous section from capital markets to structural unemployment, i.e., lack of creation and of continuation investment, can be formalized.

therefore equal to the market discount rate as all agents are assumed to be risk neutral. New production units (firms) are infinitesimally small and they combine in fixed proportions an entrepreneurial idea, one unit of labor, and k units of capital. They are only created if all three agents enter into a joint project. There is a continuum of mass one of infinitely-lived workers who in offering their one unit of labor maximize their expected present value of instantaneous utility, which depends linearly on consumption and labor supplied. Entrepreneurs are the only ones who have access to projects. Entrepreneurs are indexed by i and maximize their expected present value of consumption. Each entrepreneur i disposes of financial assets worth c_i which he commits to the project. If $c_i < k_i$, project i can only be realized if an external financier makes up for the remainder $b_i = k_i - c_i$.[20] External financing is assumed to take place via a competitive non-resource consuming financial sector. External financing may be required for starting new projects or for helping already existing firms in situations of financial distress, i.e., during periods of negative cash flow.

Projects produce a homogeneous durable output good that can either be consumed or used as capital. The output flow of production unit *i* at time *t* is given by:

$$y_{it} = v_{it} + \tilde{e}_{it}. \qquad (1)$$

$v_{it} \in [-\bar{v}, \bar{v}]$ reflects the specific productivity of unit i at date t which is decreasing in the age of the production unit, and $\tilde{e}_{it}$ is a transitory idiosyncratic shock, which alternates with probability ?, $0 < l < 1$, between the good state of the world, $e^+ > 0$, and the bad state of the world, $e^- < 0$. Firms can fail because they are getting outdated or due to negative idiosyncratic shocks. Initial wealth of entrepreneur i is assumed to be independent of the project's initial specific productivity v_i. The marginal densities of projects' productivities and of projects' financing requirements are given by $f(v)$ and $g(b)$ respectively.

It is for simplicity assumed that all of the invested capital becomes specific to the project in the sense that it completely loses its value if the project is abandoned prematurely. This gives rise to contractual difficulties in the employment and financing relationships.[21] Insiders, i.e., workers and management, may attempt to acquire a greater share of the quasi-rents that are produced within the nexus of the firm than was agreed upon ex ante thus appropriating

[20] $b_i < 0$ means that the firm has positive internal funds.

[21] The use of collateral could of course attenuate the contractual difficulties. However, the essence of the argument is valid as long as the financier does not receive full collateral.

capital. Labor and management cannot credibly precommit not to withhold their human capital from production once the production unit has been formed and capital has become fully specific to it and is sunk. Assuming imperfect legal protection of providers of capital and that fully state contingent contracts are either unenforceable or too complex, specific quasi-rents will be divided up according to the parties' ex post and not the ex ante terms of trade.

The ex-post division of rents between labor and capital is taken to be governed by continuous-time Nash bargaining. Labor therefore not only obtains at time t its opportunity costs w_t^o of participating in the production unit, but also a share $b \in (0,1)$ of the present value S of the unit's specific quasi-rents, s_{it}:

$$w_{it} = w_t^0 + b\, s_{it}\,. \tag{2}$$

The size of ß reflects the relative ex-post bargaining power of workers vis-à-vis entrepreneurs and financiers. These are taken together as capital and receive $(1-b)S$. The quasi-rents of production unit *i* are given by:

$$s_{it} = y_{it} - w_t^o\,. \tag{3}$$

The opportunity costs of labor w_t^o consist of a stock and a flow component. The latter is the level of unemployment benefits w^b, while the former is the present value of the increase in human wealth that an unemployed worker can expect to receive if he finds a new job which is given by $bE(S_t)$. The probability of reemployment is gross hiring H_t divided by total unemployment U_t. Hence:

$$w_t^o = \frac{H_t}{U_t} bE(S_t) + w^b\,. \tag{4}$$

Total unemployment is by definition equal to $U_t = 1 - N_t$, where N_t represents total employment at time t. This amount is given by adding up both, employment in firms which enjoy the good state and those which find themselves in the bad state of the world. The densities of the these two kinds of units are represented by $n_t^+(b,v)$ and $n_t^-(b,v)$ respectively. The total number of units at time t is therefore given by:

$$N_t = N_t^+ + N_t^- = \int_{-\bar{v}}^{+\bar{v}} \int_{-\infty}^{+\infty} n_t^+(b,v)\, db\, dv \;+\; \int_{-\bar{v}}^{+\bar{v}} \int_{-\infty}^{+\infty} n_t^-(b,v)\, db\, dv \quad . \tag{5}$$

Since one unit of production is by the assumption of a limitational production function restricted to using one unit of labor, the total number of firms is equal to aggregate employment. Production units are continuously created and destroyed. Creation of new firms takes place whenever the following two necessary conditions are satisfied: The unit must be profitable and it must obtain financing. Profits to be shared by the entrepreneur and the financier of unit *i* in period *t* are given by:

$$p_{it} = y_{it} - w_{it} = (1-b)s_{it}. \tag{6}$$

However, whether or not to create a new production unit depends not on one period profits, but rather on the total discounted value of future profits. As this value differs according to the current idiosyncratic state of the world, we define it to be either $\Pi_t^+(b_{it}, v_{it})$ or $\Pi_t^-(b_{it}, v_{it})$. We assume that parameter values are such that new firms are only created if this particular unit is currently in the good state of the world. Both discounted profit functions are decreasing in *b*, because a higher *b* increases the risk of privately inefficient liquidation, i.e., an in principle profitable production unit must be shut down in a situation of financial distress because financiers are not willing to inject additional liquidity into it. A unit is profitable if the expected present value of future profits is at least as large as the setup cost:

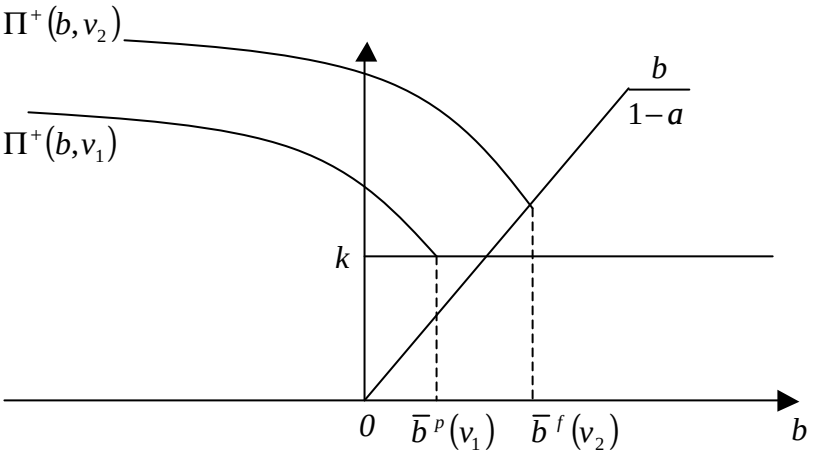
$$k \le \Pi_t^+(b,v). \tag{7}$$

New units furthermore need to be financed. The financial relationship is assumed to suffer from an equivalent problem as the employment relationship. The viability of the project depends on the cooperation of the entrepreneur, i.e., on his human capital. However, the entrepreneur cannot credibly precommit not to withdraw his participation ex post. He can always ex post threaten to stop working in which case the invested capital loses all its value as it is assumed to be fully sunk. Ex post Nash bargaining between the entrepreneur and the financier is assumed to lead to the ex-ante known result that the entrepreneur receives the share $a \in (0,1)$ of the present value of profits *?*, while the financier gets the remainder $(1-a)\Pi$. Even if the two parties, entrepreneur and financier, agree ex ante upon a set of larger payments to the financier, the entrepreneur will ex post, after the capital is sunk, always dispose over the bargaining power to renegotiate payments to the financier down to $(1-a)\Pi$ and he will in fact in any event do so. Hence, a new unit can at most incur the following amount of net uncollateralized liabilities:

$$b = k - c \le (1-a)\Pi_t^+(b, v_t). \tag{8}$$

The greater is the initial productivity v_i of unit *i*, that is about to be established, the more likely it is that the financing constraint is the one that is binding and vice versa. This can be seen immediately with the aid of figure 1, which assumes that $v_1 < v_2$, and which incorporates the aforementioned fact that $\Pi_t^+(b,v)$ is decreasing in *b*. Hence, $\bar{b}^p(v_1)$ is the maximum amount of net uncollateralized liabilities a new unit of initial specific productivity v_1 can sustain due to the profitability constraint, while $\bar{b}^f(v_2)$ is the respective amount for a new unit with initial specific productivity v_2 due to the financial constraint.

Figure 1: Financing versus profitability constraint in creation investment



Source: Caballero and Hammour (1999, 11).

Continuation investment is required whenever cash flows of an existing production unit are negative, which is assumed to be always the case in the bad state. Continuation investment again faces a profitability and a financial constraint. The profitability constraint simply states that the expected discounted value of all future profits must still be positive:

$$\Pi_t^-(b,v_t) > 0. \tag{9}$$

If the profitability constraint is no longer satisfied, privately efficient or "Schumpeterian" destruction of this very unit takes place. Whether this destruction is also socially efficient depends crucially on the ability of the economy to create new units and to thus reallocate the released production factors into new firms. Badly functioning labor and financial markets are important factors that can make privately efficient destruction of firms socially inefficient because they reduce the mobility of labor and they raise the contractual difficulties in

founding new firms. This raises the probability that the workers who are released from the destroyed unit are not reallocated to working in a new firm but rather remain trapped in unemployment.

The financial constraint for refinancing a distressed unit displays the important feature of a wedge between the option values to the entrepreneur and to the financier of refinancing a distressed firm. This option value to the entrepreneur of covering negative cash flow in the bad state of nature is in the absence of financing constraints, i.e., for $b \to -\infty$, obtained by solving the following Bellman equation for $\Pi_t^-(-\infty, v_t)$:

$$r\Pi_t^-(-\infty, v_t) = p_t^- + l[\Pi_t^+(-\infty, v_t) - \Pi_t^-(-\infty, v_t)]. \tag{10}$$

Hence this option is worth:

$$\Pi_t^-(-\infty, v_t) = \frac{p^-(v_t) + l\,\Pi_t^+(-\infty, v_t)}{r + l}. \tag{11}$$

However, due to the above argument, once the unit is back in the good state, the entrepreneur would always renegotiate the debt down to:

$$\bar{b}^f(v_t) = (1-a)\Pi_t^+[\bar{b}^f(v_t), v_t], \tag{12}$$

so that the financier's option value of injecting additional money into a financially distressed unit is no greater than:

$$\Pi_t^{-f}[\bar{b}^f(v_t), v_t] = \frac{p^-(v_t) + l(1-a)\Pi_t^+[\bar{b}^f(v_t), v_t]}{r + l}, \tag{13}$$

which is obviously smaller than the entrepreneur's option value of refinancing. This inability of the financier to capture the full set of rents that are associated with refinancing a distressed unit is the basic rationale for why liquidations take place although they are not only socially but also privately inefficient. Hence, the greater contractual difficulties are and the more indebted firms already are, the more likely it is that such inefficient liquidations occur.

Concerning the level of structural (quasi-equilibrium) unemployment, the model has the following implications.[22] For structural unemployment to occur, it is a necessary condition that the labor market is imperfect and that workers dispose over the market power to appropriate part of the rents which are created in production units. Factors contributing to such labor-market rigidities are high firing costs, strong unions, and generous unemployment

[22] For different parametric solutions of the model, see Caballero and Hammour (1999).

benefits. This rent component in wages, which is due to contracting impediments in the labor market, upsets the free-entry condition for new firms. It reduces the expected profitability of committing capital to new production units below the return required by capital markets. This disequilibrium situation is resolved by an increase in structural unemployment, which is induced by lower creation of new firms. The rise in structural unemployment and the decrease in hiring lead to higher unemployment duration U/H, thus lowering the opportunity costs of labor. This offsets rent appropriation by workers, and restores the rate of return required by the capital market for capital to enter into new joint production units or refinancing distressed firms. In this quasi-equilibrium with structural unemployment actual wages inclusive of the rent component can fall below the wage in the efficient market clearing reference situation. This possibility arises because creation incentives as well as the opportunity costs of labor are lower, and inefficient units can survive longer thus inducing sclerosis and reducing productivity growth. These effects occur because inefficient destruction lowers the opportunity costs of labor thus reducing the pressure on inefficient firms to close down.

If only the capital market is imperfect, though, there is no structural unemployment. This is the case because the lower degree of creation and the higher rate of inefficient, i.e., spurious destruction of firms due to capital-market imperfections, are fully and immediately absorbed by a falling compensation of labor under perfect labor markets. However, in case of imperfect labor markets and rent appropriation of workers, financial constraints further aggravate structural unemployment. The reduction in the steady-state demand for labor, that an imperfect capital market gives rise to via less creation and spurious destruction, is not fully and immediately absorbed by lower real wages if workers possess the ex-post bargaining power to appropriate capital. Hence, concerning the quasi-equilibrium level of structural unemployment, capital-market contraints exacerbate the effect of rigid labor market.

The degree to which the legal environment protects financiers from ex-post appropriation by workers and management therefore not only has an important influence on the capability of an economy to create new units, but also to avoid excessive and wasteful destruction of in fact profitable firms. This latter effect is in particular problematic as it not only directly reduces the steady-state demand for labor but also because it lowers productivity growth due to sclerosis effects. The hypothesis for the empirical analysis is therefore straightforward. It is conjectured that capital-market imperfections give rise to less employment and a higher level of structural unemployment in a cross-country panel analysis, even when controlling for the key institutional variables on the labor market. Measures of the degree to which capital

markets are imperfect are inter alia the effective legal protection of shareholders and creditors as well as the availability of venture capital.

IV. Empirical investigation

1. Data and stylized facts

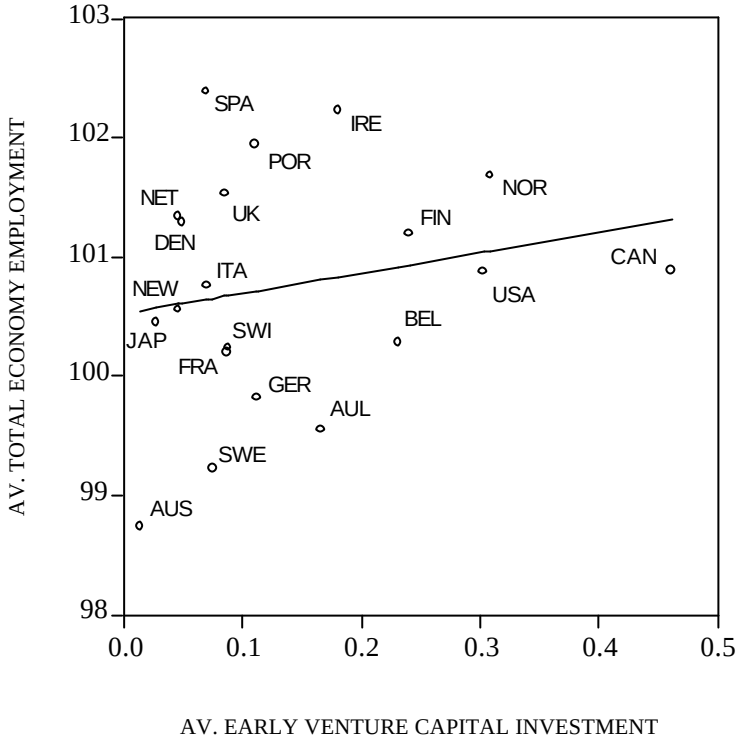
In order to test empirically for the conjectured impact of capital-market institutions and especially venture capital on labor-market performance, we employ a panel of twenty OECD countries, namely Austria (AUS), Belgium (BEL), Denmark (DEN), Finland (FIN), France (FRA), Germany (GER), Ireland (IRE), Italy (ITA), Netherlands (NET), Norway (NOR), Portugal (POR), Spain (SPA), Sweden (SWE), Switzerland (SWI), United Kingdom (UK), Canada (CAN), United States (USA), Japan (JAP), Australia (AUL), and New Zealand (NEW), using three kinds of data. Since our goal is to gain a comprehensive image, we enrich our analysis by referring to several indicators of both the labor and capital market stance and of capital- and labor-market institutions. First, we use two macroeconomic indicators on total economy unemployment and employment. Second, we introduce a standard set of institutional labor and product market variables. Third, and this is less standard, we complement our analysis by referring to selected venture capital time series and institutional capital market variables. The sample we use is based on annual data and ranges from 1986 to 1999. All relevant labor market and capital market variables are explained in Table 1.[23]

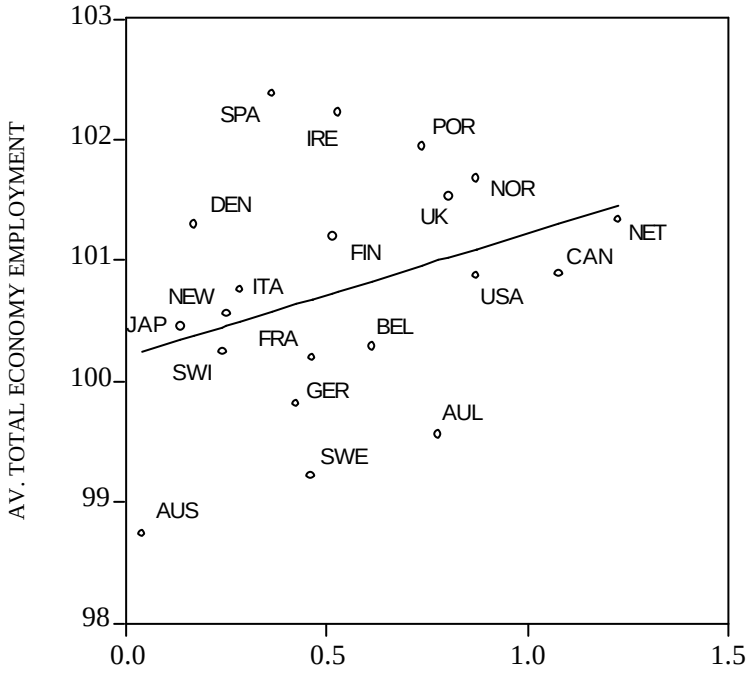
Table 1: Description of the labor market and capital market variables

In order to convey a broad brush view on the data set and some of the possible correlations two scatter plots are presented in Figure 2. It shows cross-plots of our measure for total economy employment against early stage venture capital investment (INVEARLY) and venture capital including expansion investment (VC). All variables are averaged over the period 1986 to 1999. In addition, we fit a tentative bivariate regression of employment on venture capital and a constant, which is represented by the straight line in each scatter plot. The least squares method, though, is very sensitive to the presence of even a few outlying observations. For this reason we carry out a form of weighted least squares where outlying observations are given less weight in estimating the regression coefficients (Cleveland, 1993).

[23] Like Blanchard and Wolfers (1999), we followed the principle of using as much variation in the institutional variables as possible in constructing our unbalanced panel data set. Taking logarithms of the time series under investigation did not change our regression results significantly. The corresponding results are available on request from the authors.

Figure 2: Employment performance and venture capital investment
(20 OECD countries, average 1986 – 1999)





As expressed by the regression lines, for each of the venture capital variables the conjectured *positive relationship* with respect to employment seems to exist. With the exception of the Netherlands, the position of each OECD economy in the employment/venture capital space seems to be independent of the chosen measure for venture capital. The Anglo-Saxon economies are typically located in the North-East of the scatter plots, i.e., they are characterized by a high average degree of venture capital investment and correspondingly high average employment. In contrast to this, corporatist countries like Austria, Sweden and Germany are typically located in the South-West (low venture capital investment and low employment). Notable exceptions are the Netherlands and the United Kingdom, both are characterized by comparably low early stage venture capital investment.

We start our formal empirical analysis with *tests of the non-stationarity* of the levels and the first differences of the labor-market variables under consideration, i.e., total economy employment and the unemployment rate.[24] The test we apply here is the first widely used panel data unit root test by Levin and Lin (1992).[25] This test represents a direct *extension of the univariate ADF test setting* to panel data. The results by Levin and Lin indicate that panel data is particularly useful for distinguishing between unit roots and highly persistent stationarity in macroeconomic data and that their unit root test for panel data is appropriate in panels of moderate size (between 10 and 250 cross-sections) as encountered in our study.

Table 2 displays the results of applying this unit root test to our labor-market data. As usual, we difference the data until it is stationary. In cases I to III, this leads us to use the *levels* of total economy employment and of the unemployment rate in our estimations. However, the test results from case IV (country-specific constants) reveal that the evidence on stationarity of the level of the unemployment rate is borderline. Moreover, non-stationarity of the level of employment cannot be rejected now due to the rather high (in absolute values) critical values of the test-statistics. It is therefore safer to use *both levels and changes* of our labor-market data.[26]

Table 2: Pattern of panel ADF-test statistics for labor-market variables

[24] The results of unit root tests for all the other time-variant variables investigated in this paper (see Table 1) are in principle also available on request. However, one should keep in mind that there might be serious problems for their correct empirical treatment because of the *artificial and constructed* character of these institutional variables. Hence, in cases of doubt about the order of integration we do not rely too much on the numerical results but stick to economic intuition when specifying our regression equations.

[25] This test was augmented by Levin and Lin (1993) and critically surveyed by Higgins and Zakrajsek (1999).

[26] A further argument for taking first differences pertains to the venture capital variables. Our unit root tests revealed some evidence of a non-stationary behavior of the levels of INVEARLY and VC. Thus, it is better to additionally rely on estimates based on first differences of the venture capital variables.

2. Pooled Estimation

2.1 Empirical Model

Based on our theoretical arguments, we conjecture that controlling for the key institutional variables on the labor market, venture capital improves labor-market performance in a cross-country panel analysis. To test for a significant relationship between venture capital and labor-market performance, we undertake first a pooled estimation, second a fixed effects estimation, and third we include institutional labor-, capital-, and goods-market variables in our pooled estimations. All estimations are undertaken both in levels and in differences and for early stage as well as for total venture capital investment.

We start with pooled estimations which assume *common coefficients* for the explanatory variables across all cross-section members of our pool.[27] We later on relax this assumption in the robustness section and estimate fixed effects models as well. We are aware of the fact that the literature sometimes additionally implements random effects models, mainly because implementing fixed effects models and country-dummies are costly in terms of lost degrees of freedom. However, we decided to dispense with such a kind of procedure in this paper. The main reason is that random effects would in our view only be appropriate if we believed that our sampled cross-sectional units were - deviating from our OECD country case - drawn from a large population. Moreover, there is no reason to assume the country-specific constants in the (un-) employment equations as random a priori according to our theory developed in chapters 2 and 3.

The empirical model we use can as usual be described as follows:[28]

$$y_{it} = a_i + x'_{it}\, b_i + e_{it}, \tag{14}$$

with y_{it} as the dependent (macroeconomic labor market) variable, x_{it} and β_i as k-vectors of non-constant regressors (e.g., venture capital) and parameters for i = 1,2, … ,N cross-sectional

[27] Due to the limited availability of venture capital data with a maximum of 14 annual observations country-specific regressions are not (yet) an option. It is furthermore interesting to test whether consistent and reasonable regression results hold with respect to the impact of of venture capital on labor markets if one ignores all cross-section specific features. By assuming common coefficients one essentially tests whether a common impact of venture capital on labor-market performance is valid *on average*. An empirical non-rejection of this view would point to a similar pattern of *endogeneity* of labor market developments with respect to factors *outside the labor market*. These aspects along with the obtained greater degrees of freedom motivated us to first do some *pooled estimations* taking twenty OECD countries as cross sectional identifiers.

[28] A dummy for German reunification is included throughout the regressions. Complementary regressions showed that the inclusion of a deterministic trend never changed the pattern of our results.

units and t = 1,2, … ,T as the periods for which each cross-section is observed. Imposing $\alpha_i = \alpha_j = \alpha$, a pooled analysis with common constants is nested in this specification.

In order to test for significance of the impact of venture capital on labor-market performance in OECD countries, we separate our analysis into *three logical steps*. To obtain a benchmark in the form of some prima facie evidence, we re-estimate the pioneering study by Wasmer and Weil (2000). However, we base our analysis on a larger sample and explicitly extend it to the impact of the availability of venture capital on employment. We furthermore noted that they conduct their analysis with *levels* of the unemployment rate as an endogenous lagged variable. In our view, such a kind of procedure is problematic at least due to two reasons. First, unemployment and employment time series might at least theoretically be plagued by non-stationarity problems (see section IV.1). However, this problem is less severe in light of the fact that the unemployment rate is bounded by one from above and by zero from below. Second, the well-known problem of *endogenous lagged variables* in the context of panel analyses (group effects) has to be taken into account. This is usually done in the literature in a way which as a first step presupposes taking first differences. This is a further reason why we conducted our analysis in levels *and* in first differences.

In principle, our panel data set can be used to test for *dynamic effects* as is done in Wasmer and Weil (2000). In order to grasp the speed of adjustment of labor markets, we always include lagged unemployment respectively employment variables in the set of regressors. The corresponding setting with respect to a representative regression equation for one cross-section out of the whole system (described by the index i) can be described as follows:

$$y_{it} = a_i + x'_{it}\, b_i + d y_{i,t-1} + e_{it} \qquad (15)$$

However, for estimating our first-order model substantial complications have to be taken into account. This is the case in both the fixed and in the random effects case and is due to the heterogeneity of the cross-sections analyzed (Greene, 2000, 582 ff.). The main problem to be treated here is the correlation of the lagged dependent variable (unemployment rate or level of employment) with the disturbance, even if the latter does not exhibit autocorrelation itself.

According to the general approach developed in the literature, taking first differences enables one to get rid of heterogeneity, i.e., the group effects, from the model. The problem of the correlation between the lagged dependent variable and the disturbance still remains. Moreover, a moving-average error term now appears in the specification. However, the

treatment of the resulting model now is a *standard application of the instrumental variables approach*. The transformed model looks as follows:

$$y_{it} - y_{i,t-1} = (x_{it} - x_{i,t-1})' b_i + d(y_{i,t-1} - y_{i,t-2}) + (e_{it} - e_{i,t-1}) \qquad (16)$$

Arellano (1989) and Greene (2000) for instance recommend using the differences $(y_{i,t-2} - y_{i,t-3})$ or the lagged levels $y_{i,t-2}$ *and* $y_{i,t-3}$ as instrumental variables for $(y_{i,t-1} - y_{i,t-2})$ in order to derive a simple instrumental variable estimator. The remaining variables can be taken as their own instruments. Arellano (1989) gives some theoretical and empirical support in favor of preferring levels to differences as instruments. As our second step of analysis, we therefore implement this procedure. As a third step, we conduct robustness tests by also including variables representing labor-, capital-, and goods market institutions.

2.2 Estimation procedure

Throughout the paper and following Wasmer and Weil (2000), we rely on FGLS estimates of a model assuming the presence of cross-sectional heteroscedasticity and autocorrelation but without correction for contemporaneous correlation.[29] Motivated by inspections of the country-specific residuals we include an AR error term in our specification which enables us to get rid of autocorrelation problems in the time dimension. Following Greene (2000, 605), we prefer to impose the restriction of a common autocorrelation coefficient across countries.

The *sample* has been chosen to be a maximum of 1986 to 1999 in order to exploit all available information. The structure for presenting the estimation results is the same throughout all tables with the exact specifications of the pooled estimation equations being described in the tables themselves. All specifications include an endogenous lagged labor-market variable, contemporaneous real GDP growth with or without its lagged value as cyclical control, one venture capital indicator (contemporaneous or lagged or both) and a constant (in cases where institutions do not replace the constant).[30] Note that the number of observations in each case depends on the variables included and on their lags. Following Wasmer and Weil (2000) the

[29] See Greene (2000, 592). One might argue that uncorrelatedness across our cross-sectional units (countries) is a too strong assumption because our model assigns the same parameter vector to all units in the common coefficients case, in which FGLS (SUR) estimates of a model with heteroscedasticity *and* cross-sectional correlation would be suitable. However, in view of the fact that correlations across sectors become relevant mainly in the case of *symmetric* shocks to the labor markets and the probability of the latter is small in our large OECD sample (see the debate on optimum currency areas), we refrain from considering this case and from applying SUR. An additional reason is comparability with the Wasmer and Weil (2000) study.

[30] The inclusion of a cyclical control variable can itself be interpreted as a first robustness test.

fit of each equation is checked by referring to the R-squared, the F-statistics and the Durbin-Watson time series test for autocorrelation of residuals.[31] Since the marginal significance level of the F-test of joint significance of all of the slope coefficients is in all cases clearly below one percent, the p-value is not explicitly tabulated by us throughout the tables. However, the degrees of freedom can be easily read of from the tables .[32]

2.3 Results

The results for our pooled regressions are given in Tables 3a to 4b, with Tables 3a and 3b (4a and 4b) denoting the estimated impact of venture capital on the *level (first differences)* of standardized unemployment rates and employment respectively. Hence, Tables 3a and 3b correspond to equation (15) for levels, while Tables 4a and 4b correspond to equation (16) for first differences. In all tables, the coefficient estimate (the values in brackets correspond to the empirical t-values), the R-squared and the empirical realization of the F-statistics are displayed for a given specification (specifications range from (1) to (12)). The bold numbers denote coefficient estimates of the venture capital variables which are significant at least at the ten percent level.

Table 3: FGLS estimates of a model in levels with cross-sectional heteroscedasticity and autocorrelation (20 OECD countries, common coefficients)[33]

a) Impact of venture capital investment on the unemployment rate (with cyclical control)

b) Impact of venture capital investment on employment (with cyclical control)

[31] However, some caveats with respect to the application of the DW-statistics have to be raised. The use of the DW is critical not only in cases of endogenous lagged variables, but its application in panels is also in general problematic. Our estimations showed that the DW changed its empirical realization depending on the ordering of the cross-section identifiers. However, as Wasmer and Weil (2000), we are unaware of other easily available tests for panels, and the DW indicates for our panel that we would in nearly all cases not be able to reject the null hypothesis of no autocorrelation.

[32] The numerator degrees of freedom can be calculated as the number of explaining variables less one and the denominator degrees of freedom corresponds to the numbers of observations minus the number of regressors.

[33] Dummy DUMGER (=0 for 1986 to 1990, =1 from 1991 to 1999) for reunification included; t-statistics in parentheses, common constants assumed. Early stage venture capital investment = startup and seed investment. Venture capital investment = startup, seed and expansion investment. */**/*** denotes significance at the 10/5/1 percent level.

Table 4: FGLS estimates of a model in differences with cross-sectional heteroscedasticity and autocorrelation (20 OECD countries, common coefficients)

a) Impact of the delivery of venture capital on the unemployment rate (with cyclical control)[34]

b) Impact of the delivery of venture capital on employment (with cyclical control)[35]

According to the realization of the selected weighted statistics, the hypothesis of an incorrect specification has to be rejected. There appears a bulk of significant estimates of the impact of venture capital on the labor market, all with the theoretically expected sign. As a first step, it appears to be useful to take a look at the empirical realizations of the t-values for the venture capital coefficient estimates. In Tables 3a and 3b, we find a total of 21 out of potential 32 significant relationships with t-values up to 3.64 in the case of specification (9) in Table 4b. In Tables 4a and 4b, we are still able to identify 13 significant relationships. Thus, evidence in favor of our main hypothesis is to a certain extent weaker in the case of first differences than in the cases of levels. Second, a certain clustering of significant results with the expected sign can above all be observed within Tables 3b and 4b, i.e., the significance of our measures for venture capital is *more pronounced in the employment equations* than in the unemployment equations.

Concerning the significance of *lagged versus contemporaneous* impacts, in the case of estimates in levels the early investment variable (INVEARLY) is more significant if it is lagged whereas the more comprehensive measure VC reaches the highest t-values if it is specified contemporaneously. However, the corresponding pattern of results is less clear in our estimations in first differences (Tables 4a and 4b).[36] Early investment now enters contemporaneously while the VC variable is more significant if it is lagged. The existence of a time-to-build period between investment and an improvement of the labor market stance, as proposed by Wasmer and Weil (2000), is therefore not supported unambiguously by our

[34] Dummy DUMGER (=0 for 1986 to 1990, =1 from 1991 to 1999) for reunification included; t-statistics in parentheses, common constants assumed. Early stage venture capital investment = startup and seed investment. Venture capital investment = startup, seed and expansion investment. */**/*** denotes significance at the 10/5/1 percent level. The term $\left(y_{i,t-1} - y_{i,t-2}\right)$ in eq. (16) is instrumented by the change in the unemployment rate lagged two periods.

[35] Dummy DUMGER (=0 for 1986 to 1990, =1 from 1991 to 1999) for reunification included; t-statistics in parentheses, common constants assumed. */**/*** denotes significance at the 10/5/1 percent level. The term $\left(y_{i,t-1} - y_{i,t-2}\right)$ in eq. (16) is instrumented by the level of employment lagged two periods and the level of employment lagged three periods.

[36] Note that our estimations in first differences are still characterized by relatively large R-squareds.

results. In sum, Tables 3a to 4b yield *prima facie empirical support* for our hypothesis that venture capital improves labor-market performance.

3. Are the pooled estimation results robust?

In order to avoid an omitted-variable bias we conduct several tests for robustness, each considering different aspects and including additional explaining variables. Note that our specifications in Tables 3a to 4b already contained an implicit robustness test since real GDP growth was included in the set of regressors.

3.1 Fixed effects estimation

First, we give up the assumption of common coefficients and turn to estimations of exactly the same specifications as in Tables 3a to 4b, but this time assuming *different intercepts* for the individual OECD economies. In other words, we use *alternative specifications of the constant* in the pooled regression estimation. By this, we dispense with our initial assumption of identical intercepts for all pool members. Here we consider a case of fixed effects, i.e., specific (and possibly different) intercepts for each OECD country as a pool member. Tables 5a to 6b display the corresponding estimation results:

Table 5: FGLS estimates of a model in levels with cross-sectional heteroscedasticity and autocorrelation (20 OECD countries, cross-section specific constants)[37]

a) Impact of venture capital investment on the unemployment rate (with cyclical control)

b) Impact of venture capital investment on employment (with cyclical control)

The pattern of the results in Tables 5a and 5b for the levels of unemployment and employment resembles closely those in Tables 3a and 3b. However, coefficient estimates come out to be a bit smaller in magnitude and sometimes less significant than under the assumption of common coefficients. Tables 6a and 6b display the corresponding estimation results for our first difference specifications:

[37] Dummy DUMGER (=0 for 1986 to 1990, =1 from 1991 to 1999) for reunification included; t-statistics in parentheses, common constants assumed. Early stage venture capital investment = startup and seed investment. Venture capital investment = startup, seed and expansion investment. Cross-section specific constants assumed (fixed-effects model). */**/*** denotes significance at the 10/5/1 percent level.

Table 6: FGLS estimates of a model in differences with cross-sectional heteroscedasticity and autocorrelation (20 OECD countries, cross-section specific constants)

a) Impact of the delivery of venture capital on the unemployment rate (with cyclical control)[38]

b) Impact of the delivery of venture capital on the level of employment (with cyclical control)[39]

With respect to changes in the unemployment rate, now 9 instead of 4 entries (Table 6a versus 4a) in the venture capital table rows are significant with the expected sign. At the same time, the magnitude of the estimated venture capital coefficients increases slightly. In contrast to this, the number of significant entries with the correct sign falls from 9 to 5 for the specifications for the first differences of employment (Table 6b versus 4b). Correspondingly, the magnitude of the estimated investment coefficient decreases in most cases. Overall, the VC variable seems to be more significant than the INVEARLY variable.

3.2 Including other institutional variables

As a second and most important robustness test for the impact of venture capital on labor-market performance across countries, we now include institutional labor-, capital-, and goods-market variables.[40] Like, e.g., Blanchard and Wolfers (1999) and Nickell (1997), we include these variables separately (not displayed here, available on request) and jointly. Our main intention is to investigate whether the detected impact of venture capital on labor-market performance is robust to including a large set of standard institutional variables and whether it changes the impact of the traditional labor-market variables on labor-market performance.

[38] Dummy DUMGER (=0 for 1986 to 1990, =1 from 1991 to 1999) for reunification included; t-statistics in parentheses. Early stage venture capital investment = startup and seed investment. Venture capital investment = startup, seed and expansion investment. Cross-section specific constants assumed (fixed-effects model). Instruments rely on the same specification as in Table 4a. */**/*** denotes significance at the 10/5/1 percent level.

[39] Dummy DUMGER (=0 for 1986 to 1990, =1 from 1991 to 1999) for reunification included; t-statistics in parentheses; cross-section specific constants assumed (fixed-effects model). The term $\left(y_{i,t-1} - y_{i,t-2}\right)$ in eq. (16) is instrumented by the change in employment lagged two periods. */**/*** denotes significance at the 10/5/1 percent level.

[40] As a further robustness test, we tested for robustness with respect to a *change in the membership of the pool, i.e.,* we confined ourselves to those thirteen EU countries included in our OECD sample. The large share of theoretically correct signs of the coefficient estimates of the venture capital impact on the labor market was again striking. Hence, the effect identified in this paper appears to be robust with respect to the selected OECD subsample. Corresponding estimates for the models in first differences (along the lines of Tables 4a and 4b) led to rather similar results. The results are available on request.

The following Tables 7 to 10 display estimation results based on empirical models which have been selected from Tables 3 and 4 and have been augmented by all indicators of capital-, labor-, and goods-market institutions listed in Table 1. Our tabulated preferred specifications result from a general-to-specific testing-down procedure by means of sequential tests for significance of individual or of a group of regressors. The realizations of the R-squared is tabulated as well. The models have been simplified in the usual stepwise fashion by eliminating insignificant variables or variable groups until a parsimonious adaption to the data generating process was reached. The lag number of lagged endogenous variables (one or more) is determined by this procedure as well.

The tables include the coefficient estimates for the selected venture capital variable (the empirical t-value of the coefficient estimate of this variable being the selection criterion), the cyclical control variable and (some of) the additional institutional variables from Table 1 together with the respective realizations of the t-statistics and the corresponding measures of the fit for each of the robustness test specifications. In our preferred specifications for the first differences of the labor-market variables, we do not always include a constant. In this respect, we closely follow the specification proposed by the transformation in eq. (16). In economic terms, we allow the institutional variables to substitute the constant in cases where at least one institutional variable is time-invariant.[41]

We start with displaying the estimations for levels of the unemployment rate (Table 7) and employment (Table 8) to be followed by estimations of selected models in first differences for the same variables (Tables 9 and 10). In each case, we consider a model without any venture capital variable (a), another model with the best fitting early investment variable (b), and finally a model with the best fitting overall venture capital investment variable (c). Our preferred specifications are:

- specifications (2) and (7) in Table 3a for the level of the unemployment rate (Table 7),
- specifications (2) and (7) in Table 3b for the level of employment (Table 8),
- specifications (1) and (7) in Table 4a for the difference of the unemployment rate (Table 9), and

[41] The constant or the coefficient of the institutional variables in our (un-) employment equations determine the level of equilibrium (un-)employment). Another point is worthwhile to be mentioned here. Our institutional variables for the replacement rate (RRATE, RR1 and RR25) might appear to be highly correlated at first glance. However, as Table 1 shows RRATE is much less variable over time than RR1 and RR25. In addition, RR1 and RR25 differ strongly with respect to the time span they relate to.

- specifications (1) and (8) in Table 4b for the difference of employment (Table 10).

Table 7: FGLS estimates of a pooled model for the level of unemployment augmented by indicators of the capital, labor and product market setting[42]

With respect to the models for the level of the unemployment rate (Tables 7a to 7c), a certain set of the additional institutional variables remains significant after passing the general-to-specific procedure. In the absence of any venture capital variable (Table 7a), the benefit duration, the employer coordination index, the employment protection index, the tax wedge, and union density (as institutional labor market variables) as well as the variables for shareholder and creditor rights turn out to be significant in most cases at the one percent significance level, the tax wedge being the only exception (significant at the five percent level). Moreover, the corresponding coefficient estimates display the right sign except for the shareholder rights indicator. If venture capital investment is added (Tables 7b and 7c), the results become even more pronounced. Even the tax wedge is now significant at the one percent level with the correct sign. If the more comprehensive venture capital measure VC is implemented (Table 7c), the index of shareholder rights is replaced by the barrier to entrepreneurship variable. However, the coefficient estimate for the latter variable reveals the theoretically wrong sign. It is interesting to note that active labor market programs and the replacement ratio (although three variants of the latter have been tested) are insignificant throughout the specifications in Tables 7a to 7c.[43] Finally and most important in our context, the venture capital variables remain highly significant. Let us now turn to the results for the level of employment:

Table 8: FGLS estimates of a pooled model for the level of employment augmented by indicators of the capital, labor and product market setting[44]

With respect to the models for the level of employment (Tables 8a to 8c) and compared with Tables 7a to 7c, a somewhat different set of institutional variables turns out to be significant. In the absence of any venture capital variable (Table 8a), the replacement rate (two variants), the overall coordination index, the employment protection index (as institutional labor market variables) are now significant. The employment protection index according to Blanchard and Wolfers (1999) which is highly variable over time now replaces the less time variant Layard

[42] t-statistics in parentheses, */**/*** denotes significance at the 10/5/1 percent level.
[43] In fact, active labor market programs are insignificant throughout all our specifications.
[44] t-statistics in parentheses, */**/*** denotes significance at the 10/5/1 percent level.

and Nickell employment protection index. Again, the corresponding coefficient estimates display the right sign except for the indicators for shareholder rights, employer coordination, and the Blanchard and Wolfers (1999) replacement rate RR1. If venture capital investment is added (Tables 8b and 8c), the results remain more or less the same. If the less comprehensive venture capital measure INVEARLY is implemented (Table 8b), an additional version of the replacement rate (RR25) is included. However, the coefficient estimate for the latter variable reveals the theoretically wrong sign. Moreover, the coordination variables and the employment protection index barely miss significance at the ten percent level but still are jointly significant (corresponding F-tests are available on request). Creditor rights are the only capital-market institution which displays significance and the correct sign throughout Tables 8a to 8c. Finally, our venture capital variables again turn out to be highly significant, this time even at the one percent level. We now turn to our final specifications in differences:

Table 9: FGLS estimates of a pooled model for the first difference of unemployment augmented by indicators of the capital, labor and product market setting[45]

With respect to the models for the *changes in the unemployment rate* (Tables 9a to 9c), the set of significant additional institutional variables can be characterized as follows. In the absence of any venture capital variable (Table 9a), two versions of the replacement rate, the benefit duration, the Blanchard and Wolfers employment protection index, union density (as institutional labor market variables) and the creditor rights variable turn out to be significant in most cases at the one or five percent significance level. The Layard and Nickell replacement rate is the only exception (significance at the ten percent level slightly missed but jointly significant with the other variables[46]). Moreover, the corresponding coefficient estimates display the right sign except for the Blanchard and Wolfers replacement rate. If the change in venture capital investment is added (Tables 9b and 9c), the pattern of the results is the same as before. Most important in our context, the venture capital variable VC in contrast to the less comprehensive measure INVEARLY turns out to be significant at the five percent level. Finally, we interpret the results gained for the first differences of employment:

[45] t-statistics in parentheses, */**/*** denotes significance at the 10/5/1 percent level.
[46] Note also that econometric theory in such a case recommends to implement a regressor if its t-value realization is still above one (minus one).

Table 10: FGLS estimates of a pooled model for the first difference of employment augmented by indicators of the capital, labor and product market setting[47]

In the panel regressions for the changes in employment (Tables 10a to 10c), the largest set of additional institutional variables becomes significant after passing the general-to-specific procedure. In the absence of any venture capital variable (Table 10a), both Blanchard and Wolfers replacement rates, the benefit duration, the union coverage index (which has not appeared in any table up to now), the employer coordination index, the Blanchard and Wolfers employment protection index, the product market regulation index and the variables for shareholder *and* creditor rights turn out to be significant in most cases at the one percent significance level. Moreover, the corresponding coefficient estimates display the expected sign except for the replacement rate, the employer coordination index, and the goods-market regulation indicator. This time, even the indicator for shareholder rights displays the correct sign. If venture capital investment is added (Tables 10b and 10c), the results stay as pronounced as before. If the more comprehensive venture capital measure VC is implemented (Table 9c), the tax wedge is now significant at the ten percent level with the correct sign. As in nearly all models in Tables 8 to 10 before, the venture capital variables again turn out to be highly significant.[48] To sum up, based on our empirical evidence we can clearly reject the null hypothesis that the early investment venture capital variable and the standard venture capital variable including expansion investment do not improve labor-market performance.

In order to quantify the positive effects of venture capital on labor-market performance, it is useful to calculate the short-run and the long-run impact of a *permanent positive one standard deviation shock* in our two venture capital variables on OECD labor markets.[49] Starting from the realization of our venture capital time series in the year 1999, a one standard deviation shock in the availability of venture capital means an increase of the VC variable by 0.35 percent and an increase of the INVEARLY variable by 0.38 percent. For, e.g., Germany such a shock would imply an increase of seed, startup and expansion investment by 0.46 per mil of GDP and an increase of seed and startup investment by 0.17 per mil of GDP. Based on our panel estimations, Table 11 shows that such an increase in the availability of venture capital

[47] t-statistics in parentheses, */**/*** denotes significance at the 10/5/1 percent level.
[48] An implication of our results with respect to the dynamic behavior of the labor market should also be noted. Since regression equations in Tables 9 and 10 are specified in first differences, significant institutional variables explain in principle the increase respectively decrease of our labor market series over time whereas in Tables 7 and 8 institutional variables in a strict sense contribute to explaining the level of equilibrium (un-)employment.
[49] The long-run equilibrium effect is calculated by dividing the short-run impact effect by one minus the coefficients of the lagged endogenous variables.

reduces the unemployment rate in the short run by 0.14 percentage points and in the long run by 1.13 percentage points. Columns 2 and 3 display the analogous positive impact on employment.

Table 11: Dynamic labor-market impacts of venture capital investment

If labor supply were constant, the short-term and the long-term coefficients for unemployment and employment should be approximately equal in absolute value and of opposite sign. However, this is definitely not valid in our example. On the one hand, the impact coefficient for unemployment is relatively smaller than that for employment, with non-overlapping bounds if one uses the usual standard error limit. On the other hand the long-term impact of venture capital on employment seems to be actually greater than the one on unemployment. This suggests that labor supply itself might be affected by the availability of venture capital in the short term, i.e., increasing when availability goes up, which would be consistent with our general approach considering that the decision to enter the labor market involves sunk costs.

V. Conclusions

Aggregate unemployment results from insufficient job creation and excessive job destruction. Both are inherently linked to investments and to the founding of new firms and thus to the functioning of capital markets. Institutional structures on capital markets which help to alleviate financial constraints in entrepreneurial decision-making should therefore boost employment. The great variance in venture capital markets across OECD-countries and the fact that continental Europe lags behind in this respect compared to the Anglo-Saxon countries indicates that capital-market imperfections might help standard labor-market variables in explaining differences in labor-market performances across countries. It is by now well established that flexible labor markets improve aggregate employment performance. However, by leaving out capital-market variables, past empirical results might have missed other important institutional factors and might have overstated the impact and significance of some of the labor-market variables due to an omitted variable bias.

Our empirical analysis based on panel data for 20 OECD countries from 1986 to 1999 confirms this conjecture. Both, overall venture capital investments and early stage venture capital investments in relation to GDP improve significantly labor-market performance. These effects are present in a wide array of different econometric specifications and they are in

particular still prevalent when standard institutional variables describing labor-, capital-, and goods-market regulations are included in the panel regressions.

Our results with respect to certain controversial labor-market variables are worth noting. First, active labor market policies are insignificant throughout our specifications. Hence, our results shed some doubt on the view that active labor market policies are a panacea in fighting unemployment. Second, there has been some controversy in recent years over how employment protection affects the situation on the labor market. Our results are clear-cut in this respect, employment protection raises unemployment and hampers employment throughout our specifications. Third, it is often argued that coordination and thus centralization of wage bargaining is good for labor-market performance when controlling for union strength. Our results are ambiguous in this respect. In those cases where they are significant, our coordination variables exercise a negative impact upon both, unemployment and employment. Hence, coordinating wage bargaining is not necessarily a good idea for achieving higher employment but might have helped in the past to keep official unemployment rates low.

Concerning recommendations for economic policy, our results suggest the following. Structural reforms of labor markets, especially concerning unemployment benefit systems and employment protection legislation should stay up high on the political agenda in continental Europe. However, the positive effect upon employment growth will be greater if such labor-market reforms are accompanied by improvements of the institutional set-up on capital markets, in particular concerning venture capital. Venture capital markets have grown substantially in continental Europe in recent years partially due to the improved possibilities for initial public offerings. While this should help to foster employment growth in the upcoming years, there is still considerable scope for institutional improvements. Jeng and Wells (2000) find that pension funds and flexible labor markets themselves are two other important institutional prerequisites for well-functioning venture capital markets. Hence, moving from a pay-as-you-go to a more funded pension system with real pension funds might help in further developing venture capital markets. Making labor markets more flexible is also conducive to fighting unemployment indirectly via boosting venture capital markets. Yet, politico-economic considerations suggest that the institutional structures on both markets are linked by politico-economic forces (Fehn and Meier, 2000). Hence, only comprehensive reforms exploiting such politico-economic complementarities are likely to succeed.

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Table 1: Description of the labor market and capital market variables

Macroeconomic time series	
Unemployment rate (UNEMP)	OECD standardized unemployment rate. Source: OECD Main Economic Indicators.
Total employment (EMP)	Civilian or (if not available) total economy employment (employees and self employed, index with base year 1995). Source: OECD Main Economic Indicators.
Institutional labor market variables	
Benefit replacement ratio (RRATE)	Share of income replaced by unemployment benefits. Source: Layard and Nickell (1997), p. 12, Table 6, and complementary data delivered by S. Nickell. Only two realizations per country (for 1986-89 and 1989-99).
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 realizations per country (for 1986-89, 1990-94 and 1995-99). Indicator displays more variability than RRATE.
Benefit replacement ratio (RR25)	Average replacement rate over the ensuing four years of an unemployment spell. Source: Blanchard and Wolfers (1999), pp. 11 ff. and data appendix. Three realizations 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.
Active labor market programs (ALMPHAT)	Current active labor market spending as % of GDP divided by current unemployment, instrumented. Expenditure on the disabled excluded. Source: Layard and Nickell (1997), p. 12, Tables 6 and 15, and complementary data delivered by S. Nickell.
Union coverage index (UNION)	Index, 3 = over 70% covered, 2 = 25-70 % covered, 3 = under 25% covered. Source: Layard and Nickell (1997), Table 3, 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.
Employer coordination index (EMCORD)	Employer co-ordination in wage bargaining. Source: Layard and Nickell (1997), Table 3, and complementary data delivered by S. Nickell.
Coordination index (COORD)	Average of UNCORD and EMCORD. Source: Layard and Nickell (1997), Table 3, complementary data delivered by S. Nickell and Blanchard and Wolfers (1999), pp. 11 ff.
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.
Employment protection index (NEWEP)	Index ranging from 0 to 6. The higher the index, the higher employment protection. Source: Blanchard and Wolfers (1999), data appendix, augmenting the Lazear (1990) data.

Tax wedge (TAXWEDGE))	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.
Union density (UDEN)	Trade union members as a percentage of all wage / salary earners. Source: Layard and Nickell (1997), p. 7, Table 3, and complementary data delivered by S. Nickell.
Institutional product market variable	
Barriers to entrepreneurship (PRODREG)	Summary indicator for administrative burdens on startups, regulatory and administrative opacity and barriers to competition. Country score range from 0 to 6, the higher the score, the higher the regulatory barriers. Source: Nicoletti, Scarpetta, Boylaud (1999), Table A3.2
Venture capital investment time series	
Venture capital investment (VC)	Seed, startup and expansion (both government and private sector funded) as per mil of average GDP. Source: Own calculations based on 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: Own calculations based on 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	
Shareholder rights (SHARERIGHT)	Antidirector rights. Index of the legal system's protection of minority shareholders against managers and dominant shareholders. It includes regulations on voting rights attached to shares, rights that support the voting mechanism against interference by insiders and rights to call extraordinary shareholder's meetings. Range: 0 to 5, 5 is the highest level of investor protection. Source: La Porta et al. (1999b), Table II.
Creditor rights (CREDITRIGHT)	Index of the legal system's 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.

Table 2: Pattern of panel ADF-test statistics for labor-market variables

Variable	*t-value (no lagged differences)*	*t-value (one lagged difference)*	*t-value (two lagged differences)*
	I) ADF-test statistic (no constant, no trend)		
EMP	+7.03	+3.16	+3.12
UNEMP	-2.49***	-2.91***	-1.74**
D(EMP)	-6.71***	-6.78***	-6.13***
D(UNEMP)	-7.39***	-10.20***	-9.05***
	II) ADF-test statistic (common constant, no trend)		
EMP	-3.33***	-4.71***	-4.81***
UNEMP	-3.57***	-5.06***	-3.65***
D(EMP)	-7.66***	-7.72***	-7.04***
D(UNEMP)	-7.39***	-10.18***	-9.04***
	III) ADF-test statistic (common constant and trend)		
EMP	-4.50***	-5.95***	-6.27***
UNEMP	-3.38***	-4.78***	-3.34***
D(EMP)	-7.84***	-7.93***	-7.40***
D(UNEMP)	-7.62***	-10.73***	-9.91***
	IV) ADF-test statistic (individual-specific constant and trend)		
EMP	-0.67	-3.82	-3.05
UNEMP	-3.73	-9.31***	-6.70
D(EMP)	-8.13***	-8.73***	-8.44***
D(UNEMP)	-7.33**	-9.42***	-8.57***

Note: the t-value is the realization of the usual ADF-test statistic; */**/*** denotes significance of the lagged endogenous variable; the sample range is 1986-1999 with adjustments if necessary due to the lag structure.

Ad I) test equations correspond to model 1 in Levin and Lin (1992). The relevant critical values are -1.39/-1.76/-2.45 (Levin and Lin (1992), Table 1, p. 45 (for N=20 cross-sections and t=10 periods).

Ad II) test equations correspond to model 2 in Levin and Lin (1992). The relevant critical values are -1.57/-1.94/-2.64 (Levin and Lin (1992), Table 2, p. 46 (for N=20 cross-sections and t=10 periods).

Ad III) test equations correspond to model 3 in Levin and Lin (1992). The relevant critical values are -1.75/-2.13/-2.85 (Levin and Lin (1992), Table 3, p. 47 (for N=20 cross-sections and t=10 periods).

Ad IV) test equations correspond to model 5 in Levin and Lin (1992). The relevant critical values are -6.82/-7.06/-7.51 (Levin and Lin (1992), Table 5, p. 49 (for N=20 cross-sections and t=10 periods).

Table 3: FGLS estimates of a model in levels with cross-sectional heteroscedasticity and autocorrelation (20 OECD countries, common coefficients)

a) Impact of venture capital investment on the unemployment rate (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Unemployment rate (-1)	0.95 (37.44)	0.96 (42.58)	0.96 (42.61)	0.92 (31.68)	0.93 (34.72)	0.93 (32.50)	0.95 (36.41)	0.96 (40.11)	0.96 (40.76))	0.92 (31.17)	0.93 (33.73)	0.93 (32.87)
Real GDP growth rate	-0.24 (-9.73)	-0.24 (-9.85)	-0.23 (-9.73)	-0.24 (-10.34)	-0.24 (-10.55)	-0.24 (-10.30)	-0.24 (-9.67))	-0.24 (-9.90)	-0.23 (-9.68))	-0.24 (-10.33)	-0.24 (-10.73)	-0.24 (-10.24)
Real GDP growth rate (-1)	/	/	/	-0.20 (-8.89)	-0.20 (-8.62)	-0.20 (-8.49)	/	/	/	-0.20 (-8.71)	-0.20 (-8.85)	-0.19 (-8.21)
Early stage venture capital investment	**-0.48** **(-2.40)**	/	-0.08 (-0.29)	-0.24 (-1.49)	/	**-0.33*** **(-1.60)**	/	/	/	/	/	/
Early stage venture capital investment (-1)	/	**-1.01***** **(-2.80)**	**-0.91*** **(-1.88)**	/	-0.19 (-0.60)	0.26 (0.65)	/	/	/	/	/	/
Venture capital investment	/	/	/	/	/	/	**-0.24***** **(-2.82)**	/	**-0.25***** **(-2.62)**	**-0.12*** **(-1.73)**	/	**-0.12*** **(-1.56)**
Venture capital investment (-1)	/	/	/	/	/	/	/	**-0.22*** **(-1.67)**	0.00 (0.00)	/	-0.06 (-0.50)	0.04 (0.34)
Constant	0.47 (1.99)	0.40 (1.81)	0.37 (1.67)	1.33 (4.70)	1.23 (4.56)	1.21 (4.26)	0.56 (2.27)	0.46 (1.93)	0.44 (1.87)	1.38 (4.78)	1.27 (4.51)	1.23 (4.23)
Weighted statistics												
R^2	0.98	0.98	0.98	0.99	0.99	0.99	0.98	0.98	0.98	0.99	0.99	0.99
F-statistics	2155.4	2230.679	1775.742	2389.399	2227.008	1984.933	2164.209	2067.793	1704.577	2390.667	2258.914	1913.595
Durbin-Watson	1.84	1.83	1.93	1.87	1.82	1.80	1.82	1.83	1.82	1.87	1.82	1.81
Total panel observations	207	205	202	194	192	189	207	205	202	194	192	189

b) Impact of venture capital investment on employment (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employment (-1)	0.88 (14.81)	0.89 (15.97)	0.90 (16.40)	0.89 (2.79)	0.91 (26.62)	0.91 (23.67)	0.88 (11.46)	0.88 (12.84)	0.85 (11.41)	0.89 (23.92)	0.91 (24.39)	0.89 (2.31)
Real GDP growth rate	0.27 (7.18)	0.26 (15.97)	0.27 (7.55)	0.36 (9.59)	0.36 (9.72)	0.35 (9.20)	0.26 (6.94)	0.25 (6.93)	0.25 (6.82)	0.37 (9.86)	0.36 (9.58)	0.34 (8.95)
Real GDP growth rate (-1)	/	/	/	0.35 (9.29)	0.32 (8.46)	0.32 (8.22)	/	/	/	0.34 (9.34)	0.33 (8.63)	0.31 (8.16)
Early stage venture capital investment	**1.09***** **(3.10)**	/	0.02 (0.04)	**0.68**** **(2.30)**	/	0.51 (1.38)	/	/	/	/	/	/
Early stage venture capital investment (-1)	/	**2.77***** **(3.87)**	**2.76***** **(3.12)**	/	**1.13*** **(1.86)**	0.59 (0.76)	/	/	/	/	/	/
Venture capital investment	/	/	/	/	/	/	**0.56***** **(3.51)**	/	**0.47***** **(2.78)**	**0.39***** **(2.78)**	/	**0.37**** **(2.41)**
Venture capital investment (-1)	/	/	/	/	/	/	/	**0.78***** **(2.91)**	**0.60**** **(2.11)**	/	**0.39*** **(1.64)**	0.28 (1.06)
Constant	12.62 (2.10)	11.54 (2.04))	10.96 (1.99)	9.85 (2.79)	8.16 (2.38)	8.68 (2.26)	12.37 (1.58)	13.00 (1.85)	15.76 (2.08)	10.15 (2.72)	8.78 (2.37)	10.19 (2.31)
Weighted statistics												
R^2	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999	0.999
F-statistics	94951.83	138415.3	115359	166187	162894	136788.8	96402.12	111440.6	91469.66	204039.7	143270.4	147085.4
Durbin-Watson	1.97	2.01	2.05	1.98	2.06	2.03	1.93	2.04	2.03	1.99	2.05	2.04
Total panel observations	216	214	211	202	200	197	216	214	211	202	200	197

Table 4: FGLS estimates of a model in differences with cross-sectional heteroscedasticity and autocorrelation (20 OECD countries, common coefficients)

a) Impact of the delivery of venture capital on the unemployment rate (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Instrument for the change in the unemployment rate (-1)	-0.13 (-1.81)	-0.15 (-2.09)	-0.14 (-2.03)	-0.10 (-1.87)	-0.11 (-2.06)	-0.11 (-2.06)	-0.14 (-2.03)	-0.14 (-2.03)	-0.15 (-2.21)	-0.10 (-1.93)	-0.11 (-2.07)	-0.11 (-2.13)
Real GDP growth rate	-0.27 (-10.73)	-0.26 (-10.74)	-0.26 (-10.29)	-0.24 (-10.24)	-0.24 (-10.04)	-0.24 (-9.82)	-0.26 (-10.98)	-0.27 (-10.90)	-0.26 (-10.87)	-0.24 (-10.07)	-0.24 (-10.16)	-0.24 (-9.84)
Real GDP growth rate (-1)	/	/	/	-0.20 (-8.77)	-0.20 (-8.66)	-0.20 (-8.32)	/	/	/	-0.20 (-8.52)	-0.20 -8.60)	-0.19 (-7.88)
Change in early stage venture capital investment	-0.36 (-1.39)	/	**-0.46* (-1.72)**	-0.23 (-1.10)	/	-0.17 (-0.83)	/	/	/	/	/	/
Change in early stage venture capital investment (-1)	/	-0.29 (-0.73)	-0.37 (-0.97)	/	-0.05 (-0.13)	-0.06 (-0.18)	/	/	/	/	/	/
Change in venture capital investment	/	/	/	/	/	/	**-0.26*** (-2.62)**	/	**-0.37*** (-3.40)**	-0.07 (-0.89)	/	-0.09 (-1.03)
Change in venture capital investment (-1)	/	/	/	/	/	/	/	-0.16 (-1.20)	**-0.30** (-2.35)**	/	-0.04 (-0.41)	-0.08 (-0.72)
Constant	0.54 5.38)	0.55 (5.49)	0.57 (5.59)	0.94 (9.29)	0.93 (8.90)	0.95 (9.02)	0.55 (5.55)	0.56 (5.67)	0.60 (6.15)	0.92 (9.16)	0.93 (8.92)	0.94 (8.99)
Weighted statistics												
R^2	0.63	0.63	0.63	0.73	0.72	0.72	0.65	0.63	0.66	0.72	0.72	0.71
F-statistics	58.30	57.10	46.27	74.38	69.05	58.72	63.40	57.23	51.85	72.51	68.72	57.29
Durbin-Watson	1.83	1.82	1.84	1.85	1.89	1.87	1.84	1.81	1.78	1.86	1.89	1.86
Total panel observations	174	172	169	173	171	168	174	172	169	173	171	168

b) Impact of the delivery of venture capital on employment (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Instrument for the change in employment (-1)	-0.14 (-2.23)	-0.16 (-2.67)	-0.13 (-2.10)	-0.12 (-2.72)	-0.12 (-2.64)	-0.12 (-2.63)	-0.14 (-2.33)	-0.16 (-2.76)	-0.14 (-2.44)	-0.13 (-2.79)	-0.12 (-2.64)	-0.12 (-2.54)
Real GDP growth rate	0.34 (7.71)	0.38 (8.53)	0.34 (7.55)	0.38 (9.50)	0.40 (10.13)	0.39 (9.57)	0.34 (7.76)	0.40 (8.90)	0.34 (7.71)	0.38 (9.57)	0.39 (10.03)	0.38 (9.33)
Real GDP growth rate (-1)	/	/	/	0.32 (8.30)	0.33 (8.44)	0.32 (7.96)	/	/	/	0.32 (8.22)	0.31 (8.10)	0.30 (7.32)
Change in early stage venture capital investment	**0.93** **(2.19)**	/	**0.94** **(2.22)**	0.26 (0.77)	/	0.24 (0.69)	/	/	/	/	/	/
Change in early stage venture capital investment (-1)	/	**1.31*** **(1.56)**	0.85 (1.10)	/	-0.14 (-0.20)	-0.28 (-0.38)	/	/	/	/	/	/
Change in venture capital investment	/	/	/	/	/	/	**0.37**** **(2.16)**	/	**0.55***** **(3.05)**	0.07 (0.52)	/	0.19 (1.26)
Change in venture capital investment (-1)	/	/	/	/	/	/	/	**0.73***** **(2.91)**	**0.86***** **(3.64)**	/	**0.37*** **(1.81)**	**0.47**** **(2.23)**
Constant	17.98 (5.22)	14.55 (4.76)	18.53 (5.08)	11.04 (4.42)	10.78 (4.24)	11.32 (4.06)	17.09 (5.07)	14.76 (5.11)	19.56 (5.65)	10.90 (4.40)	11.37 (4.43)	12.37 (4.23)
Weighted statistics												
R^2	0.63	0.64	0.62	0.77	0.77	0.77	0.63	0.65	0.66	0.78	0.78	0.77
F-statistics	50.26	51.15	40.31	85.15	83.89	70.42	49.99	54.06	46.84	86.33	84.77	71.29
Durbin-Watson	1.96	1.92	1.93	1.94	1.94	1.93	1.99	1.91	1.89	1.96	1.91	1.90
Total panel observations	183	181	178	182	180	177	183	181	178	182	180	177

Table 5: FGLS estimates of a model in levels with cross-sectional heteroscedasticity and autocorrelation

(20 OECD countries, cross-section specific constants)

a) Impact of venture capital investment on the unemployment rate (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Unemployment rate (-1)	1.32 (32.77)	1.32 (30.68)	1.32 (30.52)	1.21 (24.25)	1.20 (22.59)	1.22 (23.14)	1.31 (32.58)	1.33 (31.00)	1.31 (30.83)	1.21 (24.48)	1.20 (22.92)	1.22 (23.66)
Unemployment rate (-2)	-0.53 (-12.93)	-0.53 (-12.12)	-0.54 (-12.18)	-0.43 (-8.35)	-0.41 (-7.57)	-0.43 (-8.07)	-0.53 (-13.04)	-0.54 (-12.47)	-0.54 (-12.58)	-0.43 (-8.48)	-0.41 (-7.75)	-0.44 (-8.37)
Real GDP growth rate	-0.21 (-10.24)	-0.22 (-9.89)	-0.21 (-9.97)	-0.19 (-9.20)	-0.19 (-8.82)	-0.19 (-8.89)	-0.21 (-10.09)	-0.22 (-10.27)	-0.21 (-9.77)	-0.19 (-9.18)	-0.19 (-9.15)	-0.19 (-8.84)
Real GDP growth rate (-1)	/	/	/	-0.10 (-3.67)	-0.12 (-4.30)	-0.09 (-3.53)	/	/	/	-0.09 (-3.54)	-0.12 (-4.48)	-0.10 (-3.45)
Early stage venture capital investment	**-0.30**** **(-2.04)**	/	-0.20 (-0.87)	-0.20 (-1.45)	/	-0.17 (-0.74)	/	/	/	/	/	/
Early stage venture capital investment (-1)	/	**-0.54**** **(-1.96)**	-0.23 (-0.53)	/	-0.37 (-1.39)	-0.10 (-0.24)	/	/	/	/	/	/
Venture capital investment	/	/	/	/	/	/	**-0.18***** **(-2.81)**	/	**-0.22***** **(-2.61)**	**-0.13**** **(-2.04)**	/	**-0.18**** **(-2.20)**
Venture capital investment (-1)	/	/	/	/	/	/	/	-0.15 (-1.34)	0.10 (0.71)	/	-0.07 (-0.69)	0.13 (0.96)
Weighted statistics												
R^2	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
F-statistics	4200.902	4103.836	3165.712	3479.801	3275.495	2687.003	4499.029	4359.116	3506.369	3754.931	3647.535	3092.689
Durbin-Watson	2.07	2.06	2.08	1.94	1.91	1.95	2.05	2.08	2.04	1.93	1.92	1.92
Total panel observations	213	211	208	212	210	207	213	211	208	212	210	207

b) Impact of venture capital investment on employment (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employment (-1)	1.39 (32.11)	1.38 (29.93)	1.38 (29.74)	1.24 (23.90)	1.21 (22.83)	1.25 (23.52)	1.39 (32.02)	1.40 (30.00)	1.38 (29.63)	1.24 (24.03)	1.21 (22.90)	1.24 (23.46)
Employment (-2)	-0.48 (-11.03)	-0.47 (-10.80)	-0.48 (-10.67))	-0.33 (-6.15)	-0.30 (-5.53)	-0.34 (-6.31)	-0.48 (-11.12)	-0.48 (-10.76)	-0.48 (-10.71)	-0.33 (-6.21)	-0.29 (-5.55)	-0.33 (-6.27)
Real GDP growth rate	0.41 (10.88)	0.40 (10.68)	0.39 (10.39)	0.35 ((9.49)	0.33 (9.55)	0.34 (9.18)	0.41 (11.01)	0.43 (11.48)	0.40 (10.55)	0.35 (9.57)	0.34 (9.98)	0.34 (9.30)
Real GDP growth rate (-1)	/	/	/	0.25 (5.34)	0.30 (6.51)	0.25 (5.26)	/	/	/	0.25 (5.27)	0.31 (6.78)	0.25 (5.28)
Early stage venture capital investment	**0.99*** (3.13)**	/	0.62 (1.31)	**0.67** (2.16)**	/	0.59 (1.26)	/	/	/	/	/	/
Early stage venture capital investment (-1)	/	**1.84*** (3.35)**	1.07 (1.29)	/	**1.06** (1.93)**	0.35 (0.43)	/	/	/	/	/	/
Venture capital investment	/	/	/	/	/	/	**0.51*** (3.63)**	/	**0.46*** (2.49)**	**0.36*** (2.62)**	/	**0.33* (1.85)**
Venture capital investment (-1)	/	/	/	/	/	/	/	**0.52** (2.26)**	0.18 (0.59)	/	**0.40* (1.78)**	0.15 (0.52)
<u>*Weighted statistics*</u>												
R^2	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
F-statistics	242049.8	244507.1	181218.1	180275.6	147010.9	136695.1	239720.0	203136.1	168308.8	180628.8	143553.8	136026.4
Durbin-Watson	2.18	2.17	2.18	2.00	2.01	2.02	2.20	2.20	2.20	2.02	2.01	2.03
Total panel observations	222	220	217	221	219	216	222	220	217	221	219	216

Table 6: FGLS estimates of a model in differences with cross-sectional heteroscedasticity and autocorrelation

(20 OECD countries, cross-section specific constants)

a) Impact of the delivery of venture capital on the unemployment rate (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Instrument for the change in the unemployment rate (-1)	-0.14 (-2.07)	-0.18 (-2.65)	-0.19 -2.67)	-0.08 (-1.73)	-0.08 (-1.55)	-0.10 (-2.09)	-0.15 (-2.23)	-0.17 (-2.51)	-0.24 (-4.40)	-0.08 (-1.62)	-0.08 (-1.57)	-0.10 (-2.08)
Real GDP growth rate	-0.30 (-10.62)	-0.28 (-10.23)	-0.24 (-8.66)	-0.30 (-12.40)	-0.30 (-12.27)	-0.27 (-11.26)	-0.29 (-10.55)	-0.29 (-10.77)	-0.18 (-9.19)	-0.30 (-12.17)	-0.30 (-12.49)	-0.28 (-11.51)
Real GDP growth rate (-1)	/	/	/	-0.23 (-9.46)	-0.22 (-9.05)	-0.22 (-8.95)	/	/	/	-0.22 (-8.92)	-0.22 (-9.05)	-0.21 (-8.17)
Change in early stage venture capital investment	**-0.45* (-1.67)**	/	**-0.72*** (-2.51)**	**-0.62*** (-2.77)**	/	**-0.90*** (-4.36)**	/	/	/	/	/	/
Change in early stage venture capital investment (-1)	/	-0.48 (-1.10)	**-0.62* (-1.58)**	/	-0.87 (-0.23)	-0.32 (-1.30)	/	/	/	/	/	/
Change in venture capital investment	/	/	/	/	/	/	**-0.24** (-2.31)**	/	**-0.53*** (-4.90)**	-0.08 (-0.97)	/	-0.13 (-1.35)
Change in venture capital investment (-1)	/	/	/	/	/	/	/	-0.18 (-1.27)	**-0.34*** (-3.14)**	/	-0.08 (-0.73)	-0.15 (-1.29)
<u>*Weighted statistics*</u>												
R^2	0.68	0.67	0.66	0.79	0.77	0.80	0.69	0.67	0.99	0.78	0.77	0.77
F-statistics	78.91	75.61	54.80	111.31	98.10	91.23	82.97	76.30	37.99	101.36	98.01	77.84
Durbin-Watson	1.92	1.93	1.93	1.90	1.98	1.96	1.94	1.92	1.75	1.93	1.98	1.96
Total panel observations	174	172	169	173	171	168	174	172	169	173	171	168

b) Impact of the delivery of venture capital on employment (with cyclical control)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Instrument for the change in employment (-1)	0.02 (0.32)	0.02 (0.21)	0.02 (0.19)	0.08 (1.74)	0.09 (1.83)	0.10 (1.94)	0.03 (0.33)	0.01 (7.24)	0.02 (0.21)	0.09 (1.77)	0.09 (1.86)	0.09 (1.72)
Real GDP growth rate	0.37 (7.61)	0.36 (7.39)	0.37 (7.33)	0.46 (11.33)	0.46 (11.41)	0.48 (11.20)	0.36 (7.50)	0.35 (2.57)	0.34 (6.88)	0.46 (11.36)	0.46 (11.49)	0.46 (11.19)
Real GDP growth rate (-1)	/	/	/	0.39 (9.84)	0.42 (10.38)	0.41 (9.90)	/	/	/	0.39 (9.79)	0.40 (10.06)	0.38 (9.34)
Change in early stage venture capital investment	0.30 (0.66)	/	0.29 (0.64)	-0.03 (-0.08)	/	-0.18 (-0.44)	/	/	/	/	/	/
Change in early stage venture capital investment (-1)	/	0.76 (0.85)	0.76 (0.83)	/	-0.83 (-1.10)	-1.00 (-1.27)	/	/	/	/	/	/
Change in venture capital investment	/	/	/	/	/	/	0.20 (1.06)	/	**0.45** **(2.10)**	-0.03 (-0.17)	/	0.10 (0.55)
Change in venture capital investment (-1)	/	/	/	/	/	/	/	**0.72***** **(2.57)**	**0.91***** **(3.32)**	/	**0.34*** **(1.63)**	**0.36*** **(1.64)**
Weighted statistics												
R^2	0.60	0.59	0.58	0.78	0.78	0.78	0.60	0.60	0.61	0.78	0.78	0.78
F-statistics	78.78	74.58	53.54	145.45	138.54	109.61	78.45	79.43	58.75	58.75	142.45	140.22
Durbin-Watson	1.98	1.95	1.97	1.95	1.96	1.95	2.00	1.95	1.96	1.95	1.96	1.94
Total panel observations	183	181	178	182	180	177	183	181	178	178	182	180

Table 7: FGLS estimates of a pooled model for the level of unemployment augmented by indicators of the capital, labor and product market setting

	a) Without venture capital variable	b) With INVEARLY (-1)	c) With VC (0)
Unemployment rate (-1)	1.38 (33.68)	1.36 (30.92)	1.34 (32.29)
Unemployment rate (-2)	-0.49 (-11.82)	-0.47 (–10.63)	-0.46 (-11.17)
Real GDP growth rate	-0.24 (-12.33)	-0.23 (-11.32)	-0.23 (-11.55)
Dummy Germany	0.14 (1.78)	0.22 (2.54)	0.29 (3.28)
Early stage venture capital investment (-1)	/	**-0.60** (-2.28)**	/
Venture capital investment (0)	/	/	**-0.26*** (-3.63)**
Benefit duration	0.10 (3.26)	0.09 (3.14)	0.11 (3.79)
Employer coordination index	-0.27 (-3.45)	-0.31 (-3.7)	-0.33 (-4.11)
Employment protection index	0.04 (3.57)	0.03 (2.90)	0.03 (3.06)
Tax wedge	0.01 (2.28)	0.01 (2.62)	0.02 (3.68)
Union density	0.01 (3.26)	0.01 (3.37)	0.01 (2.96)
Shareholder rights	0.1 (2.78)	0.08 (2.30)	/
Barriers to entrepeneurship	/	/	-0.24 (-2.92)
Creditor rights	-0.17 (-3.87)	-0.19 (-4.08)	-0.24 (-5.15)
Constant	0.38 (1.20)	0.41 (1.22)	1.03 (4.23)
Weighted statistics			
R^2	0.98	0.99	0.99
F-statistics	1197.53	1122.65	1175.27
Durbin-Watson	1.85	1.86	1.85
Total panel observations	229	211	213

Table 8: FGLS estimates of a pooled model for the level of employment augmented by indicators of the capital, labor and product market setting

	a) Without venture capital variable	b) With INVEARLY (-1)	c) WithVC (0)
Total employment (-1)	1.00 (54.85)	0.98 (44.82)	0.99 (45.05)
Real GDP growth rate	0.50 (12.64)	0.45 (10.78)	0.46 (10.91)
Dummy Germany	-0.65 (-3.54)	-0.68 (-3.54)	-0.71 (-3.69)
Early stage venture capital investment (-1)	/	**2.05*** (3.77)**	/
Venture capital investment (0)	/	/	**0.39*** (2.59)**
Benefit replacement ratio	-0.02 (-1.93)	-0.03 (-2.51)	-0.02 (-2.03)
Benefit replacement ratio (RR1)	0.04 (4.22)	0.03 (2.85)	0.04 (3.91)
Benefit replacement ratio (RR25)	/	0.03 (2.14)	/
Benefit duration	-0.13 (-1.97)	-0.20 (-2.16)	-0.14 (-2.05)
Employer coordination index	-1.19 (-3.38)	-0.51 (-1.45)	-1.23 (-3.35)
Coordination index	0.76 (3.04)	0.45 (1.63)	0.83 (3.23)
Employment protection index (NEWEP)	-0.60 (-3.63)	-0.28 (-1.62)	-0.48 (-2.81)
Tax wedge	-0.02 (-1.74)	-0.03 (-2.16)	-0.03 (-2.71)
Union density	-0.03 (-3.64)	-0.03 (-3.95)	-0.03 (-3.73)
Shareholder rights	-0.24 (-2.56)	/	-0.22 (-2.22)
Creditor rights	0.34 (3.04)	0.40 (3.15)	0.34 (2.95)
Constant	2.57 (1.53)	4.05 (1.95)	3.49 (1.71)
Weighted statistics			
R^2	0.99	0.99	0.99
F-statistics	29077.25	29102.04	20496.03
Durbin-Watson	1.43	1.45	1.42
Total panel observations	253	221	236

Table 9: FGLS estimates of a pooled model for the first difference of unemployment augmented by indicators of the capital, labor and product market setting

	a) Without venture capital variable	b) With INVEARLY (0)	c) With VC (0)
Instrument for D (Unemployment (-1))	-0.10 (-1.73)	-0.13 (-1.90)	-0.13 (-2.05)
Real GDP growth rate	-0.32 (-12.93)	-0.30 (-11.48)	-0.31 (-12.03)
D (Dummy Germany)	0.30 (2.29)	0.21 (1.57)	/
D (Early stage venture capital investment)	/	-0.39 (-1.39)	/
D (Venture capital investment (0))	/	/	**-0.26** (-2.41)**
Benefit replacement ratio	0.00 (1.26)	0.01 (1.51)	0.01 (1.62)
Benefit replacement ratio (RR25)	-0.02 (-2.08)	-0.02 (-2.14)	-0.02 (-2.28)
Benefit duration	0.19 (3.38)	0.16 (2.67)	0.17 (2.84)
Employment protection index (NEWEP)	0.10 (1.63)	0.11 (1.74)	0.12 (1.88)
Union density	0.01 (2.31)	0.01 (1.89)	0.01 (1.92)
Creditor rights	-0.17 (-2.32)	-0.14 (-1.74)	-0.14 (-1.71)
AR (1)	0.40 (4.89)	0.41 (4.76)	0.41 (4.97)
Weighted statistics			
R^2	0.70	0.68	0.68
F-statistics	44.42	33.10	37.25
Durbin-Watson	1.92	1.89	1.93
Total panel observations	178	167	167

Table 10: FGLS estimates of a pooled model for the first difference of employment augmented by indicators of the capital, labor and product market setting

	a) Without venture capital variable	b) With INVEARLY (0)	c) With VC (-1)
Instr. for D (Employment (-1))	-0.15 (-2.20)	-0.08 (-1.17)	-0.15 (-2.21)
Real GDP growth rate	0.50 (10.71)	0.33 (7.43)	0.44 (9.14)
D (Early stage venture capital investment (0))	/	**0.90** (1.90)**	/
D (Venture capital investment (-1))	/	/	**0.74*** (2.82)**
Benefit replacement ratio (RR1)	0.02 (2.03)	/	0.02 (1.61)
Benefit replacement ratio (RR25)	0.04 (1.97)	/	0.04 (2.12)
Benefit duration	-0.49 (-2.47)	-0.38 (-2.19)	-0.57 (-2.82)
Union coverage index	1.03 (1.80)	2.42 (3.52)	1.31 (2.44)
Employer coordination index	-0.61 (-2.09)	/	-0.59 (-2.06)
Employment protection index (NEWEP)	-0.99 (-2.76)	-1.51 (-3.33)	-0.89 (-2.66)
Barriers to entrepreneurship	2.39 (3.49)	2.05 (2.71)	2.95 (3.57)
Shareholder rights	0.70 (3.31)	0.76 (2.99)	0.88 (3.59)
Creditor rights	1.04 (3.56)	0.65 (2.21)	1.10 (3.49)
AR (1)	0.38 (4.61)	0.50 (6.68)	0.34 (4.00)
Weighted statistics			
R^2	0.66	0.60	0.66
F-statistics	28.10	26.26	21.82
Durbin-Watson	2.04	2.04	1.99
Total panel observations	186	183	174

Table 11: Dynamic labor-market impacts of venture capital investment

Specification	*Table 7c (VC)*	*Table 10b (INVEARLY)*	*Table 10c (VC)*
a) Short-run impact effect	-0.26	0.90	0.74
b) Long-run equilibrium effect	-2.17	0.83	0.68
c) Std. dev. of venture capital variable	0.52	0.20	0.52
d) Impact effect of one std. dev. shock = a) times c)	-0.14	0.18	0.38
e) Equilibrium effect of one std. dev. shock = b) times c)	-1.13	0.17	0.35