# Labor Regulations and European Private Equity*

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**Abstract**

European nations substitute between employment protection regulations and labor market expenditures (e.g., unemployment insurance benefits) for providing worker insurance. Employment regulations more directly tax firms making frequent labor adjustments than other labor market insurance mechanisms. Venture capital and private equity investors are especially sensitive to these labor adjustment costs. Nations favoring labor market expenditures as the mechanism for providing worker insurance developed stronger private equity markets in high volatility sectors over 1990-2004. These patterns are further evident in US investments into Europe. In this context, policy mechanisms are more important than the overall insurance level provided.

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# 1 Introduction

Many European leaders want to replicate the innovation and economic growth spurred by venture capital and private equity investors in the US. Both the European Union and OECD are urging member states to promote the availability of risk capital financing for entrepreneurs (e.g., OECD 2004a). A number of European governments are also investigating which policies best facilitate the development of home-grown private equity markets and the companies in which they invest. These efforts are encouraged by more than just flashy case studies of Silicon Valley. Recent academic studies link these private equity investors to better performance of portfolio companies (e.g., Kerr et al. 2010, Lerner et al. 2010) and stronger aggregate innovation and economic growth (e.g., Kortum and Lerner 2000, Samila and Sorenson 2010).

We study in depth how labor market regulations across European countries influence the development of VC and buy out investors. A better understanding of these issues is essential for several reasons. First, many policy makers are attracted to active policy interventions like public venturing as a means of seeding or expanding their entrepreneurial communities. Yet, most of these active efforts are unsuccessful (e.g., Lerner 2009). Our work instead highlights how influential passive policies like general labor regulations are. Adjusting labor market policies may not be as sexy as announcing tax breaks for a new biotech cluster, but we demonstrate just how important the proper ground rules are.

Second, policy makers can be forgiven for being confused by the academic literature. While the flexible labor markets in Silicon Valley are frequently lauded, the closest empirical work for Europe focuses on the strong empirical link between stricter employment protection and higher self employment rates. Some take this correlation to suggest that employment protection increases entrepreneurship generally. We find the opposite relationship, however, with respect to VC investments and the high growth entrepreneurship associated with them. This difference is not due to technical details, but it is instead evident in the raw data. For example, southern European countries tend to rank very high on self employment scales but have smaller private equity markets; the opposite is true for Scandinavian countries. Definitions of entrepreneurship matter a lot in this context (e.g., Glaeser and Kerr 2009).

More deeply, our study makes three important contributions to the literature. First, we make a methodological contribution by distinguishing between the general level of labor market insurance provided to workers and the policy mechanisms used to implement the insurance. As we discuss further below, we find that the mechanisms make all the difference for the development of private equity investment, while the level of security is second order. Our technique may find application in other settings, too. Second, recent theoretical models predict that countries with stricter labor policies will specialize in less innovative activities due to the higher worker turnover frequently associated with rapidly changing sectors. We provide the first empirical evidence for this prediction at the sector level in the entrepreneurial finance literature. Our final contribution is systematic evidence on higher rates of labor volatility among European firms backed by private equity investors.

### Graphical Illustration

We begin with a series of graphs using country level variation as a simple introduction to our study. The central policy trade-off that we model is illustrated in Figure 1 for 1998. The vertical axis documents the average labor market expenditures as a share of GDP taken from the OECD Social Expenditures database. Labor market expenditures include both active

and passive policies designed to facilitate job creation and transitions, with the majority of expenditures being unemployment insurance benefits. The horizontal axis provides an employment protection index developed by the OECD. Higher employment protection scores indicate more heavily regulated labor markets, factoring in a wide variety of legislation concerning the individual and collective dismissals of both temporary and regular workers.

This plot illustrates two important features. First, Anglo Saxon countries provide lower worker insurance on both dimensions than Continental Europe. These differences in absolute *levels* of worker insurance provided by nations have been a frequent political economy topic since at least de Tocqueville (e.g., Alesina et al. 2001, Kerr 2007). Second, the trend line, which is calculated only for Continental European nations, indicates that economies with higher labor market expenditures have weaker employment protection. These differences in the *mechanisms* used to provide worker insurance has received less attention, but the empirical substitution of policies across Europe is clear. Denmark provides the highest labor market expenditures per GDP but has the second-lowest employment protection in Continental Europe. This reflects the well-publicized Danish "flexicurity" approach that emphasizes high job mobility facilitated by generous out-of-work benefits and active labor market programs to promote worker re-entry. Portugal, on the other hand, provides strong security to the employed but weaker benefits to the unemployed.

While employment protection and transition/re-entry assistance are perhaps substitutes for providing worker security, they have different implications for the costs firms face. Labor rigidities have a stronger impact on the adjustment margins of firms, especially those undertaking substantial restructurings. Even if general corporate or payroll taxation is higher to support labor market expenditures, the direct incidence on hiring/firing is weaker in regimes favoring labor market expenditures than in strict employment protection regimes. These labor adjustment costs are particularly pertinent for private equity investments, which thrive in dynamic industries that require frequent labor adjustments. This private equity focus on high growth opportunities and rapid restructuring is necessary for achieving sufficient returns when portfolio companies offer the potential for exceptional investment returns but also carry a high risk of failure.

Combining these observations, nations emphasizing labor market expenditures over employment protection should be more attractive for the development of private equity financing, even after conditioning on the level of worker insurance provided. While labor market regulations do not specifically target the portfolio companies of private equity investors, these investors are seeking opportunities that are generally more sensitive to these taxes on labor adjustment. We investigate this hypothesis using private equity surveys provided by the European Private Equity and Venture Capital Association and Thomson Financial. Figures 2 and 3 show that policy choices are correlated with private equity placement (trend lines are still for Continental Europe). European countries with stricter employment protection have lower private equity investments per GDP, while those favoring labor market expenditures are more attractive to these financial forms.

**The Structure and Methodology of the Study**

While these graphs are suggestive, many other factors vary across countries besides labor market policies, and it is quite likely that omitted factors that correlate with labor market policies are important for private equity formation. Labor market policies tend to evolve slowly in most countries, limiting the scope of panel estimation techniques at the country level for

disentangling these effects. Theoretical models (e.g., Saint-Paul 1997, 2002a, Samaniego 2006), however, provide subtler predictions that we can test. These models predict that countries with strong employment protection specialize in less innovative activities as firms respond to costs they face. They further predict patterns of specialization across countries, such that firms avoid the most volatile sectors when labor adjustment costs are strongest.

We build our empirical analysis at the country-sector level to test these predictions and quantify the role of labor market policies. We employ a differences-in-differences approach similar to Rajan and Zingales (1998) that uses country-sector variation in private equity market size over the 1990-2004 period. We specifically model whether countries that favor labor market expenditures over employment protection for providing worker insurance develop relatively stronger private equity markets in more volatile sectors. We calculate the volatility of sectors using US establishment level data from the US Census Bureau, which we take to be the unconstrained case, and from European firm level data.

Our simplest regressions find that employment protection has a negative effect on private equity formation in volatile sectors, while the opposite is true for labor market expenditures. As a methodological contribution, we then show that the coefficients on the base policies are less informative than their joint effect. This concept relates back to the policy decisions illustrated in Figure 1. Individual policies are simultaneously reflecting both the level of labor market insurance provided and the mechanism used to provision the insurance. An empirical evaluation of an increase in employment protection will encompass both increases in insurance levels (e.g., Anglo Saxon versus Continental Europe) and changes in policy mechanisms (e.g., Denmark versus Portugal). These two objects are distinct from a policy perspective, however, and it is important to distinguish their individual effects as much as possible.

We show two techniques to isolate policy mechanisms from overall insurance levels. One approach is particularly simple, just taking the linear difference of two policy coefficients after a multivariate regression. A second approach transforms the base policies into more intuitive indices. Both approaches find that policy mechanisms are robustly important for private equity investment patterns, while the overall level of labor market insurance provided is of much weaker importance. This is true on both the entry margin (i.e., whether private equity investments exist in a country-sector) and for the volume of deals subsequently conducted. The effects are particularly strong for US-sourced VC investments, and we show the sector level patterns are generally robust to other policy characteristics and traits of countries.

As a road map to our paper, Section 2 provides a simple framework for understanding how labor market insurance policies can influence private equity investments. Section 3 describes our data, while Section 4 provides our analysis of labor volatilities within private equity backed firms in Europe. Section 5 quantifies how labor market insurance policies shape the country-sector private equity distribution. The last section concludes.

**Managerial and Policy Implications**

The findings of this project are important for policy makers, private equity investment managers, and entrepreneurs seeking high growth opportunities. Returning to the policy choices highlighted earlier, our work emphasizes the impact of adjusting the mechanisms used to provide labor market insurance, while keeping the overall level of insurance provided by a country constant. While it is rare for a country to dramatically alter the level of labor market insurance provided, policy makers frequently contemplate moving toward or away from flexible labor markets with concomitant adjustments in other insurance programs (e.g., the recent interest

in the Danish model). These decisions regarding optimal levels and mechanisms are complex and should consider many economic and non-economic factors. While it is well beyond this paper's scope to determine how labor market insurance should be provisioned, we highlight one factor that should influence this decision given the desire of many European leaders to promote entrepreneurial financing.

More broadly, this study is part of a growing body of academic and policy research examining how labor market regulations influence entrepreneurship and productivity growth. Many observers, both within and outside of academia, believe strict European labor policies hinder economic restructuring and subsequent productivity growth. The private equity funds studied here support firm creation and restructuring. As such, our findings provide a complementary measure to studies considering entrepreneurship rates or reallocation measures directly.

This study also has important implications for private equity fund managers and the entrepreneurs they support. As background for this project, we undertook semi-structured interviews of private equity professionals in ten European countries. Across respondent countries and fund types, investment managers generally believed labor regulations to be an important factor in the development of both VC and buy out markets. Most respondents further rated local labor regulations as a first-order concern when evaluating investment candidates, although several noted that they were willing to enter heavily regulated markets if other advantages existed like high quality labor. One respondent even suggested that past concern over labor regulations may have hidden some high quality opportunities in countries with heavily regulated labor markets.[1]

Our analysis provides quantitative evidence of this general pattern. Moreover, the sector level specialization that we document is very important for private equity placement decisions. This includes the direct labor adjustment costs of these policies for portfolio firms, but it also extends much further. Many aspects of private equity investment exhibit agglomeration or cluster economies, where larger numbers of similar firms that are spatially proximate increase the productivity of each firm. Some examples include entrepreneurial awareness of private equity investment models, legal and contractual support, clearly-defined exit opportunities, and strong local labor markets for specialized professionals. As many of these agglomeration economies are further specific to individual sectors, private equity managers should factor in how these policy differences across nations influence local investment activity. Active policies like public venturing may not have their advertised effect if the underlying passive policies are incompatible for a sector. These concerns will in turn influence location choices of entrepreneurs anticipating using private equity funding to support firm creation and growth.

# 2 Theoretical Framework

## 2.1 Labor Market Policies and Private Equity Firms

### Employment Protection and Labor Volatility

A vast theoretical literature considers the economic effects of employment protection. These

[1] Two sample interview quotes are: "We want our early stage investments to grow quickly to 50-100 employees, but they may also need to fall back to 25 workers. Strict employment regulations make it less attractive for starting these risky businesses." Also, "National differences in labor regulations are an important factor for where pan-European funds place their resources."

models differ sharply with respect to how employment protection influences total employment levels, technical efficiency, and many other economic outcomes. Our study, however, focuses on one economic outcome where the models share a common finding. The models uniformly suggest that employment protection should dampen labor fluctuations by firms when binding. If not binding, perhaps because the value that workers place on employment protection exactly offsets costs to firms, then no changes in labor fluctuations should be observed. Otherwise, employment protection results in labor adjustment costs to firms that reduce job separations. Moreover, if firms are forward-looking and anticipate these separation costs, they reduce their hiring rates as well. While the net effect of this reduced hiring and firing is ambiguous for many outcomes like firm productivity, overall employment volatility unambiguously declines.[2]

The existing empirical evidence, while small, supports this prediction. Autor et al. (2007) find that US firms reduce their annual and quarterly labor turnover when state level employment protection regulations are passed. Moreover, a substantial decline in the entry of new firms and establishments is evident. Wolfers (2010) also finds employment protection impacts high frequency labor adjustments, and Blanchard and Portugal (2001) suggest more rigid employment protection can explain differences in labor market flows between the US and Portugal. Addison and Teixeira (2003) survey the industry level evidence of slower labor adjustment speeds under employment protection.

This labor adjustment cost feature of employment protection differs from alternative policies that also protect workers from labor market risks. In particular, labor market expenditures (e.g., unemployment insurance benefits, job re-training) do not tax the separation of firms and workers. Thus, firms have greater flexibility in their hiring and firing if worker insurance is provided through labor market expenditures rather than employment protection. Of course, general taxation may need to be higher to support labor market expenditures, compared to employment protection, but this taxation will be generally shared throughout the economy, rather than concentrated on one margin of firm activity.[3]

Thus, firms and industries with high inherent labor volatility are disadvantaged, all else being equal, when labor market insurance is provided to workers via employment protection rather than through labor market expenditures. This is quite interesting given that European economies select different mixes of employment protection and labor market expenditures while providing comparable amount of labor market insurance (Figure 1). Despite the theoretical work examining each policy separately, we are just beginning to model and evaluate their optimal design jointly (e.g., Pissarides 2001, Blanchard and Tirole 2007, Boeri et al. 2010). Optimal insurance design may involve both policies to a degree, and there are many factors well beyond the scope of this study to consider. But, through our investigation of the development and growth of private equity investments in Europe, we hope to provide among the first empirical evidence of this important policy trade-off.

[2] An earlier version of this paper discusses in detail the conditions under which employment protection improves or reduces economic efficiency in the standard competitive model of the labor market. Relevant papers include Summers (1989), Lazear (1990), Aghion and Hermalin (1990), Levine (1991), Bertola (2004), Agell (1999), Wasmer (2006), Autor et al. (2007), and Macleod and Nakavachara (2007). Autor et al. (2007) also discuss how the basic findings regarding dampened labor adjustment by firms extend to the Mortensen and Pissarides (1994) equilibrium unemployment framework, too. The political economy of employment protection is analyzed by Saint-Paul (2002b), Brügemann (2007), and Algan and Cahuc (2009).

[3] An Experience Rating system links unemployment insurance contributions of a firm to its dismissal history. This system is employed by the US but otherwise fairly rare. The adjustment costs to firms in this setting are only a partial incidence that remains weaker than when under employment protection.

**Venture Capital Investments**

There are two general ways in which the labor adjustment costs associated with employment protection impact private equity investors. First, labor adjustment costs hinder the development of the high growth or rapidly restructuring sectors in which these investors specialize. This channel represents a market size effect, rather than a specific issue for private equity investors, but it is still an important building block for understanding the role of labor market policies. Second, labor adjustment costs can weaken the specific business models of private equity investors over-and-above the former market size effects. This can lower rates of return for the investors and lead them to decline marginal deals that they would have pursued without labor adjustment costs. We discuss each of these effects, with an initial focus on VCs.

Young entrepreneurial firms often struggle with financing the pursuit of their innovations or business concepts. These start-ups have few tangible assets that can be pledged for a bank loan, and traditional financial institutions typically lack the expertise to assess the creditworthiness of the proposed ventures, especially in emerging sectors. VCs screen entrepreneurial projects, structure financing deals, and monitor the performance of their portfolio companies in which they take equity stakes. VCs also provide non-financial resources like customer and supplier contacts, technical expertise, employee recruitment, and so on. Gompers and Lerner (2002) provide a detailed introduction to these investment models.

Recent work suggests that strict labor regulations hinder the development of high growth or volatile sectors. This sector level prediction is more subtle than the general prediction of declining employment fluctuations noted above for the whole economy. In these models, employment protection reduces the attractiveness of industries where substantial technical change occurs relative to more stable industries, all else being equal, as a given job match becomes obsolete faster (e.g., Saint-Paul 2002a, Samaniego 2006, Bartelsman and Hinloopen 2006). These policy differentials result in comparative advantages for countries with more flexible labor markets in developing sectors characterized by high labor volatility (e.g., Cuñat and Melitz 2010). Hopenhayn and Rogerson (1993) also model how labor regulations slow reallocation across sectors.

VC investors are very sensitive to this weakening of high growth, volatile industries. Growing sectors create opportunities for the rapid development of portfolio companies along with the markets. Moreover, many screening, monitoring, and reputation features of the value-added investment model of VC investors are most beneficial in these settings characterized by incomplete information and uncertainty (e.g., Hsu 2004). VC backed firms can support the emergence of new technology-based industries, and the available evidence suggests that they are efficient at these investments (e.g., Kortum and Lerner 2000). We should thus anticipate weaker VC investments for high volatility sectors in the presence of strong employment protection as these policies weaken the general attractiveness of these types of industries.

In addition to this market size effect, employment rigidities can hinder VC formation by reducing their ability to close or dramatically restructure poorly performing companies. This flexibility is central to the VC business model. Characteristic of most entrepreneurial and innovative endeavors, the majority of companies in a VC portfolio fail despite the assistance extended. Over half of VC investments yield zero or negative returns, with a small number of great successes generating most of the profits (e.g., Huntsman and Hoban 1980, Sahlman 1990, Cochrane 2005). A successful investor needs to maintain a portfolio of projects and to reallocate resources aggressively from failing ventures to high performing investments. This

staged approach yields option values for investments, and an important role of VC investors is to close under-performing ventures for the sake of better opportunities. These economics also underlie many of the legal and structural VC features like syndication, convertible securities, and control rights (e.g., Kaplan and Strömberg 2003). Puri and Zarutskie (2008) and Chemmanur et al. (2009) provide micro-data evidence on the higher volatility of VC backed firms compared to their peers, and strict employment protection increases the costs of these labor adjustments and the closures of under-performing ventures.

**Buy Out Investments**

Buy out investors are a second class of private equity. Buy out investors frequently acquire inefficient companies or subsidiaries with the expectation of restructuring poor operations and making a profit from better management. To purchase the target company's equity, buy out investors often undertake substantial debt burdens and use the acquired company's existing assets as collateral for the loans. This debt financing and rigorous loan repayment schedules discipline the target's management to be more efficient in operations, often with an emphasis on cost minimization. In many cases, the firm's labor force is restructured to facilitate these leaner operations, and non-core or underperforming divisions may be sold to third parties. The buy out investors profit in these turnaround projects if the value of the acquired firm increases with better performance.[4]

Strict employment protection is also likely to hinder the development of buy out investors, but for somewhat different reasons than VC investments. Buy out investments are much more concentrated in manufacturing and industrial products and services than VC investments; high tech sectors accounted for only 10% of European buy out investments in 2000. Moreover, buy out investors do not target rapid growth for their portfolio firms like VC investors do. Thus, we anticipate that our first channel—the market size effect where strict employment protection reduces the attractiveness of volatile sectors and thus investment opportunities—should not be as important for the placement of buy out investments across Europe as it is for VC investments. We find evidence for this in our empirical work.

The business models of buy out investors, on the other hand, can be adversely affected by labor adjustment costs. Buy out investors seek opportunities where an acquired firm can be restructured so that it becomes more profitable. These restructurings can involve dramatic changes in the labor forces of firms (e.g., Davis et al. 2008). Davis et al. (2009) find that a third of the productivity gains following buy out investments come through opening and closure of establishments within firms. Amess and Wright (2007), Boucly et al. (2009), and Cressy et al. (2010) also note employment changes in European firms after buy outs.

Whether or not the net effect of these hirings and firings increases or decreases the overall employment level of the firm after restructuring is of second-order importance with respect to employment protection. Past employment obligations generally transfer to new owners (e.g., a transfer of undertaking), so that employment protection applies at the level of the worker. Thus, greater restructuring results in greater labor adjustment costs, even if overall employment in the firm rises. As strict employment protection increases the cost of existing employment contracts and their duties, the gap between current firm valuations and potential worth after restructuring must be larger to induce a takeover and restructuring. Moreover,

[4] Harris et al. (2005), Boucly et al. (2009), and Gottschalg and Phalippou (2009) examine the productivity growth of European firms after buy outs; Davis et al. (2009), Guo et al. (2010), and Lerner et al. (2010) study the US. Kaplan and Strömberg (2009) provide a broad review.

this threshold effect grows in high labor volatility sectors because it is increasingly likely that the firm's existing workforce is not the appropriate match for the firm after restructuring.

**Levels of Labor Market Insurance versus Mechanisms**

There is a common feature to the adverse effects identified for private equity investments in volatile sectors due to greater adjustment costs—these effects are coming from the incidence of the adjustment costs, rather than the level of labor market insurance provided. Whether or not a higher level of labor market insurance improves or reduces investment levels differentially in volatile sectors is theoretically ambiguous. On one hand, generous insurance may reduce incentives to quickly acquire new jobs or enter entrepreneurship upon job termination. This slows the rapid labor movements across firms and entry/exit that are frequently associated with the performance of high volatility sectors. Fallick et al. (2006), for example, provide a theoretical model where rapid labor mobility is a key feature of industrial organization in high tech sectors, along with empirical evidence of this effect in the US. High levels of labor market insurance, independent of policy choice, can weaken these mobility incentives.

On the other hand, a higher provision of public insurance may aid high growth, volatile firms. If workers are insecure about their job prospects should a job match or venture fail, they will demand higher wages and similar compensating differentials due to the uncertainty. These costs reduce firm profitability and may depress entry rates. Stronger unemployment insurance benefits and labor market expenditures, however, can effectively subsidize volatile sectors by providing a generous safety net. The key to the subsidization is that the labor market expenditures are paid through general taxation rather than a specific tax for volatile firms. Thus, the central question is how policy mechanisms shape the costs firms bear when adjusting employment. This motivates our comparison of employment protection and labor market expenditures; it further motivates separating the levels and mechanisms effects.

**Prior Empirical Studies**

Despite these theoretical linkages, our understanding of how labor regulations shape private equity investment is still developing. Much of the literature focuses on the role of flexible labor markets and non-compete clauses in the spatial distribution of the US high tech industry.[5] Jeng and Wells (2000) first empirically evaluated VC development across countries using multivariate analyses. In cross-sectional analyses, they find strict labor regulations (modeled using labor market tenures) hinder early stage VC investment but not later stage investments. In a subsequent study of the cyclicality of the VC industry, Romain and van Pottelsberghe (2004) find that labor market rigidities (modeled through employment protection indices) reduce the impact of a country's economic expansions for concomitant growth in its VC industry.[6]

The empirical evidence for industry level differences due to worker insurance policies is even rarer. The paper closest in spirit to ours is Da Rin et al. (2006). In a very interesting paper, the authors find within-country variations of managers' perceptions of hiring and firing conditions (modeled through IMD management surveys) reduce the ratio of high tech funding to total private equity investments. Given the interests of their study, they do not pursue

[5] See Gilson (1999), Hyde (2003), Stuart and Sorenson (2003), Fallick et al. (2006), Armour and Cumming (2006), and Marx et al. (2009a,b).

[6] Bozkaya and Kerr (2009) provide extended references regarding a second literature strand that considers the impact of labor market policies on entrepreneurship rates. European evidence includes Ilmakunnas and Kanniainen (2001) and Kanniainen and Vesala (2005).

this angle further. Two papers from the broader economics literature are also relevant for this topic. Micco and Pagés (2007) find that stringent employment protection reduces the sizes of sectors characterized by high intrinsic labor volatility. Moreover, employment fluctuations in these volatile sectors is dampened. Cuñat and Melitz (2010) further relate more flexible labor markets to comparative advantages in trade for industries with high labor volatility. Empirical evidence on this prediction is just emerging, and our study contributes evidence from private equity placements. We also hope to draw attention to the levels versus mechanism effects.

## 2.2 Empirical Methodology

Our analysis centers on differences across industries in their inherent labor volatilities in an empirical framework similar to Rajan and Zingales (1998) and Carlin and Mayer (2003). Measuring the inherent labor volatilities—as opposed to the realized labor volatilities by country and sector—is important given that labor market policies directly influence realized employment flows. We begin with some simple examples to illustrate these econometric issues.

Consider a sector with inherent labor volatility $v \geq 0$ in a country with employment protection levels $EPR \geq 0$. The sector is sufficiently small and open such that it takes prices and policies as exogenously determined. A continuum of entrepreneurial opportunities in the sector are ordered by their quality $q_i$, which is distributed uniformly from zero to $\bar{q}$. A risk neutral entrepreneur with a project quality $q_i$ decides to enter the market or not by examining the profitability

$$(1-t)[\pi(q_i) - c(v, EPR)] - FC. \tag{1}$$

In this expression, $t$ is the corporate tax rate, $\pi(q_i)$ is the natural profit for a given project quality, and $c(v, EPR)$ is an additional cost due to labor volatility and employment protection. $FC \geq 0$ is a fixed cost of entry that we assume cannot offset profits. Profits are increasing in project quality: $\pi(0) = 0$ and $\partial\pi/\partial q > 0$ (e.g., $\pi = \gamma \cdot q$, $\gamma > 0$). Higher volatility and employment protection generate higher costs: $c(0, EPR) = c(v, 0) = 0$, $\partial c/\partial v > 0$, $\partial c/\partial EPR > 0$, and $\partial^2 c/\partial v \partial EPR > 0$ (e.g., $c = \eta \cdot v \cdot EPR$, $\eta > 0$).

Entrepreneurs enter if their qualities equal or exceed a lower threshold $q_{\min}$ defined by $(1-t)[\pi(q_{\min}) - c(v, EPR)] - FC = \bar{u}$, where $\bar{u}$ is a reservation utility, or

$$q \geq q_{\min} = \pi^{-1}\left[\frac{\bar{u} + FC}{1-t} + c(v, EPR)\right]. \tag{2}$$

We assume the parameters of the model are such that positive entry always occurs. Thus, the size of the sector in terms of the number of firms can be represented as $\bar{q} - q_{\min} > 0$. Sector size increases with a lower tax rate, lower employment protection, lower volatility, and lower fixed costs. Allow for two sectors that are identical except sector 1 is more volatile than sector 2: $v^1 > v^2$. Sector 2 is larger than sector 1 ($q^1_{\min} > q^2_{\min}$). Taking the simple case of a linear profit function $\pi = \gamma \cdot q$, differences in sector size grow with greater employment protection due to the incidence it has on labor adjustments, while changes in corporate taxes affect sectors equally due to their general incidence.[7]

[7] Technically, $\partial(q^1_{\min} - q^2_{\min})/\partial EPR > 0$; $\partial^2 q_{\min}/\partial v \partial EPR > 0$; $\partial(q^1_{\min} - q^2_{\min})/\partial t = 0$; $\partial^2 q_{\min}/\partial v \partial t = 0$. Adding curvature to the profit function yields sector growth differences with respect to marginal tax rate changes, but the spirit of our predictions with respect to labor volatility continue to hold.

This set-up is very simple and abstracts from many important general equilibrium features, but the framework captures several of the issues we face empirically. First, let the level of worker insurance provided in the country be

$$I(EPR, LME) = \alpha_{EPR} EPR + \alpha_{LME} LME, \tag{3}$$

where $LME \geq 0$ represents labor market expenditures like unemployment insurance benefits. This $I(\cdot)$ function assumes the two policies are additive and separable, and the alphas ($\alpha_{EPR} > 0, \alpha_{LME} > 0$) weight the importance of each policy for worker insurance. Labor market expenditures are paid for by corporate taxes, such that $\partial t / \partial LME > 0$. If a policy maker sought to maintain a level of insurance $\bar{I}$ but to move from a regime emphasizing employment protection to one that emphasizes greater labor market expenditures, the required adjustment is

$$\Delta LME = -\Delta EPR \cdot (\alpha_{EPR} / \alpha_{LME}). \tag{4}$$

Thus, higher corporate taxes are necessary to maintain a given labor market insurance level as employment protection declines. Whether or not sectors generally increase or decline requires further model structure ($\partial q_{\min} / \partial EPR > 0$, $\partial q_{\min} / \partial t > 0$), but the relative size of the volatile sector to the less volatile sector increases in our simple linear case ($\partial^2 q_{\min} / \partial v \partial EPR > 0$, $\partial q_{\min} / \partial v \partial t = 0$). We return to this calculation in Section 5.1 of our empirical work.[8]

Second, consider the empirical challenge of measuring sector volatility. Under the simple conditions outlined so far, one could measure each country and sector's labor volatility directly, as it is the same for all firms in a sector. This feature does not hold, however, under any realistic scenario where labor volatility varies across firms in a sector. Instead, a more appropriate metric is the inherent volatility of a sector across the full support $[0, \bar{q}]$.[9] As a tractable example, allow volatility to vary continuously with quality $v(q)$. A natural assumption for our entrepreneurial setting is that higher quality opportunities have greater employment volatility as firms strive to obtain scale: $\partial v / \partial q > 0$. In this case, $q_{\min}$ is implicitly defined by $(1 - t)[\pi(q_{\min}) - c(v(q_{\min}), EPR)] - FC = \bar{u}$, and we continue to assume that the parameters are such that positive entry occurs.

Empirically, one would measure the average volatility of a given country and sector as

$$vol = \frac{1}{\bar{q} - q_{\min}} \int_{q_{\min}}^{\bar{q}} v(i) di. \tag{5}$$

As $q_{\min}$ is a function of $EPR$, measured volatility depends upon employment protection. This selection margin becomes ever more severe with stricter regulations and in more naturally volatile sectors. Thus, employment regulations can distort the empirical measurements of volatilities across sectors. Our particular finding that measured volatility rises with higher employment protection is due to our assumption that volatility rises in project quality. The more general point is that the observed labor volatilities for a country-sector is strongly influenced

[8] For simplicity, this framework does not model channels through which labor market insurance levels $I(\cdot)$ can benefit sector size. Thus, higher insurance levels unambiguously result in smaller sectors.

[9] In practice, the lower bound of zero is unrealistic as it requires reservation utilities, fixed costs, and corporate taxes to all be zero, in addition to labor policies being non-distortionary. One might instead suggest the true measure to be $[q_{LB}, \bar{q}]$, where the lower bound $q_{LB}$ is defined by the lowest possible values of the above three factors.

by these selection margins, and is thus incomplete. These issues extend, albeit much more weakly, to differences in taxes, fixed costs, and reservation utilities by country and sector.

Related factors are outside of our simple model. For example, entrepreneurs may be able to adjust their labor volatilities in response to employment protection, but with a diminished profit function due to the added constraint. This process would also distort measured volatility. Second, while we have assumed a full distribution of project ideas, countries and sectors are often subject to randomness in the entrepreneurial opportunities that arise. This randomness makes it harder to estimate true volatilities in small countries and sectors. These factors, and many more, would suggest caution in measuring volatility directly for each country-sector pair.

Instead, the best setting to measure labor volatility, and in particular the differences across sectors, is where the distortions are weakest and the fullest distribution of entrants and firms is observed. Accordingly, our primary measures are developed using the volatilities of plants and firms in the US. The policy choices of the US are the least distortionary in these respects, and we have access to a full census of firms spanning 1977-1999. In a hypothetical industry with no inherent labor volatility, we would not expect significant differences across European countries in private equity formation due to their labor market policy choices. Labor adjustment costs are likely to be more binding, however, in sectors where the US demonstrates substantial labor churn. In these settings, we would expect more substantive differences to emerge across Europe. Under some conditions, these sector level differences are augmented by the general equilibrium effects of comparative advantage and trade.[10]

# 3 Data Preparation

## 3.1 Labor Market Insurance Policies

### OECD Employment Protection Index

Our employment protection index is sourced from the OECD (2004b) with a theoretical range from zero to five. Higher employment protection scores indicate more heavily regulated labor markets, factoring in a wide variety of legislation concerning the individual and collective dismissals of both temporary and regular workers. While the index is comprehensive in design, the OECD notes that its primary limitations are for capturing employment protection inherent in judicial procedures or voluntary contractual provisions among workers and firms. The OECD includes in its rating the difficulty of worker dismissals (e.g., how challenging it is for firms to justify dismissals as "fair"), the number of procedural steps required of employers to dismiss a worker, and mandated requirements for severance pay and notice periods.

Table 1 documents the index for our European sample. In practice, the lowest employment protection score in 1998 is the US at 0.2, while Turkey is judged to have the most stringent

[10] Extensions to this framework can model channels that make private equity investors more sensitive to labor market policies than their general sectors. Section 2.1 emphasizes that private equity investors raise the volatility of their portfolio firms, for example by a constant $\varepsilon > 1$. As a benefit, one can model that private equity investors lower the fixed costs of entry $FC$ for portfolio firms, perhaps due to scarce industry expertise or prohibitive financial constraints of entrepreneurs. These fixed cost adjustments can be sector specific. In this framework, $\partial q_{\min}^{PE}/\partial EPR > \partial q_{\min}/\partial EPR$ and $\partial^2 q_{\min}^{PE}/\partial v \partial EPR > \partial^2 q_{\min}/\partial v \partial EPR$, where $q_{\min}^{PE}$ is the minimum threshold for private equity investors. As an alternative to adjusting the fixed costs, one can model that private equity investors increase the profit function for a given quality. More ambitious and complete extensions could incorporate the portfolio of a private equity investor (e.g., with random shocks across portfolio firms) to allow for shut-down decisions and similar.

restrictions at 3.8. Switzerland (1.1), Denmark (1.4), Portugal (3.7), and Spain (2.9) are extreme values for 1998 within the Continental Europe sample. The UK (0.6) and Ireland (0.9) provide intermediate levels between the US and the most flexible labor markets in Continental Europe. Most countries either receive the same employment protection rating in 1990 and 1998 or move toward more flexible labor markets, especially for temporary workers. Only France increases its protection, from 2.7 to 3.0.

**Labor Market Expenditures**

Labor market expenditures are taken from the OECD Social Expenditures database and include unemployment insurance benefits and active labor market policy expenditures. Unemployment insurance benefits comprise approximately 60% of the total expenditures, with this share declining somewhat in recent years. Active labor market programs include all social expenditures, excepting education, that are designed to improve the beneficiaries' prospects for finding employment or increasing earnings. Examples include labor market training, school-to-work transition assistance for youth, and programs to help the unemployed obtain jobs.

Table 1 documents each country's average annual labor market expenditures expressed as share of GDP. Denmark provides the highest labor market expenditures share at 4.9% in 1998-2001 (or 1482 ECUs/Euros per capita). Belgium, Finland, and Sweden are the next three nations between 3.2% and 3.6%. The UK provides the lowest expenditures at 0.7% (or 173 ECUs/Euros per capita), followed by Italy and four other countries between 1.2% and 1.5%. The US' share of 0.4% is less than the UK. The unweighted average of the labor market expenditures share declines from 3.0% in 1990-1997 to 2.3% in 1998-2001; it is roughly constant between the two periods in nominal per capita terms.

## 3.2 European Private Equity

**European Private Equity and Venture Capital Association Data**

Our first data source is the European Private Equity and Venture Capital Association (EVCA). PriceWaterhouse Coopers and Thomson Financial conduct surveys of European private equity investors on behalf of the EVCA. The EVCA provided us statistics on fifteen European nations from 1990 to 2004. Table 1 documents at the country level the private equity investments of domestic investors over the period. The largest European private equity community in per capita terms is the UK, followed by Sweden and the Netherlands. In absolute terms, France, Germany, Italy, and Spain also maintain significant aggregate investment levels due to their large country sizes. The weakest per capita investments are in Portugal, Austria, and Spain.

Substantive differences exist between the private equity supported entrepreneurship studied here and entrepreneurship defined through self employment. The survey by Addison and Teixeira (2003) notes a consistent empirical finding of a positive association between stronger employment protection and self employment rates. Table 1 suggests that this relationship is unlikely to hold in estimations of cross-country private equity differences within Europe. Southern European countries like Portugal and Greece rank very high on self employment scales but have smaller private equity per capita markets. On the other hand, Scandinavian countries rank low on self employment indices, but have been among the most successful European countries in attracting VC and buy out investments.[11]

[11] Ardagna and Lusardi (2009) and Glaeser and Kerr (2009) further discuss these differences in entrepreneur-

Table 2 documents the sector level distribution of investments for Europe as a whole. These sectors are defined by the EVCA, and App. Table 1 provides additional detail on the sub-industries. Aggregate investments are highest over 1998-2004 for the sectors of Consumer related, Communications, Industrial products and services, and Computer related. The least represented sector is Agriculture. The correlation between shares in the two periods is 0.84. One important trait of the EVCA classification system is that Computer and Communications categories focus on hardware and software development particular to those sectors. Thus, as an example, VC support for a start-up in on-line banking would fall under Financial services.

The central advantage of the EVCA data are their fairly consistent measurement of private equity markets across European countries and industrial sectors during the 1990-2004 period. This consistency for innovative sectors is substantially better than most other sources of economic data. Indeed, an important outcome of this project is simply quantifying how labor market policies shape these country-sector differences in a consistent manner. The most important liability of the EVCA data, which directly influences our empirical approach, is that VC and buy out investments are not separately reported at the sector level (only the aggregate level for a country). This is unfortunate as many of the rationales in the previous section would suggest a stronger impact for VC investors than buy out investors.[12]

**Thomson Financial's Venture Xpert Database**

Our second data source complements the EVCA and helps address the EVCA's limitations. We obtained individual records for private equity investments made in Europe from Thomson's Venture Xpert database. By mapping the countries and sectors used by Thomson to the EVCA's structure, we generate a complementary set of statistics. Table 1 provides the total deal counts by country and time period, while Table 2 gives again the share breakdowns by sector. Reassuringly, there is a close correspondence of these aggregates to the EVCA. For example, the correlation of sector placements in 1998-2004 is 0.71 between the datasets.

There are two central advantages of the Thomson data. Most importantly, because the data are available at the deal level, we can separate VC activity from buy out activity for each country-sector. This separation was not feasible with the EVCA, but it plays a central role in our econometric analyses. Indeed, most of our reported results build upon the Thomson data so that we can exploit these details, with cross-validation to the EVCA aggregates.

The deal level data also allow us to identify country of origin for investments. We use this feature to separate out deals where European firms are funded by private equity investors located in the US. This exercise serves two purposes. First, this analysis provides a second view of the emergence of European private equity markets. The EVCA data do not capture investments where the US private equity investor did not have a physical office in Europe, which is often the case for initial investment entry. Second, we discuss later how these investments can be viewed as more exogenous from factors like public venturing. The rapid development of

ship metrics and policy environments. Bottazzi et al. (2004) and Bozkaya and Kerr (2009) provide a deeper introduction for European private equity markets.

[12] The EVCA data also do not allow us to consider cross-border investments within Europe. The EVCA surveys all private equity investors with a physical presence in Europe, regardless of EVCA membership status. Approximately 75% of European private equity investments recorded by the EVCA are raised within the investing country (an unweighted average across countries). Our EVCA data report the amounts invested abroad by European countries, but the destination countries are not identified. Again, this distinction is not made at the sector level either. We focus on the investment amounts for countries in this paper.

these investments in the last decade, long after labor market insurance policies were devised, helps support the causal direction of our results.

There are two important liabilities, however, of this second dataset. The first is that investment amounts are not reported for about half of the deals. For this reason, we mostly focus on the count of deals by country-sector, which we can identify consistently in both data sources. When we do analyze the overall value of the private equity markets using the Thomson dataset, we impute the missing deal values through a two-step procedure.[13]

A second factor is that the database's coverage of deals increases during the sample period. This expansion, to the extent that it is uniform across sectors or countries, does not influence our results due to our specification choices that control for overall sector and country investment levels. But to the extent that coverage changes in a unique way for a specific country-sector, then these reporting changes cannot be distinguished from more meaningful changes in investment levels. Given the broad comparability of our results across multiple data sources, this does not appear an important factor.

### 3.3 Labor Volatilities for Sectors

#### US Census Bureau Data

We develop our primary measure of the inherent labor volatilities of sectors using the Longitudinal Business Database (LBD) of the US Census Bureau. Sourced from US tax records and Census Bureau surveys, the LBD provides annual observations for every private sector establishment with payroll from 1976 onwards. In 1997, the data include 108 million workers and 5.8 million establishments. Each establishment has a unique, time invariant identifier that can be longitudinally tracked. The LBD also assigns firm identifiers that facilitate the linkages of establishments. Davis et al. (1996) and Kerr and Nanda (2009) further describe these data.

Our primary measure of labor volatility is the absolute employment change of an establishment $e$ in year $t$ from the previous year,

$$ABS_{e,t} = \frac{|E_{e,t} - E_{e,t-1}|}{(E_{e,t} + E_{e,t-1})/2}, \tag{6}$$

where $E$ is the employee count of the establishment. This measure is bounded between zero and two and reduces the impact of outliers. It incorporates the entry and exit of plants that theoretical models emphasize (e.g., technological obsolescence of a facility). The $ABS$ metric also symmetrically treats positive and negative employment shifts for a comprehensive view of labor volatility. This is important as labor adjustment costs can affect hiring decisions just as much as dismissals. Autor et al. (2007) further motivate the $ABS$ metric of labor volatility and relate it to the reallocation metrics developed by Davis et al. (1996).

We prefer to calculate $ABS$ at the establishment level, versus higher levels of aggregation like firms or sectors, for two reasons. First, the establishment level allows for the most accurate sector assignments possible, whereas all of the employment changes for firms must be assigned

[13] This imputation maintains a consistent sample, and we reassuringly obtain very similar patterns to the EVCA data at an aggregate level where imputation is not necessary. The first step of the procedure regresses available deal amounts on vectors of fixed effects for countries, industries, years, and number of investors. We then predict deal values for missing observations using the estimated parameters. The predictions take negative values for a small fraction of the observations, which we replace in the second step with the minimum deal amount by industry and type. This procedure is done separately for VC and buy out investments.

to a single sector, resulting in less precision. Second, higher levels of aggregation dampen volatility measurements as one only uses the net changes in employment across the periods (instead of the gross changes). The micro-data contain the most information.

After calculating $ABS$ at the establishment-year level, we take the mean across establishments within each sector over the 1977-1999 period. We denote this sector level mean as $Labor_s^{US}$. We define sectors through two representative three-digit industries from the US Standard Industrial Classification system (SIC3).[14] We select these industries to reflect where private equity investments are likely to occur. We calculate volatility across the longest period possible to provide a comprehensive metric that does not depend upon particular business cycle conditions or industry life cycle stages. This construction most closely matches our model.[15]

While the establishment level calculation is the most appropriate, we also test its general robustness by calculating a second version of $ABS$ at the sector level for 1992-1999 (i.e., net employment changes by sector-year). This latter version focuses on net industry shifts during a period of overlap with the European private equity data. The measured sector volatility is a tenth of the establishment level, reflecting the higher aggregation, but its correlation across sectors with our preferred metric is 0.73. Generally, we find consistent results across a range of approaches and time periods for calculating US labor volatility.

Table 2 lists the two volatility calculations for the EVCA sectors. The Computer (0.52) and Energy (0.49) sectors have the largest mean US labor turnover, while Chemicals and materials (0.28) and Industrial products and services (0.31) have the lowest. The LBD cannot support accurate calculations for Agriculture, Construction, and Other sectors. These sectors are small in terms of private equity investment and are excluded below. Sector concordances developed in this project are available upon request.

**Bureau van Dijk's Amadeus Database**

Our final data source is Bureau van Dijk's Amadeus database. Amadeus is a financial database containing information on several million companies from all countries and industries within Europe. The database includes both public and private companies, with the underlying information drawn from multiple international and local information providers. The collected records include the country and industry of the firm, as well as annual operating data like employment and sales. Amadeus also provides information on firm ownership structures that includes whether or not a firm's owner is a private equity investor. Private equity ownership is evident in about one percent of the Amadeus sample.

The Amadeus database serves three purposes in this study. First, and most importantly, we use these records to show that firms supported by private equity investors display greater labor volatility than their close peers in Europe. This is a necessary first stage for our hypothesis. Second, we use these data to calculate the general labor volatility of European firms by sector. These pan-European volatilities complement the US volatilities just discussed. Finally, Section 2 noted that a central mechanism through which labor market insurance policies can influence private equity investment is differences in sector size (and thus potential investment opportunities). We use Amadeus to model underlying country-sector sizes in terms of aggregate

[14] We use the term "industry" to denote an SIC3 industry and the term "sector" to denote an EVCA sector.

[15] While the 1977 start date is mostly determined by the LBD, the late 1970s and early 1980s also represent when US private equity began to grow in earnest, along with some of its major sectors (e.g., Gompers and Lerner 2002). This is attractive for modelling the inherent labor volatilities surrounding Europe's emergence after 1990 as it includes some of the initial phases of sector development.

employment so that we can distinguish these effects.

Our calculations of $ABS$ within Amadeus resemble (6) with some exceptions. First, the Amadeus metrics are calculated at the firm level rather than the establishment level due to the higher level of reporting. Second, despite the vendor's best efforts, the coverage of firms in Amadeus is not universal, unlike the Census Bureau data. We thus only calculate $ABS$ over year-to-year employment changes for surviving firms. That is, we only consider employment differences between two consecutive years in which the firm is in operation, which abstracts from entry and exit patterns that are an important part of the theory. These calculations focus on the period after 1999 when Amadeus' coverage is most complete.[16]

The last two columns of Table 2 list these European firm volatility metrics. We use the same mappings from SIC3 industries to EVCA sectors that we use with the US data. The firm level employment volatilities in Amadeus fall in between the US volatilities measured at the establishment and sector levels, reflecting the intermediate level of aggregation. The differences across sectors are again highly correlated. The Amadeus measures have a joint correlation of 0.88 across sectors, and a correlation with the US establishment level data of about 0.85. The average volatility for private equity backed firms is higher than that for general firms in all but two sectors. The unweighted premium in volatility is about 20% across sectors.

Our final data preparation step is to combine where possible the Bureau van Dijk's Amadeus database with the deal level records available from Thomson. Our matching effort begins with an automated name-matching routine to pair Amadeus firms with private equity ownership to the Thomson's dataset. We then manually verify all automated matches and correct evident errors. This exercise validates the Amadeus ownership data, as we can verify over 70% of the listed private equity owners in Amadeus as also being private equity investors in the Thomson's dataset. Moreover, where this match occurs, we can also use deal types to separate VC and buy out investments. This separation is useful when examining employment volatilities.

# 4 Labor Volatility in Private Equity Backed Firms

Our first analysis quantifies the extent to which firms backed by private equity investors in Europe are more volatile with respect to employment than their peers. This is an important starting point for understanding how labor market policies influence these firms. We continue with our $ABS$ metric, calculated annually at the firm level after 1999 using the formula (6). We only consider observations for which we observe positive employment in two consecutive

[16] We also require that included firms have four or more employees. This restriction is partly due to Amadeus' coverage of very small firms being significantly more incomplete than among larger firms. This requirement also reflects a data constraint, as we are only able to obtain consistent private equity ownership data for all countries in our sample within Bureau van Dijk's "medium and large firm" datasets. Bureau van Dijk defines medium and large firms to be those above the median firm size at the industry level. This threshold is uniform across countries for a sector and typically quite small: its median value is one employee, and its mean value is four employees. We confirm that this data constraint does not influence our results in two ways. First, we have the private equity ownership data for the complete sample of firms in nine countries. We find almost exactly the same outcomes in these nine countries when using either the medium and large sample or the full sample; moreover, these results are extremely close to those we report in Table 3. Second, we find very similar results when looking at a variety of subsamples (e.g., minimum sizes for country-industries). For comparison, Kerr and Nanda (2010b) report that 20 million of the 26 million firms in the US are self employed individuals without paid employees. Of the remaining six million businesses, 80% have 20 employees or fewer.

years, for a total count of 2.35 million firm-years.[17] The private equity ownership data in Amadeus do not vary longitudinally for firms, and instead most frequently reflect the latest ownership structures known to Bureau van Dijk. We thus prepare a fixed indicator variable for private equity ownership in firms.

The first column of Panel A in Table 3 simply regresses the $ABS$ metric on a constant and the private equity indicator. The regression is unweighted and clusters standard errors by firm. We transform $ABS$ to have unit standard deviation to aid interpretation. The estimation finds that the employment volatility of private equity backed firms is 0.18 standard deviations higher than that of firms without private equity investors. This is an important deviation.[18]

It is natural to question whether this higher employment volatility is simply due to firms backed by private equity investors being in more volatile sectors or at a different point in their life cycle. The remaining columns in Panel A investigate this question. Columns 2 and 3 continue with the full sample, first including country-industry-year fixed effects. These controls lower the volatility premium by about a quarter of its raw effect, but the private equity difference remains strong and statistically significant. Column 3 further controls for the firm's contemporaneous employment and revenues. These controls further raise the premium.

Columns 4 and 5 take a second approach of restricting the sample to country-industry pairs where private equity investment is common (defined as more than 5% of firms). This stricter framework excludes over 95% of the sample but further conforms the treatment and control groups. The average employment volatility in this sample is 13% higher than in the full sample. The coefficients are reduced by a third to a half, but the private equity differential remains robust.

Column 6 takes a third approach of creating a control group that most closely matches the employment and revenues of the firms backed by private equity investors. We select for each firm backed by VC or buy out investors the closest peer within the same country-industry-year. We exclude private equity backed firms where we do not know the investment type or cannot find a peer within the same country-industry-year. With this technique, the volatility estimate is about 0.17 again. Looking across these specifications, we thus conclude that firms backed by private equity investors are systematically more volatile than their European peers.

Panel B uses the match between the Amadeus and Thomson datasets to separate effects for firms backed by VC and buy out investors. As we do not match all firms with private equity ownership in Amadeus, we also include an indicator variable for unknown private equity investor type. Quite clearly, VC backed firms are significantly more volatile in all of the specification variants, with a premium of 0.17-0.29 standard deviations. This reflects both greater VC investment levels in volatile sectors, and greater volatility of VC backed firms compared to their closest peers.

The labor volatility of firms backed by buy out investors is more nuanced. These firms tend to be slightly more volatile, but this premium is not due to these investments being in more volatile sectors or at more volatile points in the firm life cycle. In fact, these factors push buy out investments to have a lower volatility than European firms generally. However, firms backed by buy out investors do display higher volatility relative to their close peers in Columns

[17] We exclude Ireland and Switzerland from this analysis as their firms show an abnormally high likelihood of maintaining the exact same employment from year-to-year (ten times higher than the next closest country). We do use the Amadeus data to calculate the country-sector sizes for these countries.

[18] The mean values of $ABS$ within Amadeus are 0.231 for firms backed by VCs, 0.165 for firms backed by buy out investors, and 0.156 for firms generally. These values only consider employment changes in surviving firms.

3 and 7. Moreover, we likely under-estimate this difference (both with respect to peers and with respect to VC investments) since we can only measure net changes in firm employment, which misses restructuring that leaves the size of the firm unaffected.

These results suggest that labor market insurance policies should influence both VC and buy out investment patterns, with effects for VC investments being particularly strong. Policy choices influence VC investors through both sector development and the viability of their business model. Buy out investors are much less influenced in terms of sectors, but the impact on their business model remains important.

# 5 Private Equity Placements in Europe

## 5.1 Empirical Specification with Base Policies

Table 4 analyzes the country-sector distribution of private equity placements using the base employment protection and labor market expenditures policies directly. This multivariate framework closely connects with prior studies, and we introduce a simple linear test to show how policy mechanisms matter. Our basic specification takes the form

$$PE_{c,s} = \phi_c + \eta_s + \beta_{EPR} EPR_c \cdot Labor_s^{US} + \beta_{LME} LME_c \cdot Labor_s^{US} + \varepsilon_{c,s}. \quad (7)$$

We use this empirical framework to test separately three outcome variables $PE_{c,s}$ using the Thomson data. Columns 1-3 are for VC investments, and Columns 4-6 are for buy out investments. Within each triplet, the first column models an indicator variable for whether annual investments greater than one Euro/ECU per capita occur in the country-sector during the 1990-2004 period.[19] The second column is the log count of deals observed, and the third column of each triplet is the log value of investments made.

For explanatory variables, we interact the two labor market policies, $EPR_c$ and $LME_c$, with the sector level US labor volatility metric $Labor_s^{US}$ developed from establishment data. $LME_c$ is the log value of labor market expenditures as a share of GDP. $\phi_c$ and $\eta_s$ are vectors of country and sector fixed effects, respectively. Country fixed effects absorb the main effects of the labor market policies, while sector fixed effects absorb the main effects of $Labor_s^{US}$. As these fixed effects also control for overall European private equity investment behavior by country and sector, we only exploit residual variation for identification. The explanatory variables are transformed to have unit standard deviation for interpretation. The interaction of 15 countries and 14 sectors yields 210 observations per regression on the entry margin. Analyses of investment intensity are conducted over country-sector observations where positive investments exist.

We weight estimations by an interaction of country population with total sector size across countries. We place more faith in weighted estimations than unweighted estimations since many country-sector observations are by their nature very small (e.g., Austria's energy sector). Measurement error is generally less for investment counts and deal amounts in larger countries and sectors. However, we explicitly want to avoid weighting by realized country-sector size since

[19] Multiple country-sector observations receive very small investments over the period studied. Accordingly, we define the entry threshold for extensive margin analyses as annual private equity investment of one Euro/ECU per capita in the sector. For domestic investments, 34% and 62% of country-sectors meet this bar for VC and buy out placements, respectively. The results presented below are generally robust to adjusting this threshold amount so long as a meaningful degree of variation remains.

this is endogenous to the mechanisms that we are studying. Using the interaction for weights focuses attention on better measured outcomes without encountering this latter concern. We later report unweighted specifications in Tables 9a and 9b. Finally, estimations cluster standard errors by sector. App. Table 2 also reports robust standard errors and clustering by country. Sector level clustering tends to be the most conservative technique.

Columns 1-3 find a very consistent impact of labor market policies on VC investments. There is a negative $\beta_{EPR}$ elasticity, and a positive $\beta_{LME}$ elasticity. All elasticities are statistically significant at a 90% confidence level, excepting $\beta_{LME}$ in Column 2 that is of borderline precision. Stronger employment protection dampens VC entry and investment levels in volatile sectors, while greater labor market expenditures aid these placements.

We earlier emphasize how these policies are jointly chosen. This suggests that their joint strength may be more important than their partial elasticities. Recall our conceptual model (3) where policy adjustments along the labor market insurance frontier required $\Delta LME = -\Delta EPR \cdot (\alpha_{EPR}/\alpha_{LME})$. Using the results from specification (7), the impact of such an adjustment on private equity investment is $\Delta PE = \beta_{LME} - \beta_{EPR} \cdot (\alpha_{LME}/\alpha_{EPR})$. The bottom of Table 4 presents this comparative static with $I(\cdot)$ defined by $\alpha_{LME} = \alpha_{EPR}$. This equal contribution of employment protection and labor market expenditures is motivated by Figure 1's policy trade-off within Continental Europe that is further discussed below.

The linear combinations of $\beta_{LME} - \beta_{EPR}$ are more stable and well measured than the individual policies are. The joint test suggests that a one standard deviation change from employment protection toward labor market expenditures is associated with a 26% higher rate of VC entry for sectors with high labor volatility compared to sectors with low volatility; growth in investment counts and valuations are around 35%. Both margins are thus important. Comparing Columns 2 and 3 suggests that average deal sizes are not affected, such that the impact of labor market policies is mostly on the number of investments made.[20]

Columns 4-6 consider buy out investments, where the results are more mixed. There is no evidence that choice of employment protection versus labor market expenditures differentially affects entry of buy out investors in volatile sectors. There is evidence of relatively more deal counts among volatile sectors in countries favoring labor market expenditures over employment protection, but this result is not confirmed when looking at the total value of investments. As anticipated, comparing Columns 4-6 to Columns 1-3 shows that the impact for buy out investors is substantially weaker than for VC investors. These patterns are repeated at several points throughout this study.

### 5.2 Policy Transformations

Our theory discussion highlights that incorporating base labor market policies directly into regressions captures both differences across nations in the level of labor market insurance provided and differences in the mechanisms employed. Our proposed linear test in Table 4 provides a more consistent estimator, but the ideal estimation would separately quantify both traits as they are distinct from a policy perspective. While both features are exceptionally complex and multi-dimensional, we next develop a Levels Index and Mechanism Index that model more clearly these important policy trade-offs.

[20] Related work on estimating average sizes includes Ardagna and Lusardi (2010), Da Rin et al. (2010b), and Kerr and Nanda (2010a).

We begin with the 1990 employment protection index and the 1990-1997 labor market expenditure shares of GDP given in Table 1. We choose these periods to fix the variables near the start of the sample period, well before the dramatic growth in European private equity investments after 1998, while also allowing for some smoothing across differences in national business cycles for the labor market expenditures shares. We transform these base policies to have unit standard deviation, so that their scales are comparable. We measure the single-dimension distance for each policy from the corresponding US value, which is lower than all European countries on both dimensions. Both of these distances have a maximum of less than four standard deviations.

We calculate the Levels Index as the average of these policy distances for each observation. This Levels Index estimates in standard deviations the distance from a country's joint provision of (employment protection, labor market expenditures) to the US. Table 1 documents these values, and the vertical axis of Figure 4 plots these distance metrics. The UK provides the weakest labor market insurance measured through this technique, followed by Switzerland, Ireland, Austria, and Norway. Sweden, Denmark, Belgium, Spain, and Portugal are among the highest insurance levels.

The Mechanism Index describes the technique used to provision the labor market insurance. It is a radian measure of the labor market expenditures distance divided by the employment protection distance. The Mechanism Index can be thought of as the slope of a ray extending from the origin of Figure 1 to the nation's position in (employment protection, labor market expenditures) space. The radian measure is a simple monotonic transformation (inverse tangent) of the base distance ratio that is bounded by $[0, \pi/2]$. This transformation eliminates the asymmetry that arises with a simple ratio. Larger values of the Mechanism Index indicate greater reliance on labor market expenditures than employment protection for providing labor market insurance. Portugal, Italy, and Spain are the lowest values, indicating strong dependency on employment protection, while Denmark, Ireland, the UK, and Switzerland most emphasize labor market expenditures. The values are again listed in Table 1 and are plotted as the horizontal axis of Figure 4.

The trend line for Continental Europe in Figure 4 is very flat, illustrating better than Figure 1 the empirical substitution of European economies between labor market expenditures and employment protection for the provision of labor market insurance. This approximate orthogonality of the two indices for Continental Europe is not by construction but instead the result of selected policy levels. Including Ireland and the UK in the trend line results in a negative correlation of about -0.9. In words, countries providing higher levels of labor market insurance tend to employ more stringent employment protection when the Anglo Saxon economies are incorporated. Within Continental Europe itself, however, there is no clear relationship between the level of labor market insurance provided and the mechanisms employed.

### 5.3 Empirical Specification with Transformed Policies

Table 5 repeats Table 4 with the transformed labor market policies. App. Table 3 again reports alternative techniques for calculating standard errors. Our estimating framework is similar to specification (7) except that we use our transformed indices instead of the base policies. As would be expected, our results for the Mechanism Index closely parallel the estimates discussed in Table 4. We again find strong evidence that labor market insurance policies that emphasize labor market expenditures rather than employment protection are associated with stronger

private equity entry and investment levels in more volatile sectors. The transformation of the underlying policies simply makes the results easier to interpret.

Our proposed transformation also allows us to assess the relative importance of the total level of worker insurance provided as opposed to the policy mechanism used to implement it. Coefficients for the Levels Index in Table 5 are uniformly smaller than those for the Mechanism Index, especially with respect to VC investments, and the values are not statistically different from zero. We thus generally conclude that the mechanisms used to provide labor market insurance are the more important attribute for private equity investors. The remainder of this paper provides a variety of extensions and robustness checks on this conclusion.[21]

### 5.4 Including Country-Sector Size and Patenting Rates

There are several theoretical channels in Section 2 through which labor market policies affect private equity investment. Some channels focus on the generation formation of sectors and opportunities that private equity investors find attractive, while other rationales suggest effects for private equity investors over-and-above general sector development. Our estimations in Tables 4 and 5 are an aggregate of these channels. In Table 6, we separate from the aggregate effect two specific components: 1) the portion due to overall larger sector size and 2) the portion due to changes in the innovativeness of the sector (conditional on size). While these types of controls are a typical part of the Rajan and Zingales (1998) methodology, the explanatory power of these factors is also of direct interest to us.

We estimate country-sector size through the Amadeus database. Official statistics are not very useful for this exercise given the difficulty in comparing them across countries; the specialized nature of our sector definitions for private equity are also a factor. Thus, we map the firm records in the Amadeus dataset to the EVCA sectors by SIC3 industry. We then aggregate total employment across all firm records from 1999-2004 to the country-sector level as our measure of size. We also find similar results when using firm counts or aggregate firm revenues instead of employment.[22]

In addition to country-sector size, labor market policies may directly influence innovation levels. If innovation brings with it risks of costly employment adjustment, firms may pursue alternative strategies even within the same sector across countries. VC investors, in partic-

[21] Our discussion also suggests a broader prediction that private equity investment for a country as a whole is stronger when labor market insurance policies favor labor market expenditures over employment protection, conditional on the level of worker insurance provided. This prediction is similar in spirit to Figures 2 and 3, but accounts for joint policy determination and is invariant to including or excluding Anglo Saxon nations. We find this prediction to be true, but these results are subject to typical concerns of a cross-sectional analysis with country level observations. These results are available upon request.

[22] Three econometric details about this calculation are important to note. First, estimating country-sector sizes across the 1999-2004 period is necessary given Amadeus' incomplete coverage beforehand. By coming at the end of the sample period, this measure tends to find a larger role for country-sector size compared to a measure from the beginning of the sample period or an average measure throughout 1990-2004. Second, coverage in Amadeus differs somewhat across countries and sectors. Systematic differences in coverage along either dimension (e.g., weaker coverage for one nation versus another) does not influence our estimations due to the country and sector fixed effects. Systematic reporting differences for a particular country-sector can bias our estimates, but we have not discerned these in the data. Finally, we use a more encompassing mapping of SIC3 industries to EVCA sectors than the representative industries that we use with the labor calculations. This is because the more encompassing measure performs better econometrically, creating a higher bar for our labor market policies to exceed.

ular, are attracted to technological opportunities, and thus their entry may be deterred by these forces. To account for this factor, we estimate country-sector patenting through records provided by the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO). Both datasets have their own technology classifications that we map to EVCA sectors. Our reported results simply control for the sum of country-sector patenting in the two datasets during the 1990-2004 period.[23,24]

The first column in Table 6 simply replicates the base estimation from Table 5 for convenience. Column 2 demonstrates that country-sector size is an important determinant of placements. A 10% growth in country-sector size correlates with a 3% growth in the count of VC investments made. Looking at the Mechanism Index, the estimated role of labor market policies declines by a little over 20%. An important part of the aggregate effect is thus the development of sectors generally that are attractive to private equity investors. The importance of labor market policies is further robust to controlling for the level of patenting in the country-sector, which also strongly predicts VC placements. In fact, the standard errors decrease slightly from Column 1 to Column 3.

Many observers believe that agglomeration economies exist for the types of firms supported by private equity investors. These returns to co-location or clustering may occur directly due to spillovers between portfolio firms. For example, jobs in innovative firms, which face substantial risks of negative employment shocks, are more attractive to specialized workers if there are a large group of similar firms nearby to which workers can easily move in the event of job loss. Agglomeration economies also emerge through the development of special support services (e.g., intellectual property lawyers), thicker markets for matching firms and workers, a more entrepreneurial culture, and so on.[25]

Unreported estimations test whether our findings are solely due to agglomeration economies by introducing a squared term for country-sector size. The relationship is convex, such that investment levels grow disproportionately in larger country-sectors than in smaller ones. But, this non-linear effect is not very strong, and the addition of the higher order terms does not influence the estimated effects for labor market policies. We also find our results robust to controlling for firm concentration ratios. We thus maintain the simpler linear control. Finally, we also find similar results when using Amadeus to exclude country-sectors with very small activity.

The final three columns consider the log count of buy out investments. These investments behave similarly to the VC investments. The additional controls reduce the estimated effect of labor market policies by about 18%. Unreported specifications find that the other private equity outcomes in Table 5 behave similarly in the presence of these controls. The additional covariates explain 17% of the VC entry effect and 20% of the value of VC investments, and the role for labor market policies remains strong and statistically significant. The null effects

[23] This approach double counts inventions that are filed with both patent authorities. This is acceptable, and perhaps even advantageous, as inventions filed with multiple patent offices are typically of higher quality than those filed with just home country patent offices. This approach again creates a higher hurdle.

[24] An alternative view of the patent control is that it seeks to capture a second market size effect. The market size captured by Amadeus includes many types of firms that are not appropriate to private equity investors. We would ideally have a second measure of market size that accounts for the number of potential investment opportunities. This is generally unobservable excepting for where actual investments occur. The patent measure in part proxies for this more specific opportunity set.

[25] Ellison et al. (2010) provides a comprehensive overview of the determinants of agglomeration, and Glaeser and Kerr (2009) provide specific tests for entrepreneurship.

for buy out entry and investment sizes also persist. In summary, controlling for country-sector sizes and patenting rates generally explains about 20% of the aggregate effect.

### 5.5 Alternative Private Equity Data

Table 7 considers alternative measures of private equity investment. Panel A reports aggregate effects for labor market policies similar to Table 5, while Panel B reports effects after conditioning on country-sector size and patenting rates. We keep this format in subsequent tables as we are interested in both estimates.

The first two columns of Table 7 present estimates using the EVCA private equity data. These data are attractive in that they are perhaps more official estimates of private equity placement across European countries. The EVCA also has access to some information not contained in the deal level reports available in Thomson. For example, while a private equity investor may be reluctant to disclose publicly the investment values of deals individually, it will generally be willing to disclose its investments by sector to its industry association under confidentiality. This verification in a second data source is thus quite important.

Columns 1 and 2 find similar effects to our earlier results. The elasticity estimates in both panels fall in between those of our VC and buy out investments in Tables 5 and 6 using Thomson data. This is comforting given that the EVCA's total counts and investment values aggregate across these two investment types. The entry margin likewise blends the earlier results with an elasticity of 0.057 (0.037). Unfortunately, we cannot separate VC and buy out placements with the EVCA data.

The next four columns present estimates of private equity placements into Europe by US investors. These US-based investments were very trivial at the start of the sample period, but grew remarkably after 1990. The patterns of overseas placements, coming well after basic labor policies were established, thus aid in a causal interpretation of the findings. As noted in the data description, US-based investors are also less likely to be influenced by public venturing and similar industrial policies, which we have yet to control for in the analysis.

Column 3 finds a robust elasticity with respect to the Mechanism Index for US-sourced VC investments. The elasticities, in fact, are stronger than those estimated for domestic VC investments in Tables 5 and 6. These differentials might suggest that public venturing or a similar factor dampens the negative impact of strict employment regulations on the development of volatile sectors. While suggestive, the larger standard errors of the US-sourced investments mean that it is less precisely estimated than the domestic effects. We also find an economically smaller entry margin of 0.073 (0.025).[26] We thus interpret these results as more of a confirmation using foreign investors. More robustly, there is evidence of larger investment sizes in more volatile sectors by US investors when the labor market policies favor flexibility.

The pattern for US-sourced buy out investors is not very different from domestic investments. We find almost exactly the same elasticities for the log count of investments. This is despite losing 43 country-sector observations from the domestic sample due to lack of US-sourced investments. We also continue to find a null effect on the entry margin. In Column 6, we find that both the Levels Index and Mechanism Index points toward lower investment amounts. Together with Column 5, this suggests that deal sizes decreased. We do not have

[26] About 21% and 23% of country-sector observations achieve one Euro/ECU per capita for US-sourced VC and buy out placements, respectively.

a strong rationale for this effect, and we hope that others are able to evaluate whether this finding holds more generally.

### 5.6 Alternative Sector Volatilities

Table 8 considers alternative measures of sector volatility. In this table and the next, we focus on the count metrics of VC and buy out investments that are central to our study. Results for the other VC variables (i.e., the entry margin and log investment amounts) behave similarly to the VC count variable. Likewise, the additional estimations do not change the null result observed on the entry of buy out investors or their total investment amounts.

Column 1 first considers a measure of labor volatility estimated specifically for European firms backed by private equity investors. We calculate these metrics at the sector level across all countries in our sample. The estimated impact of labor market policies on VC investments is greater with this measure of sector volatility. It declines somewhat when using the labor volatilities of all firms in Europe by sector, but these latter effects in Column 2 still remain above those using the US metrics based upon establishment data. Columns 4 and 5 find similar results for buy out investments, although the estimates conditional on country-sector sizes and patenting are smaller in Column 5 than with the US metrics.

These results suggest even more strongly that private equity investments are discouraged from entering volatile sectors in countries that favor strict employment protection. Our model makes clear, however, that the higher elasticity can reflect a selection effect as to the type of investments pursued, as well as the underlying economic effects we wish to quantify. Indeed, these differences to the US-based outcomes are due in part from the higher relative differences across sectors within Europe for the most volatile sectors (e.g., Energy, Computers). It is also possible that recent birth and growth of some sectors within Europe after 1999 biases the European measures. Thus, we believe that the establishment level volatilities calculated for the US across the full distribution of firms from 1977 onwards are most appropriate, although it is clearly comforting to find similar results with European measures directly.[27]

Column 3 takes the other extreme where we only calculate volatility at the sector level using the US data from 1992-1999. By aggregating over establishments and firms, we remove much of the inherent labor volatility at the plant level in which we are most interested. Nonetheless, we find quite comparable effects with this measure, although the effects for VC investors conditional on country-sector size and patenting is only of borderline statistical significance. This broad comparability across multiple datasets and techniques suggests that our calculations (6) are successful in capturing the inherent labor volatilities of sectors.

### 5.7 Additional Robustness Checks

Tables 9a and 9b provide additional robustness checks on these specifications. These tables are repeated for US sourced investments in App. Tables 4a and 4b. Before going through each specification in detail, it is important to recall that any fixed trait of a country or sector is accounted for by our country and sector fixed effects. We are thus looking to test factors that can vary in their impacts across sectors within a country. Column 1 starts by incorporating additional national policies to test whether the Mechanism Index reflects other policies that

[27] Our model also makes clear that we explicitly do not want to consider the volatility of firms at the country-sector level within Europe, where selection margins and industry life cycle issues become even more severe.

encourage private equity formation. Similar to the main regressors, these additional policies are interacted with US labor volatility by sector.

We include four factors that the entrepreneurial finance literature frequently emphasizes and that we think may also relate to sector volatility. The first is the strength of stock markets for initial public offerings by private firms (e.g., Black and Gilson 1998, Michelacci and Suarez 2004). Higher labor volatility related to technological opportunities might also be correlated with greater need for large capital infusion to realize technological potential (e.g., biotech, clean energy). We next model corporate tax rates (e.g., Da Rin et al. 2010a) as our discussion in Section 2 emphasizes that general taxes may need to be higher to support greater labor market expenditures. Our third measure concentrates on business entry regulation barriers (e.g., Fonseca et al. 2001, Klapper et al. 2006, Ciccone and Papaioannou 2007). The entry and exit of establishments and firms is a primary component of the labor volatility measure (6), and heavy entry regulations could dampen this margin. Finally, we control for the share of national private equity investments made by public investment funds (e.g., Leleux and Surlemont 2003). As mentioned earlier, governments may seek to compensate in volatile sectors for strict labor regulations through public sponsorship and related industrial policies.

The unreported coefficients for these additional explanatory variables are mostly small and statistically insignificant. The factors, of course, are important for the development of private equity investments and entrepreneurship generally in countries, but their systematic variation across sectors within countries are weak along the volatility dimensions that we model here. The estimated role of labor market policies remains almost exactly the same for VC placements in the presence of these controls. The role of labor market policies for buy out investors diminishes, however, especially when also conditioning on country-sector size and patenting.

Unreported specifications further verify the robustness of the results to including volatility interactions with measures of product market regulations, government ownership of banks, total government expenditures per capita, and the level of captive investments for private equity. We also find robust results when looking at average education levels or the overall patenting intensity by country, but our country-sector patenting controls are more important here. Finally, we find very similar outcomes when interacting collective bargaining arrangements or trade union density by country with sector volatility. The latter arrangements are interesting given that they also influence labor market flexibility, even though they are less emphasized by the entrepreneurial finance literatures.[28]

Column 2 incorporates interactions with national populations and GDP per capitas. These covariates model effects related to market sizes and country wealth. They specifically test, for example, alternative explanations like poorer, smaller countries having greater reliance on employment protection and weaker investments in volatile sectors because these sectors are relatively underdeveloped. We find very similar results when including these controls.

Perhaps most important, Column 3 includes interactions for differences across countries in their legal origins. A number of studies conclude that the legal origins of countries shape modern institutions and concomitant economic development. These institutions and legal regimes impact the development of private equity markets beyond the labor market policies that we explicitly model (e.g., Cumming and Johan 2009, Cumming et al. 2009). Botero et

[28] The interaction terms for collective bargaining and unionization are negative but not statistically significant. This may be the true economic effect, but it may also reflect difficulty in comparing these metrics across countries. These statistics are not available at the country-sector level, but this is an important avenue for future research as data availability improves.

al. (2004) find that legal origins explain more of the existing differences in labor regulations across countries than recent political outcomes. Given these deep antecedents, we interact indicator variables of legal origins with sector volatilities, which partly act as region-industry fixed effects, too. Column 3 further emphasizes the Mechanism Index effect for VC investors, while buy out investors are dampened somewhat.[29]

We next exclude the UK and Ireland from the sample. Our results in Column 4 are very similar to the full sample. In Figures 1-3, these two countries are outliers, and it is important to understand why they their exclusion no longer matters. The relationship between policy mechanisms and sector specialization patterns in Anglo Saxon countries are similar to those from Continental Europe. This cannot be observed when modeling a single policy as in the cross-sectional graphs. But by controlling for the overall level of labor market insurance provided, either explicitly or implicitly through country fixed effects, the more robust pattern related to the mechanism used for providing labor market insurance emerges. A contribution of our paper is to bring this out.

Column 5 shows comparable results when we drop the sample weights. VC investment patterns are generally robust, although the effect after controlling for country-sector size and patenting is of borderline statistical significance. Buy out investments are generally weaker. This latter effect comes, however, mainly through an 80% increase in standard errors, compared to just a 30% decline in measured economic performance. Our weighting scheme, while not emphasizing the particular outcomes of country-sector observations, improves the precision of estimates by emphasizing portions of the data that are more robustly measured.

Finally, Column 6 includes additional interactions with each sector's aggregate growth rate for European private equity from 1990-2004. We explicitly measure our labor volatilities across a long period and through the formula (6) to guard against labor volatilities reflecting sector expansions or declines. We more formally test this independence in Column 6 by interacting sector growth with both the Levels Index and Mechanism Index. The correlation of aggregate sector growth for European private equity investments and US sector labor volatility is 0.20. All of our effects persist. Interestingly, sector development for rapidly growing sectors across Europe is relatively stronger in countries that favor more flexible labor markets. The estimated effects, however, are only about half of the comparable differences due to sector labor volatility.

The appendix to this paper considers changes in labor market insurance schemes from 1990-1997 to 1998-2004. We emphasize in this paper the cross-sectional patterns due to both theoretical and empirical issues discussed in the appendix. The appendix provides suggestive evidence that changes toward providing worker insurance through labor market expenditures are associated with a mixture of growth in aggregate private equity investments and/or shifts in investment composition toward sectors with higher labor volatility.

### 5.8 Alternative Mechanism Designs

In addition to these robustness checks, we also test several modifications to our index design. Perhaps most important, an earlier version of this paper shows very similar results when normalizing labor market expenditures by country population instead of GDP. The comparability

[29] These classifications follow La Porta et al. (1997). French/Spanish countries include Belgium, France, Italy, Netherlands, Portugal, and Spain. Germanic countries include Austria, Germany, and Switzerland. Scandinavian countries include Denmark, Finland, Norway, and Sweden. The UK origin countries include Ireland and the UK. For this sample, the common versus civil law distinction overlaps entirely with the UK origin.

of the two results suggests that country wealth or wages levels are not determining the patterns observed. Our results are also robust to using the full sample period to measure the employment protection and labor market expenditures variables.

We also find similar outcomes when replacing the Mechanism Index, which employs a bounded radian measure of policy ratios, with a simple ratio of policy distances. Likewise, we find similar results with variants of the Levels Index. One variant models the overall labor market insurance level through Euclidean distances rather than linear distances. The Euclidean distance can be thought of as the length of a ray from the origin of Figure 1 to the nation's position in (employment protection, labor market expenditures) space. A second variant uses empirical results from Clark and Postel-Vinay (2009) to weight the Levels Index by how much employment protection and labor market expenditures boost workers' perceptions of security. The greater importance of policy mechanisms persists with these index variants.[30]

Ultimately, there is no single approach for estimating the level of labor market insurance. While we focus on the two most important policy levers for providing labor market insurance, other techniques exist and, to some degree, normative values will always play an important role in these choices (e.g., Kerr 2007). Nevertheless, the Mechanism Index captures a meaningful, first-order policy trade-off that is evident empirically, grounded in theory, and strongly associated with how private equity markets have formed in Europe. We are unable to draw consistent conclusions regarding the level of insurance provided, except that it is of lesser importance than the mechanism. Our policy transformations in Section 5.2 demonstrate these features in an intuitive manner, and we hope that future research will further refine these metrics and our understanding of these policy structures.

# 6 Conclusions

European economies empirically substitute between employment protection regulations and labor market expenditures (e.g., unemployment insurance benefits, job transition assistance) as mechanisms for providing worker security. A growing body of theoretical and empirical evidence finds employment protection acts as a tax on firm adjustments, while the incidence of labor market expenditures on this margin is less direct. Many European policy makers and business leaders want to replicate US VC and buy out communities in their home countries. Both of these private equity groups, however, operate in dynamic environments that require frequent adjustments of the labor forces of their portfolio companies. Their business models make these investors very sensitive to strict labor regulations.

We find that worker insurance policies favoring labor market expenditures over employment protection encourage greater private equity entry and larger investment levels. This is true for both domestic and US-sourced investments. It is particularly strong for VC investments. This

[30] Clark and Postel-Vinay (2009) empirically evaluate whether employment protection or unemployment insurance benefits (the largest portion of labor market expenditures) better promote perceptions of job security as measured through the European Community Household Panel surveys. These are the only other empirical estimates of the $\alpha_{LME}$ and $\alpha_{EPR}$ parameters in the $I(.)$ function of which we are aware. Strikingly, these authors find that employment protection does not raise worker perceptions of security; if anything, Clark and Postel-Vinay's (2009) estimates imply stricter employment protection lowers perceived labor market insurance by private sector workers. On the other hand, unemployment insurance benefits robustly increase perceived insurance. We hope that future research estimates the levels of labor market insurance provided through other economic data like worker income and consumption stability.

effect is conditional on the level of worker insurance provided, which is of lesser importance for private equity patterns than the policy mechanisms employed. Policy choices regarding the optimal levels and mechanisms of labor market insurance are complex and should consider many economic and non-economic factors. This study highlights one factor that should influence the trade-off between employment protection and labor market expenditures.

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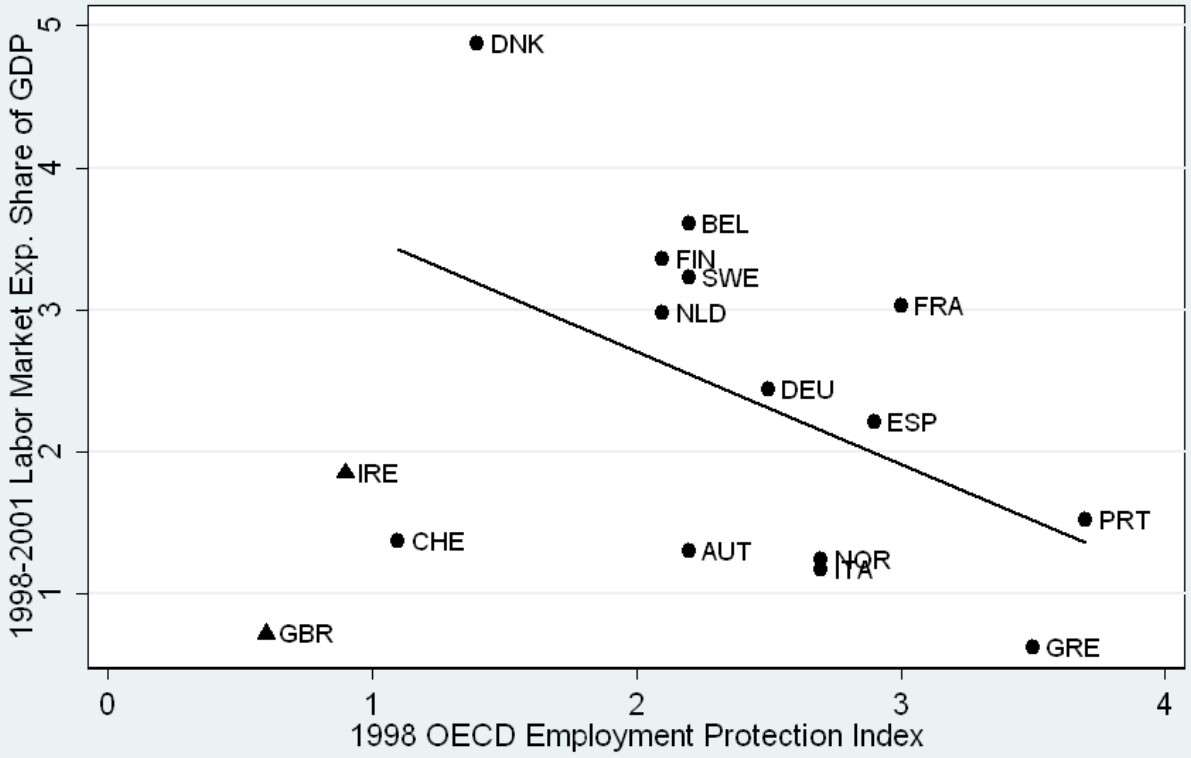
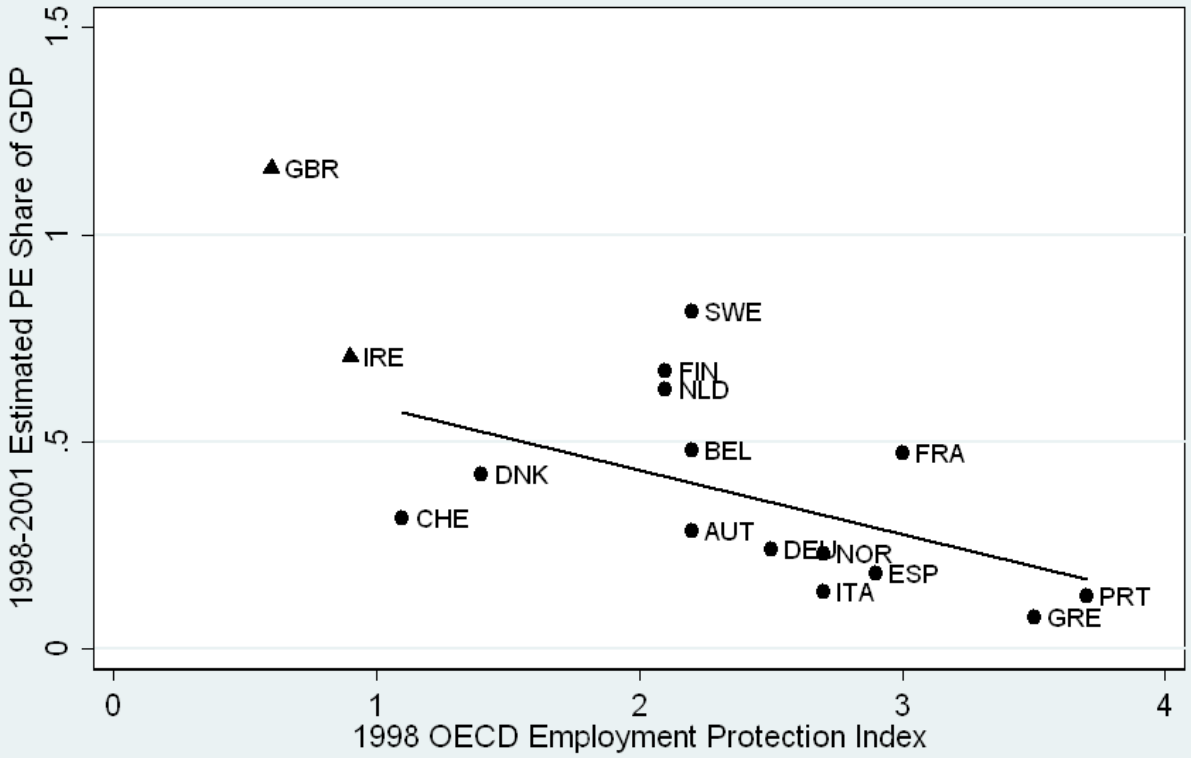
## Fig. 1: Employment Protection & Labor Mkt. Expenditures



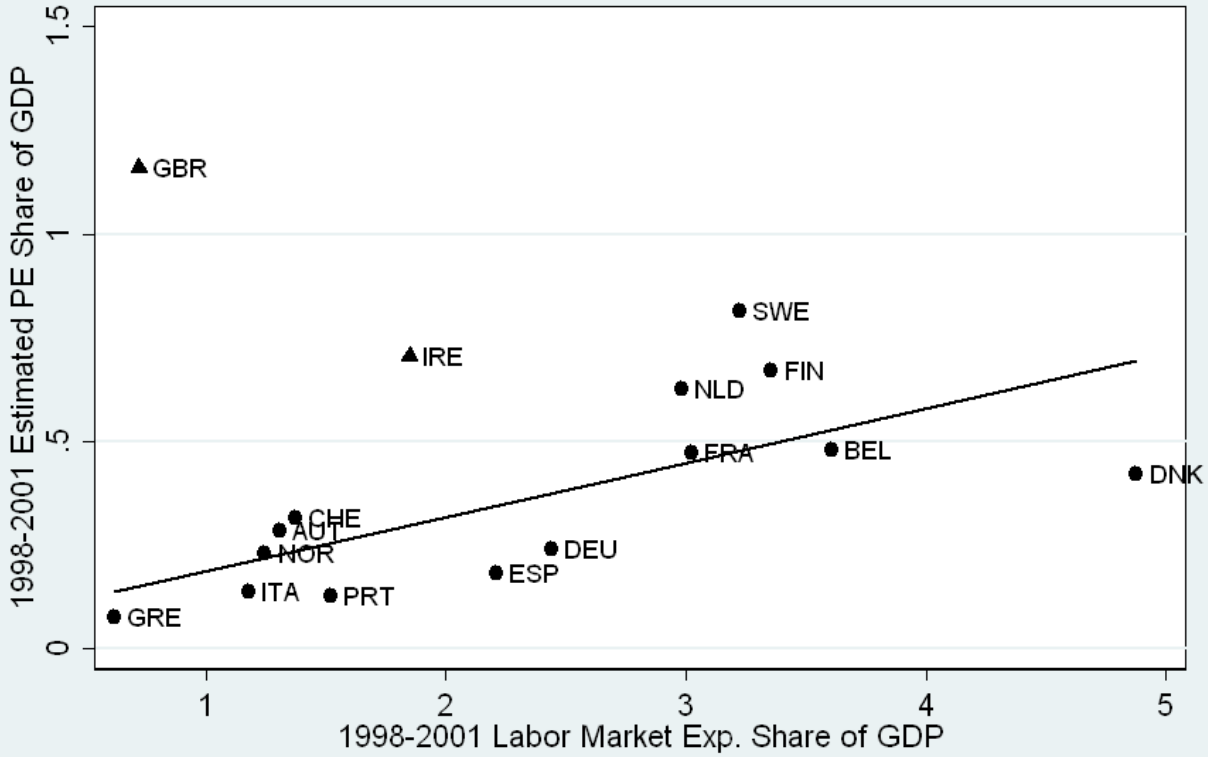

Notes: Trend Line Estimated for Continental Europe

## Fig. 2: Private Equity & Employment Protection



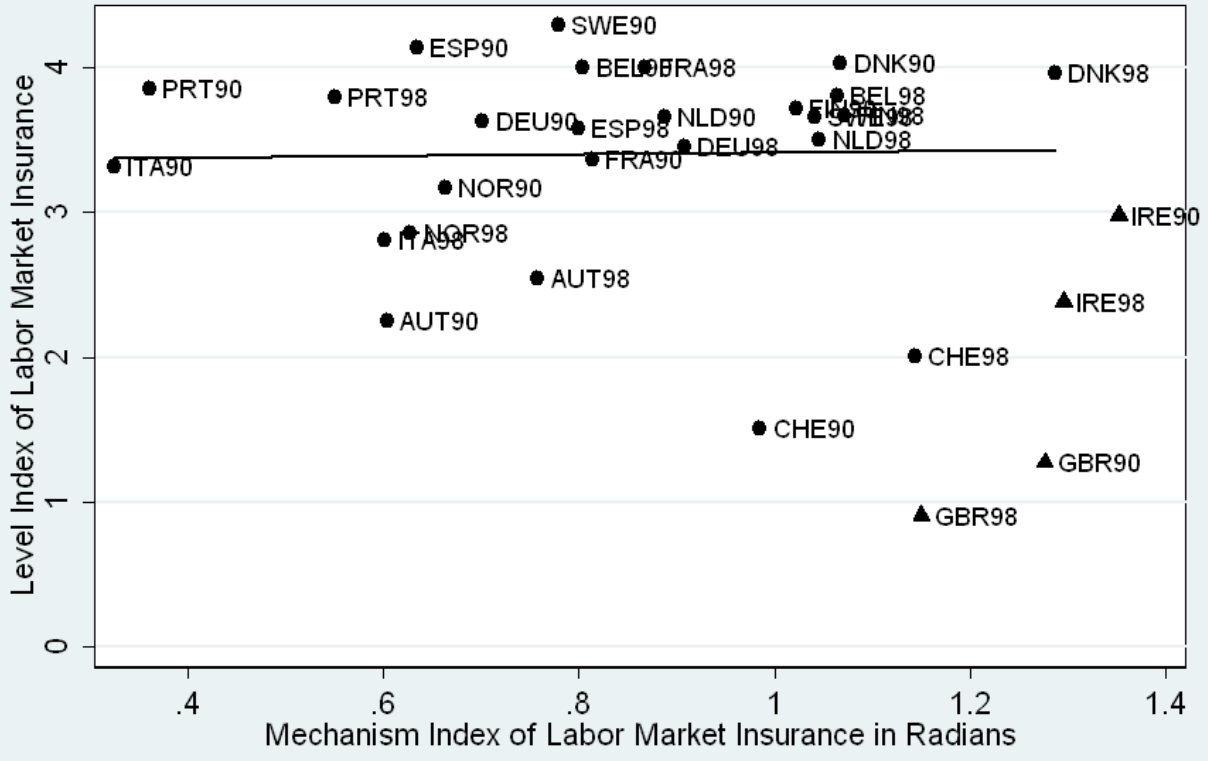

Notes: Trend Line Estimated for Continental Europe

## Fig. 3: Private Equity & Labor Mkt. Expenditures




Notes: Trend Line Estimated for Continental Europe

## Fig. 4: Level & Mechanism Indices of Labor Insurance




Notes: Trend Line Estimated for Continental Europe

Table 1: Descriptive statistics for European private equity sample

| | OECD employment protection index | | Labor market expenditures share of GDP | | Annual EVCA private equity invest. per cap | | Reported Venture Xpert private equity deals | | Levels index of labor market insurance | | Mechanism index of labor market insurance | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90 | 98 | 90-97 | 98-01 | 90-97 | 98-04 | 90-97 | 98-04 | 90-97 | 98-04 | 90-97 | 98-04 |
| Austria | 2.2 | 2.2 | 1.4% | 1.3% | 0 | 15 | 10 | 254 | 2.2 | 2.5 | 0.6 | 0.8 |
| Belgium | 3.2 | 2.2 | 4.0% | 3.6% | 11 | 40 | 30 | 482 | 4.0 | 3.8 | 0.8 | 1.1 |
| Denmark | 2.3 | 1.4 | 6.1% | 4.9% | 4 | 48 | 38 | 575 | 4.0 | 4.0 | 1.1 | 1.3 |
| Finland | 2.3 | 2.1 | 4.9% | 3.4% | 7 | 61 | 43 | 941 | 3.7 | 3.7 | 1.0 | 1.1 |
| France | 2.7 | 3.0 | 3.1% | 3.0% | 17 | 69 | 420 | 3456 | 3.4 | 4.0 | 0.8 | 0.9 |
| Germany | 3.2 | 2.5 | 2.9% | 2.4% | 9 | 40 | 213 | 2086 | 3.6 | 3.5 | 0.7 | 0.9 |
| Ireland | 0.9 | 0.9 | 4.1% | 1.9% | 8 | 35 | 35 | 462 | 3.0 | 2.4 | 1.4 | 1.3 |
| Italy | 3.6 | 2.7 | 1.3% | 1.2% | 7 | 37 | 57 | 504 | 3.3 | 2.8 | 0.3 | 0.6 |
| Netherlands | 2.7 | 2.1 | 3.9% | 3.0% | 25 | 99 | 95 | 941 | 3.7 | 3.5 | 0.9 | 1.0 |
| Norway | 2.9 | 2.7 | 2.2% | 1.3% | 17 | 57 | 7 | 327 | 3.2 | 2.9 | 0.7 | 0.6 |
| Portugal | 4.1 | 3.7 | 1.5% | 1.5% | 5 | 11 | 58 | 214 | 3.9 | 3.8 | 0.4 | 0.6 |
| Spain | 3.8 | 2.9 | 3.1% | 2.2% | 4 | 27 | 58 | 634 | 4.1 | 3.6 | 0.6 | 0.8 |
| Sweden | 3.5 | 2.2 | 4.4% | 3.2% | 19 | 159 | 66 | 1038 | 4.3 | 3.7 | 0.8 | 1.0 |
| Switzerland | 1.1 | 1.1 | 1.4% | 1.4% | 9 | 46 | 30 | 412 | 1.5 | 2.0 | 1.0 | 1.1 |
| UK | 0.6 | 0.6 | 1.4% | 0.7% | 42 | 197 | 844 | 4848 | 1.3 | 0.9 | 1.3 | 1.2 |
| Average | 2.6 | 2.2 | 3.0% | 2.3% | 12 | 63 | 134 | 1145 | 3.3 | 3.1 | 0.8 | 0.9 |

Notes: The employment protection regulations index is taken from the OECD. It has a theoretical range of zero to five, with higher scores indicating stronger employment protection. Labor market expenditures as a share of GDP is derived from the OECD Social Expenditures and Labour Force databases. Private equity investment traits are taken from the European Venture Capital Association and Venture Xpert databases. Private equity includes buy out funds and venture capital placements. Investments and expenditures are in nominal ECUs/Euros per capita.

Levels Index and Mechanism Index of labor market insurance are transformations of the employment protection and labor market expenditures policies. The Levels Index estimates the joint insurance provided through these two policies; higher values indicate greater worker insurance provision. The Mechanism Index estimates the relative importance of the two policies; higher values indicate greater reliance on labor market expenditures versus employment protection in the provision. Base policies are first transformed to have unit standard deviation. Univariate distances are measured from the US' provision of each policy (which is lower than any European country for both policies). The Levels Index averages these univariate distances. The Mechanism Index is the radian measure of the transformed labor market expenditures to employment protection ratio. The text provides additional details.

Table 2: Descriptive statistics for European private equity sectors

| | EVCA private equity investments | | Venture Xpert private equity deal counts | | US calculations of labor volatility by sector | | Amadeus calculations of labor volatility by sector | |
|---|---|---|---|---|---|---|---|---|
| | 1990-1997 | 1998-2004 | 1990-1997 | 1998-2004 | Establishment | Sector | PE firms | All firms |
| Communications | 3.7% | 12.7% | 10.3% | 17.2% | 0.34 | 0.03 | 0.19 | 0.16 |
| Computer related | 5.8% | 9.0% | 13.3% | 19.2% | 0.52 | 0.08 | 0.23 | 0.18 |
| Others electronics related | 3.9% | 2.4% | 3.8% | 5.5% | 0.36 | 0.02 | 0.17 | 0.14 |
| Biotechnology | 2.1% | 2.8% | 6.3% | 6.6% | 0.43 | 0.04 | 0.22 | 0.16 |
| Medical or health related | 4.2% | 6.6% | 10.1% | 7.1% | 0.35 | 0.02 | 0.16 | 0.12 |
| Energy | 1.4% | 1.4% | 1.0% | 1.2% | 0.49 | 0.05 | 0.26 | 0.21 |
| Consumer related | 21.2% | 19.4% | 19.0% | 12.9% | 0.41 | 0.03 | 0.16 | 0.14 |
| Industrial products and services | 13.6% | 9.7% | 7.3% | 4.2% | 0.31 | 0.03 | 0.14 | 0.13 |
| Chemicals and materials | 3.5% | 3.6% | 4.2% | 2.3% | 0.28 | 0.03 | 0.11 | 0.12 |
| Industrial automation | 1.1% | 1.2% | 0.9% | 1.4% | 0.33 | 0.05 | 0.14 | 0.13 |
| Other manufacturing | 10.0% | 8.0% | 8.7% | 3.8% | 0.37 | 0.03 | 0.13 | 0.13 |
| Transportation | 4.7% | 2.8% | 3.7% | 3.4% | 0.35 | 0.02 | 0.14 | 0.13 |
| Financial services | 4.0% | 2.7% | 2.7% | 2.7% | 0.40 | 0.03 | 0.18 | 0.13 |
| Other services | 11.0% | 8.9% | 5.2% | 5.7% | 0.41 | 0.04 | 0.22 | 0.15 |
| Agriculture | 1.4% | 0.5% | 0.6% | 0.5% | n.a. | n.a. | n.a. | n.a. |
| Construction | 4.1% | 2.8% | 2.9% | 2.1% | n.a. | n.a. | n.a. | n.a. |
| Other | 4.4% | 5.5% | 2.2% | 2.4% | n.a. | n.a. | n.a. | n.a. |

Notes: The first four columns present private equity investment traits in Europe taken from the European Venture Capital Association and Venture Xpert databases. Private equity includes buy out funds and venture capital placements. Values are presented as shares of total investments over the 1990-1997 and 1998-2004 sample periods. The last four columns present labor volatility measures using several techniques. US labor volatility metrics are calculated for establishments from US Census Bureau data for 1977-1999. Volatility is defined as the mean absolute change in establishment employment from the previous year divided by the average employment in the current and previous year. The sector level calculation employs the same formula using industry level data from 1992-1999. The last two metrics use employment volatility of firms from 1999-2004 in the Amadeus database. Due to data restrictions, the Amadeus calculations do not include entry/exit that are included in the US establishment level calculations. Firms backed by private equity are identified through ownership structures. Further details on the construction of the metrics are included in the text.

# Table 3: Labor volatility of private equity backed companies in Europe

| Dependent variable is labor volatility of firm transformed to have unit standard deviation | Full sample of Amadeus firms | | | Restricted sample of country-industry pairs with substantial private equity investment levels | | Restricted sample with matched control group by employment and revenue in country-industry-year | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| | | | | A. Combined private equity ownership variable | | | |
| Indicator variable for private equity ownership of firm | 0.180 | 0.139 | 0.177 | 0.092 | 0.126 | 0.172 | |
| | (0.010) | (0.009) | (0.009) | (0.015) | (0.015) | (0.021) | |
| Country-industry-year fixed effects | | Yes | Yes | | Yes | | |
| Firm size and revenue covariates | | | Yes | | Yes | | |
| Observations | | 2,350,858 | | 100,589 | | 15,612 | |
| | | | | B. Separated private equity ownership types | | | |
| Indicator variable for venture capital ownership of firm | 0.290 | 0.227 | 0.247 | 0.171 | 0.206 | 0.220 | |
| | (0.024) | (0.023) | (0.022) | (0.029) | (0.028) | (0.027) | |
| Indicator variable for buy out group ownership of firm | 0.035 | 0.022 | 0.102 | -0.055 | 0.041 | | 0.086 |
| | (0.030) | (0.028) | (0.028) | (0.052) | (0.046) | | (0.032) |
| Indicator variable for unknown type of private equity ownership of firm | 0.177 | 0.137 | 0.173 | 0.084 | 0.113 | | |
| | (0.011) | (0.011) | (0.010) | (0.018) | (0.017) | | |
| Country-industry-year fixed effects | | Yes | Yes | | Yes | | |
| Firm size and revenue covariates | | | Yes | | Yes | | |
| Observations | | 2,350,858 | | 100,589 | | 9,659 | 6,023 |

Notes: Firm-year estimations consider labor volatility among private equity investments in Europe for 1999-2006 using the Amadeus database. Dependent variables are the absolute values of employment changes by firm from the prior year relative to the average employment level of the firm in the current and previous year. These volatility measures are transformed to have unit standard deviation for interpretation. Indicator variables are included for known private equity backing and type. Regressions include country-industry-year fixed effects (where indicated) and cluster standard errors by firm. Industries are defined at the three-digit level of the Standard Industrial Classification system. Firm size covariates include log employment and log revenues of firms. The restricted sample in Columns 4-5 only includes country-industry pairs where private equity ownership is identified in greater than 5% of the firms. The sample in Columns 6-7 creates a control group that most closely matches the employment and revenue of portfolio firms in the same country-industry-year by investment type. Venture capital backed firms display particularly strong labor volatility. Buy out backed firms display higher labor volatility than their closest peers.

Table 4: Estimations of European investments using raw labor market policies

| | Venture capital placements | | | Buy out placements | | |
|---|---|---|---|---|---|---|
| | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| OECD employment protection index | -0.096 | -0.134 | -0.132 | 0.000 | -0.107 | 0.011 |
| interacted with US labor volatility by sector | (0.020) | (0.057) | (0.054) | (0.048) | (0.024) | (0.069) |
| Log labor market expenditures per GDP | 0.164 | 0.197 | 0.232 | 0.015 | 0.117 | -0.112 |
| interacted with US labor volatility by sector | (0.050) | (0.125) | (0.136) | (0.103) | (0.060) | (0.145) |
| Linear combination for policy mechanism: | 0.260 | 0.331 | 0.364 | 0.015 | 0.223 | -0.123 |
| $\beta$[Labor market exp.] - $\beta$[Employment protection] | (0.051) | (0.171) | (0.185) | (0.149) | (0.079) | (0.209) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 210 | 206 | 206 | 210 | 194 | 194 |

Notes: Country-sector estimations consider private equity investments in Europe for 1990-2004. The dependent variable in the first column of each triplet is an indicator variable for investments above one Euro per capita in the country-sector. The dependent variable in the second column of each triplet is the log count of investments. The dependent variable in the third column of each triplet is an estimated log value of investments. Dependent variables are specific to investment type. Explanatory variables interact country-level employment regulations and labor market expenditures as a share of GDP with sector-level labor volatility of establishments in the US. Main effects are demeaned prior to interactions and are absorbed by country and sector fixed effects. Variables are transformed to have unit standard deviation for interpretation. Regressions include country and sector fixed effects and are weighted by country populations interacted with aggregate sector size. Standard errors are clustered by sector, and App. Table 2 presents alternative cluster strategies. The bottom row presents the linear difference $\beta$[Labor market exp.] - $\beta$[Employment protection] and its standard errors. This difference approximates a policy change that holds the level of worker insurance provided constant but adjusts the insurance mechanism from employment protection towards labor market expenditures. Countries favoring the provision of worker insurance through labor market expenditures developed stronger private equity markets in more volatile sectors, especially among venture capital investments.

Table 5: Estimations of European investments using transformed labor market policies

| | Venture capital placements | | | Buy out placements | | |
|---|---|---|---|---|---|---|
| | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Levels index of labor market insurance | 0.025 | 0.025 | 0.040 | 0.020 | 0.016 | -0.033 |
| interacted with US labor volatility by sector | (0.021) | (0.041) | (0.042) | (0.028) | (0.024) | (0.045) |
| Mechanism index of labor market insurance | 0.108 | 0.145 | 0.158 | 0.021 | 0.116 | -0.015 |
| interacted with US labor volatility by sector | (0.023) | (0.058) | (0.068) | (0.055) | (0.036) | (0.095) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 210 | 206 | 206 | 210 | 194 | 194 |

Notes: See Table 4. The Levels Index and Mechanism Index of labor market insurance are transformations of employment protection and labor market expenditures policies for countries. The Levels Index estimates the joint insurance provided through these two policies; higher values indicate greater worker insurance provision. The Mechanism Index estimates the relative importance of the two policies; higher values indicate greater reliance on labor market expenditures than employment protection in the provision. The construction of these indices is described in the text and Table 1. Countries favoring the provision of worker insurance through labor market expenditures developed stronger private equity markets, especially among venture capital investments.

Table 6: Estimates including country-sector size and patenting rates

| | Venture capital placements (log count) | | | Buy out placements (log count) | | |
|---|---|---|---|---|---|---|
| | Base estimation | Incorporating country-sector size control | Incorporating country-sector patenting control | Base estimation | Incorporating country-sector size control | Incorporating country-sector patenting control |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Levels index of labor market insurance interacted with US labor volatility by sector | 0.025 | 0.011 | 0.026 | 0.016 | 0.007 | 0.016 |
| | (0.041) | (0.035) | (0.034) | (0.024) | (0.025) | (0.026) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.145 | 0.115 | 0.111 | 0.116 | 0.099 | 0.097 |
| | (0.058) | (0.056) | (0.046) | (0.036) | (0.029) | (0.029) |
| Log employment in country-sector | | 0.299 | 0.244 | | 0.194 | 0.158 |
| | | (0.060) | (0.064) | | (0.078) | (0.081) |
| Log patenting in country-sector | | | 0.318 | | | 0.204 |
| | | | (0.127) | | | (0.058) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 206 | 206 | 206 | 194 | 194 | 194 |

Notes: See Table 5. Country-sector covariates are developed from the Amadeus database and EPO/USPTO patent data. The size and patenting of the country-sector are important determinants of private equity placements. While these are channels through which labor policies operate, other factors may explain their levels, too. Labor policies have an independent effect on private equity placements beyond these determinants.

Table 7: Estimations with alternative private equity data

| | EVCA private equity data | | US-sourced venture capital | | US-sourced buy out | |
|---|---|---|---|---|---|---|
| | Log count of investments | Log value of investments | Log count of investments | Log value of investments | Log count of investments | Log value of investments |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Base estimation | | | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | 0.022 | 0.064 | 0.031 | 0.131 | 0.033 | -0.116 |
| | (0.067) | (0.081) | (0.048) | (0.078) | (0.079) | (0.062) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.129 | 0.142 | 0.189 | 0.376 | 0.114 | -0.120 |
| | (0.054) | (0.057) | (0.103) | (0.122) | (0.045) | (0.105) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 210 | 210 | 186 | 186 | 151 | 151 |
| | B. Extended estimation controlling for country-sector size and patenting rates | | | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | 0.017 | 0.055 | 0.034 | 0.117 | 0.041 | -0.108 |
| | (0.060) | (0.072) | (0.030) | (0.064) | (0.073) | (0.062) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.109 | 0.114 | 0.137 | 0.314 | 0.097 | -0.146 |
| | (0.055) | (0.063) | (0.071) | (0.087) | (0.030) | (0.115) |
| Country-sector size and technology covariates | Yes | Yes | Yes | Yes | Yes | Yes |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 210 | 210 | 186 | 186 | 151 | 151 |

Notes: See Tables 5 and 6. Estimations consider other private equity data sources and sample design.

Table 8: Estimations with alternative sector volatilities

| | Venture capital placements (log count) | | | Buy out placements (log count) | | |
|---|---|---|---|---|---|---|
| | European labor volatility for private equity backed firms in sector | European labor volatility for all firms in sector | Aggregate US annual labor volatility for sector 1992-1999 | European labor volatility for private equity backed firms in sector | European labor volatility for all firms in sector | Aggregate US annual labor volatility for sector 1992-1999 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | A. Base estimation | | | | | |
| Levels index of labor market insurance interacted with labor volatility by sector | 0.053 | 0.062 | 0.041 | 0.059 | 0.051 | 0.025 |
| | (0.049) | (0.040) | (0.022) | (0.039) | (0.039) | (0.024) |
| Mechanism index of labor market insurance interacted with labor volatility by sector | 0.233 | 0.209 | 0.117 | 0.178 | 0.126 | 0.081 |
| | (0.068) | (0.082) | (0.053) | (0.041) | (0.048) | (0.028) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 206 | 206 | 206 | 194 | 194 | 194 |
| | B. Extended estimation controlling for country-sector size and patenting rates | | | | | |
| Levels index of labor market insurance interacted with labor volatility by sector | 0.028 | 0.040 | 0.031 | 0.042 | 0.037 | 0.018 |
| | (0.052) | (0.040) | (0.024) | (0.042) | (0.035) | (0.026) |
| Mechanism index of labor market insurance interacted with labor volatility by sector | 0.155 | 0.130 | 0.079 | 0.131 | 0.075 | 0.060 |
| | (0.071) | (0.085) | (0.054) | (0.044) | (0.042) | (0.020) |
| Country-sector size and technology covariates | Yes | Yes | Yes | Yes | Yes | Yes |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 206 | 206 | 206 | 194 | 194 | 194 |

Notes: See Tables 5 and 6. Estimations consider other measures of labor volatility of sectors. The dependent variable is indicated by the major column header, and the labor volatility calculation is indicated by the sub-column header.

Table 9a: Estimations considering alternative national policies and traits - European venture capital placements

| Dependent variable is log count of venture capital investments in country-sector | Including interactions with other national policies | Including interactions with other national traits | Including interactions with national legal origins | Excluding UK and Ireland from the sample | Excluding sample weights from estimation | Including interactions with sector's growth rate |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | | A. Base estimation | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | -0.051 | 0.020 | -0.012 | -0.029 | 0.014 | 0.021 |
| | (0.047) | (0.040) | (0.027) | (0.043) | (0.036) | (0.037) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.149 | 0.138 | 0.175 | 0.167 | 0.126 | 0.132 |
| | (0.064) | (0.047) | (0.067) | (0.086) | (0.060) | (0.040) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 206 | 206 | 206 | 180 | 206 | 206 |
| | | | B. Extended estimation controlling for country-sector size and patenting rates | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | -0.053 | 0.015 | -0.023 | -0.022 | 0.018 | 0.022 |
| | (0.032) | (0.031) | (0.029) | (0.051) | (0.040) | (0.033) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.115 | 0.106 | 0.136 | 0.134 | 0.084 | 0.107 |
| | (0.048) | (0.039) | (0.054) | (0.070) | (0.055) | (0.042) |
| Country-sector size and technology covariates | Yes | Yes | Yes | Yes | Yes | Yes |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 206 | 206 | 206 | 180 | 206 | 206 |

Notes: See Tables 5 and 6. Column 1 includes additional interactions of sector labor volatility with the strength of IPO markets, corporate tax rates, business entry regulation barriers, and the share of national investments made by public investment funds. Column 2 includes interactions with national populations and GDP per capitas. Column 3 includes interactions with the legal origins of countries. Column 4 excludes the UK and Ireland from the sample. Column 5 presents unweighted regressions. Column 6 includes additional interactions of each sector's total growth for private equity investment in Europe over 1990-2004 with the Levels and Mechanism Indices.

Table 9b: Estimations considering alternative national policies and traits - European buy out placements

| Dependent variable is log count of buy out investments in country-sector | Including interactions with other national policies | Including interactions with other national traits | Including interactions with national legal origins | Excluding UK and Ireland from the sample | Excluding sample weights from estimation | Including interactions with sector's growth rate |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | | A. Base estimation | | | |
| Levels index of labor market insurance | -0.010 | -0.008 | -0.023 | 0.023 | -0.011 | 0.011 |
| interacted with US labor volatility by sector | (0.029) | (0.030) | (0.027) | (0.051) | (0.047) | (0.023) |
| Mechanism index of labor market insurance | 0.079 | 0.104 | 0.110 | 0.109 | 0.079 | 0.109 |
| interacted with US labor volatility by sector | (0.059) | (0.045) | (0.063) | (0.041) | (0.061) | (0.036) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 194 | 194 | 194 | 168 | 194 | 194 |
| | | | B. Extended estimation controlling for country-sector size and patenting rates | | | |
| Levels index of labor market insurance | -0.008 | -0.009 | -0.032 | 0.023 | -0.010 | 0.014 |
| interacted with US labor volatility by sector | (0.019) | (0.034) | (0.024) | (0.046) | (0.043) | (0.028) |
| Mechanism index of labor market insurance | 0.059 | 0.086 | 0.086 | 0.091 | 0.070 | 0.096 |
| interacted with US labor volatility by sector | (0.060) | (0.038) | (0.065) | (0.041) | (0.057) | (0.031) |
| Country-sector size and technology covariates | Yes | Yes | Yes | Yes | Yes | Yes |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 194 | 194 | 194 | 168 | 194 | 194 |

Notes: See Table 9a.

# App. Table 1: EVCA sector definitions

Communications - Internet Technology: browsers, portals, search engines and other internet enabling technologies, website design and consultancy, ISPs. Telecommunications (Hardware): voice and data communications equipment, cable/mobile/satellite network equipment excluding telecommunications carriers. Telecommunications (Carriers): cable/mobile/satellite telecommunications carriers. Communications (other): TV and radio broadcasting, media houses, publishing.

Computer Related - Computer (Hardware): computer mainframes, laptops, minicomputers, PDA/hand-held devices, optical scanning equipment, voice synthesis/recognition equipment. Computer (Semiconductors): semiconductors, electronic components (e.g., integrated circuits, transistors), semiconductor fabrication equipment. Computer (Services): data processing, hardware maintenance, IT consulting, IT training. Computer (Software): application software products, operating systems and systems-related software for all types of hardware, systems integration, software development. Includes manufacturers, resellers, and distributors.

Other Electronics Related - batteries, power supplies, fibre optics, analytical and scientific instrumentation.

Biotechnology - agricultural/animal biotechnology (e.g., plant diagnostics), industrial biotechnology (e.g., derived chemicals), biotechnology related research and production equipment.

Medical/Health Related - Medical (Healthcare): health institutions, hospital management, handicap aids & basic healthcare supplies. Medical (Instruments/Devices): technologically advanced diagnostic & therapeutic products and services. Medical (Pharmaceuticals): drug development, manufacture and supply.

Energy - oil and gas exploration and production, exploration and drilling services and equipment, coal related, energy conservation related, alternative energy.

Consumer Related - Consumer (Retail): retailing of consumer products and services (including leisure and recreational products). Consumer (Other): manufacture and supply of consumer products.

Industrial Products and Services - industrial equipment and machinery, pollution and recycling related, industrial services.

Chemicals and Materials - agricultural chemicals, commodity chemicals, specialty or performance chemicals/materials, coating and adhesives, membranes and membrane-based products.

Industrial Automation - industrial measurement and sensing equipment, process control equipment, robotics, machine vision systems, numeric and computerized control of machine tools.

Other Manufacturing - business products and supplies, office furniture, textiles, hardware and plumbing supplies, pulp and paper, printing and binding, packaging products and systems.

Transportation - airlines, railways, buses, airfield and other transportation services, mail and package shipment.

Financial Services - banking, insurance related, real estate, securities and commodities brokers.

Other Services - engineering services, advertising and public relations, distributors, importers and wholesalers; consulting services (excluding IT consulting – see Computer: Services).

Agriculture - animal husbandry, crop cultivation, fishing, forestry.

Construction - construction services, manufacture of building materials, manufacture of pre-fabricated buildings and systems.

Other - mining, utilities, conglomerates.

Source: Compiled from EVCA Private Equity Survey Guidance Notes and Glossary by EVCA (2005), Thomson Financial, and PriceWaterhouseCoopers.

App. Table 2: Table 4 with alternative clustering strategies

| | Venture capital placements | | | Buy out placements | | |
|---|---|---|---|---|---|---|
| | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Empl. protection index x sector volatility | -0.096 | -0.134 | -0.132 | 0.000 | -0.107 | 0.011 |
| Robust standard errors | (0.027) | (0.040) | (0.041) | (0.031) | (0.023) | (0.052) |
| Clustered by industry | (0.020) | (0.057) | (0.054) | (0.048) | (0.024) | (0.069) |
| Clustered by country | (0.023) | (0.023) | (0.044) | (0.017) | (0.025) | (0.031) |
| Labor market expenditures x sector volatility | 0.164 | 0.197 | 0.232 | 0.015 | 0.117 | -0.112 |
| Robust standard errors | (0.050) | (0.090) | (0.101) | (0.081) | (0.055) | (0.122) |
| Clustered by industry | (0.050) | (0.125) | (0.136) | (0.103) | (0.060) | (0.145) |
| Clustered by country | (0.060) | (0.068) | (0.104) | (0.032) | (0.058) | (0.069) |
| Linear combination for policy mechanism: | 0.260 | 0.331 | 0.364 | 0.015 | 0.223 | -0.123 |
| $\beta$[Labor market exp.] - $\beta$[Employment protection] | (0.056) | (0.114) | (0.131) | (0.107) | (0.068) | (0.160) |
| | (0.051) | (0.171) | (0.185) | (0.149) | (0.079) | (0.209) |
| | (0.079) | (0.087) | (0.136) | (0.039) | (0.077) | (0.086) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 210 | 206 | 206 | 210 | 194 | 194 |

Notes: See Table 4.

App. Table 3: Table 5 with alternative clustering strategies

| | Venture capital placements | | | Buy out placements | | |
|---|---|---|---|---|---|---|
| | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments | Extensive: (0,1) invest >1 Euro/capita | Intensive: Log count of investments | Intensive: Log value of investments |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Levels index x sector volatility | 0.025 | 0.025 | 0.040 | 0.020 | 0.016 | -0.033 |
| Robust standard errors | (0.038) | (0.048) | (0.052) | (0.035) | (0.027) | (0.057) |
| Clustered by industry | (0.021) | (0.041) | (0.042) | (0.028) | (0.024) | (0.045) |
| Clustered by country | (0.029) | (0.029) | (0.049) | (0.023) | (0.017) | (0.039) |
| Mechanism index x sector volatility | 0.108 | 0.145 | 0.158 | 0.021 | 0.116 | -0.015 |
| Robust standard errors | (0.025) | (0.049) | (0.054) | (0.046) | (0.029) | (0.076) |
| Clustered by industry | (0.023) | (0.058) | (0.068) | (0.055) | (0.036) | (0.095) |
| Clustered by country | (0.030) | (0.029) | (0.043) | (0.012) | (0.017) | (0.031) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 210 | 206 | 206 | 210 | 194 | 194 |

Notes: See Table 5.

App. Table 4a: Estimations considering alternative national policies and traits - US-sourced venture capital placements

| Dependent variable is log count of venture capital investments sourced from US in country-sector | Including interactions with other national policies | Including interactions with other national traits | Including interactions with national legal origins | Excluding UK and Ireland from the sample | Excluding sample weights from estimation | Including interactions with sector's growth rate |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | | A. Base estimation | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | -0.020 | 0.050 | 0.020 | 0.005 | -0.015 | 0.026 |
| | (0.071) | (0.061) | (0.074) | (0.072) | (0.043) | (0.031) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.227 | 0.196 | 0.235 | 0.215 | 0.112 | 0.169 |
| | (0.101) | (0.111) | (0.101) | (0.117) | (0.082) | (0.067) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 186 | 186 | 186 | 160 | 186 | 186 |
| | | | B. Extended estimation controlling for country-sector size and patenting rates | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | -0.020 | 0.045 | 0.001 | 0.016 | -0.011 | 0.027 |
| | (0.047) | (0.037) | (0.075) | (0.063) | (0.038) | (0.028) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.171 | 0.148 | 0.176 | 0.167 | 0.068 | 0.130 |
| | (0.063) | (0.078) | (0.074) | (0.088) | (0.066) | (0.057) |
| Country-sector size and technology covariates | Yes | Yes | Yes | Yes | Yes | Yes |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 186 | 186 | 186 | 160 | 186 | 186 |

Notes: See Table 9a.

App. Table 4b: Estimations considering alternative national policies and traits - US-sourced buy out placements

| Dependent variable is log count of buy out investments sourced from US in country-sector | Including interactions with other national policies | Including interactions with other national traits | Including interactions with national legal origins | Excluding UK and Ireland from the sample | Excluding sample weights from estimation | Including interactions with sector's growth rate |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | | | A. Base estimation | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | 0.034 | 0.034 | -0.005 | 0.015 | 0.040 | 0.024 |
| | (0.068) | (0.080) | (0.084) | (0.059) | (0.028) | (0.066) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.189 | 0.107 | 0.157 | 0.123 | 0.123 | 0.107 |
| | (0.023) | (0.038) | (0.045) | (0.060) | (0.035) | (0.025) |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 151 | 151 | 151 | 130 | 151 | 151 |
| | | | B. Extended estimation controlling for country-sector size and patenting rates | | | |
| Levels index of labor market insurance interacted with US labor volatility by sector | 0.042 | 0.038 | -0.008 | 0.030 | 0.039 | 0.036 |
| | (0.060) | (0.072) | (0.090) | (0.072) | (0.028) | (0.064) |
| Mechanism index of labor market insurance interacted with US labor volatility by sector | 0.161 | 0.089 | 0.133 | 0.122 | 0.109 | 0.096 |
| | (0.031) | (0.027) | (0.033) | (0.037) | (0.029) | (0.024) |
| Country-sector size and technology covariates | Yes | Yes | Yes | Yes | Yes | Yes |
| Country and sector fixed effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 151 | 151 | 151 | 130 | 151 | 151 |

Notes: See Table 9a.

# Appendix

This appendix discusses longitudinal variations in policy mechanisms. The main text focuses on the 1990-2004 cross-section of country-sector private equity placements for both theoretical and empirical reasons that we discuss below. We provide here simple, suggestive evidence that changes in labor market insurance policies from 1990-1997 to 1998-2004 are associated with growth in private equity investment levels and shifts in investment composition across sectors.

Several theoretical issues influence our approach. The simple model in Section 2.2 provides a foundation for panel analysis across countries and sectors. If everything is constant across sectors and countries, this framework predicts that longitudinal changes in policy mechanisms should influence sector size the most in the highest volatility sectors, just as in the cross-section. The basic model suggests that changes in average sector sizes are ambiguous because taxes increase when employment protection declines, and we have not specified this relationship. Under realistic conditions, however, we anticipate that average investment levels across sectors grow with shifts away from employment protection, too. The empirical evidence in Table 3 stresses that private equity backed firms have greater labor volatility than the general economy, and so shifts in labor adjustment costs disproportionately influence total investments levels.

Caution should be exercised, however, around the simple prediction that one can rank order the magnitudes of effects by sector volatility. One set of complications is evident in the simple model itself. Cross-sectional predictions are quite robust to details like the curvature of the profit function and the size of fixed costs were they allowed to vary across countries and/or sectors systematically. This robustness is much weaker, however, when looking at panel changes across countries and sectors simultaneously. Moreover, the model does not consider trade across countries, which is clearly a factor among European countries. One can derive the same predictions for cross-sectional placements when allowing for trade, but the comparative statics do not hold at the sector level.[31]

These theoretical issues result in econometric challenges. As an example, consider a scenario where the nation that most strongly favored employment protection moves toward more flexible labor markets. This nation has the largest absolute and relative shifts in policies in Europe, but these changes do not affect its rank order among European nations. In such a scenario, our simple model suggests that the largest growth effects should be evident in the most volatile sectors (e.g., computers, biotech). The reality, however, is that the growth is more likely to come in moderate volatility sectors compared to the low volatility sectors in which the nation initially specialized. This example is not too different from Italy, which has the largest absolute and relative policy changes toward labor market expenditures from 1990-1997 and 1998-2004. This change, however, only moves Italy from being the lowest nation in terms of the Mechanism Index to being equal with Portugal, still tied for lowest. Italy's private equity growth is strongest in the second lowest quartile of the volatility distribution across sectors.[32]

[31] When allowing for trade, labor market insurance policies can be thought of as creating Ricardian comparative advantages for countries in terms of sector technologies and productivities. Indeed, many of the theory models we cite in Section 2.1 use this construct for identifying why labor policies should matter for industry differences across countries. Ricardian trade theory in a multi-country setting replicates the cross-sectional predictions that we develop in our simple model, but localized comparative statics are not generally defined by country-sector (e.g., Eaton and Kortum 2002, Costinot et al. 2010).

[32] The highest volatility quartile is Biotech, Computers, and Energy. The second highest quartile is Consumer related, Financial services, Other manufacturing, and Other services. The second lowest quartile is Communications, Medical or health related, Other electronics, and Transportation. The least volatile quartile is Chemicals

To address these theoretical issues, we develop a measure of the volatility inherent in private equity investments by country in each period. Our measure is simply a weighted average by country of the US establishment level volatilities, with the weights being the count of deals in each sector for the country. We find similar patterns to those reported below when using investment amounts as weights or when using European sector volatilities. The average of this composite metric across countries increases from 0.39 in 1990-1997 to 0.40 in 1998-2004 when using either the Thomson or EVCA data. In 1998-2004, Ireland has the highest volatility composition in both data sets (0.43) while Italy is the lowest (0.37-0.38), which matches our cross-sectional patterns. We examine below changes in these volatility composition metrics, which better align with theory than looking at individual sector growth rates. We also calculate the change in investments per capita from 1990-1997 to 1998-2004 by country to test the aggregate growth prediction.[33]

Our estimation technique is very simple. We regress this change in investment levels or composition on the change in the Levels Index and Mechanism Index between 1990-1997 and 1998-2004 and indicator variables for legal origins of countries. App. Table 5 reports the coefficients from the regressions, while App. Figures 1a-2b provide graphical depictions of the coefficients for the Mechanisms Index. These plots are residuals from regressing the changes in private equity outcomes and the Mechanism Index on the other variables. The slopes of the trend lines through these data points are the regression coefficients reported in App. Table 5. They depict the partial elasticity between private equity changes and policy adjustments.

There is strong evidence in the Thomson data for shifts in investment composition toward more volatile sectors when policy mechanisms adjust toward labor market expenditures. On the other hand, the evidence for aggregate growth in country investment levels per capita is weak. In the EVCA data, the patterns are more balanced. There is more evidence for total investment growth, with more modest changes in investment compositions.

While these figures provide some suggestive evidence for longitudinal responses, we remain very cautious about them. In addition to the theoretical issues noted above, we are only able to exploit a very narrow range of data. For example, the correlation of the Mechanism Index across 1990-1997 and 1998-2004 at the country level is 0.9. A similar correlation exists for the Levels Index, and the rank orders of countries are very persistent. We thus hope that future research can identify opportunities (with or without private equity outcomes, within or outside of Europe) where more powerful longitudinal variation in the joint design of labor market insurance policies is feasible.

and materials, Industrial automation, and Industrial products and services.

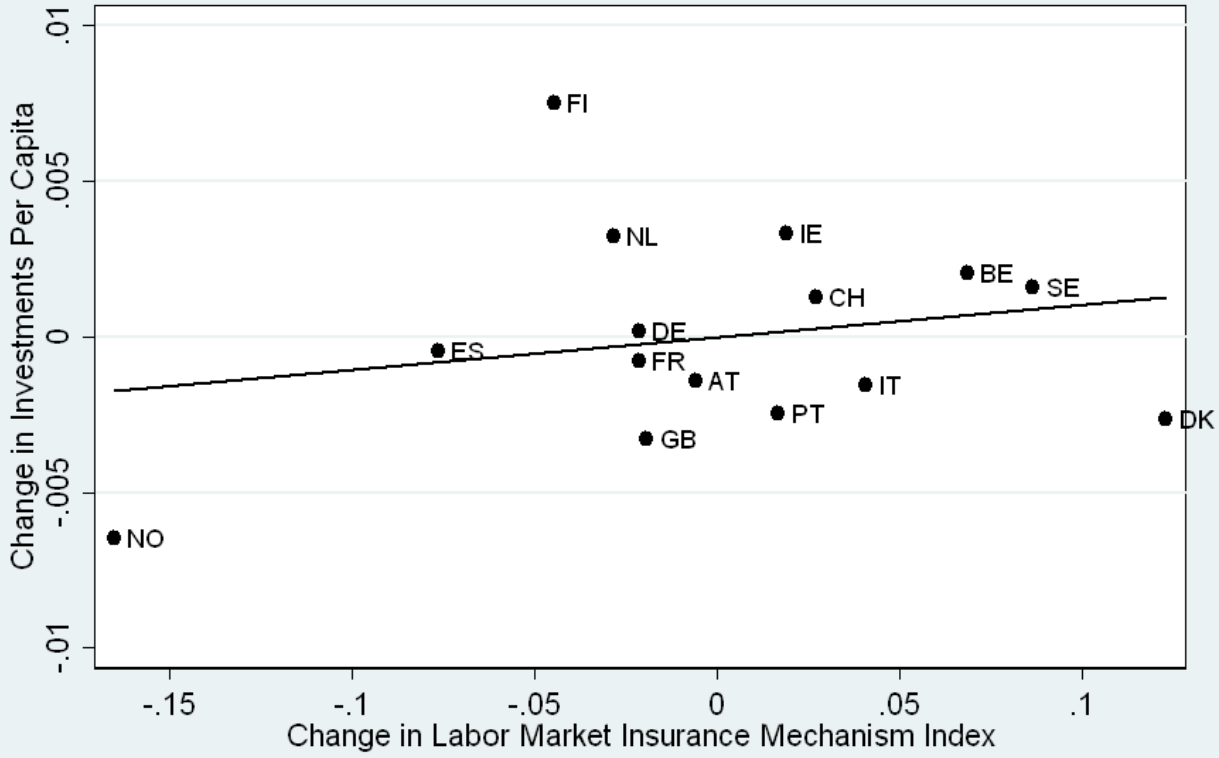
[33] This approach also produces much more stable estimates due to serious data challenges for estimating individual growth rates by country-sector. Initial investments during 1990-1997 are very low (or even zero) for many country-sectors, which generates too many outliers in terms of growth rates to be useful. Moreover, our two data sources (Thomson and EVCA) closely agree on the cross-sectional patterns and on these aggregated composition shifts. They can differ much more, however, with respect to the particular growth rate of a small country-sector that has very few investments in the initial period.

App. Table 5: Estimations considering longitudinal policy shifts

| Dependent variable is change in indicated by private equity outcome from 1990-1997 to 1998-2004 | Thomson dataset | | EVCA dataset | |
|---|---|---|---|---|
| | Annual deal counts per capita (x1000) | Estimated labor volatility of investments | Annual deal counts per capita (x1000) | Estimated labor volatility of investments |
| | (1) | (2) | (3) | (4) |
| Change in levels index of labor insurance from 1990-1997 to 1998-2004 | 0.006 | 0.002 | 0.001 | 0.006 |
| | (0.003) | (0.011) | (0.009) | (0.008) |
| Change in mechanism index of labor insurance from 1990-1997 to 1998-2004 | 0.009 | 0.094 | 0.042 | 0.031 |
| | (0.018) | (0.040) | (0.048) | (0.025) |
| Legal origin fixed effects | Yes | Yes | Yes | Yes |
| Observations | 15 | 15 | 15 | 15 |

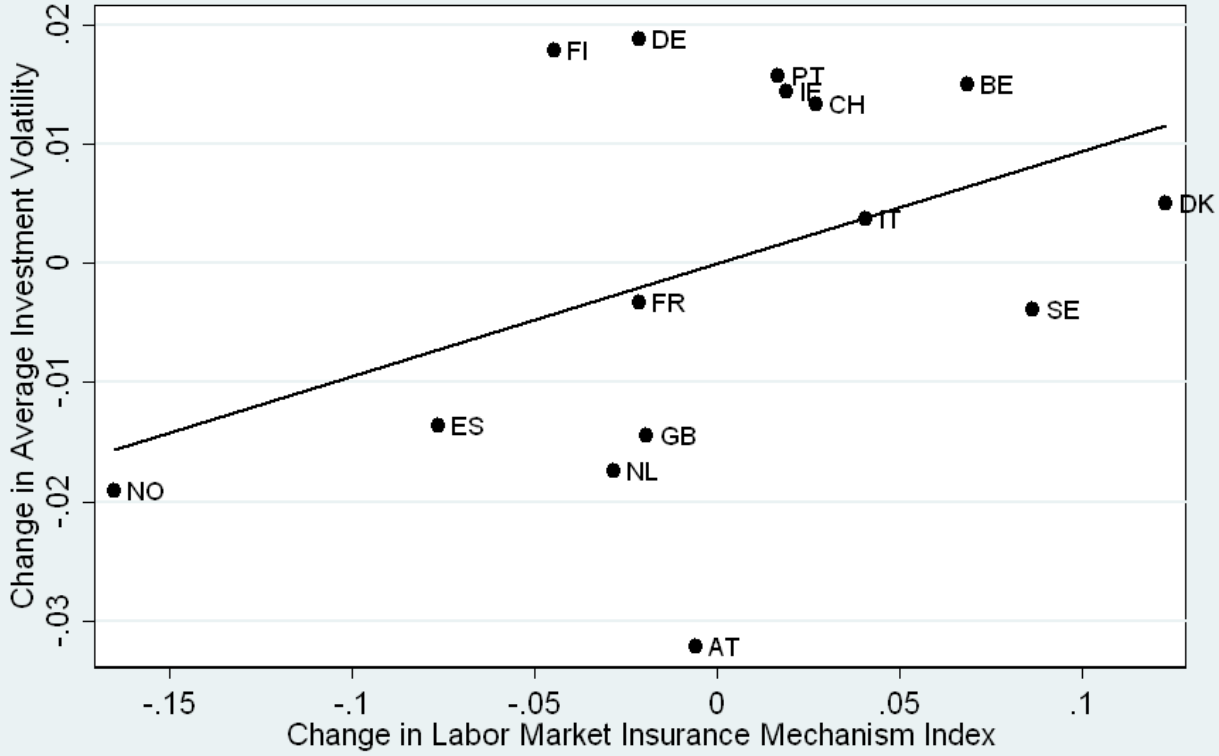
Notes: Estimations consider aggregate changes in private equity investments from 1990-1997 to 1998-2004 by country. Columns 1 and 3 consider changes in annual deal counts per capita (multiplied by a thousand). Columns 2 and 4 consider the weighted volatility of investments by country. Weighted volatilities are calculated by summing the share of deal counts across sectors in each period multiplied by the US labor volatility levels listed in Table 2. Regressions are unweighted and report robust standard errors. App. Figures 1a-2b present graphically the coefficients for the changes in labor market insurance mechanisms through residual regressions.

## App. Fig. 1a: Thomson Investment Levels



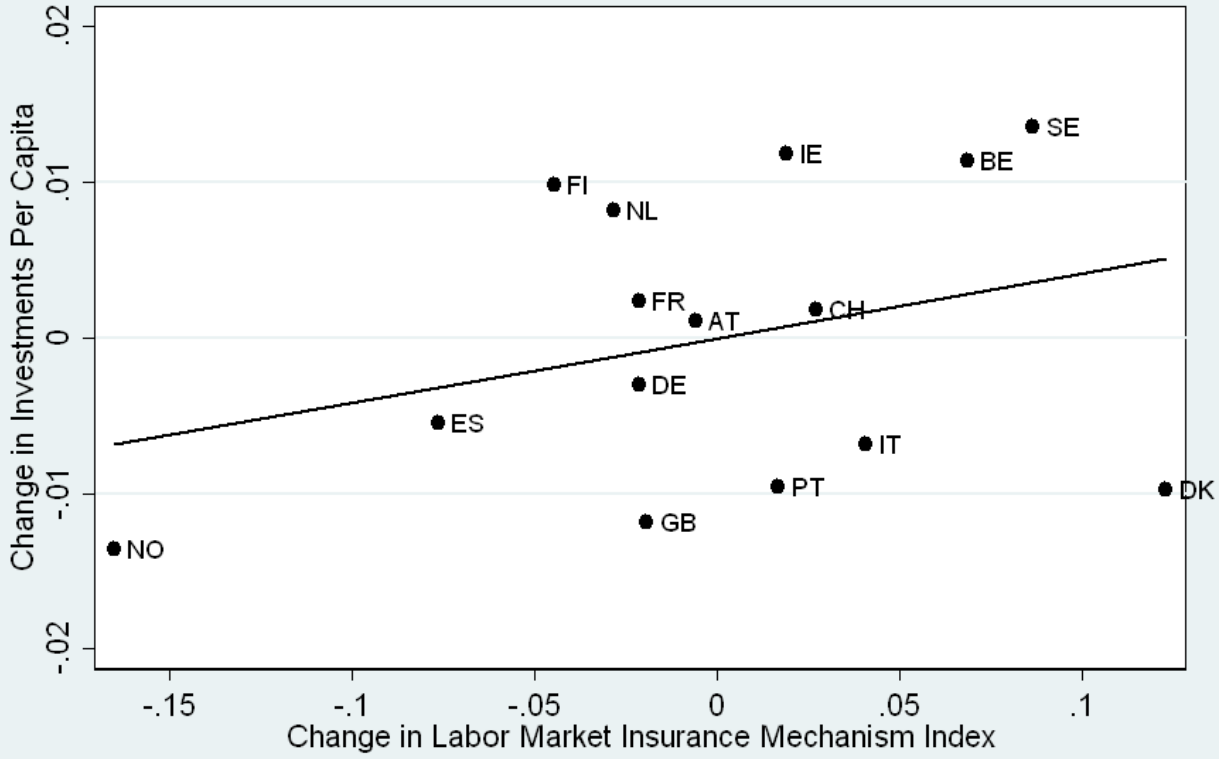

Notes: Points are Residuals from a Regression Described in Text

## App. Fig. 1b: Thomson Investment Composition



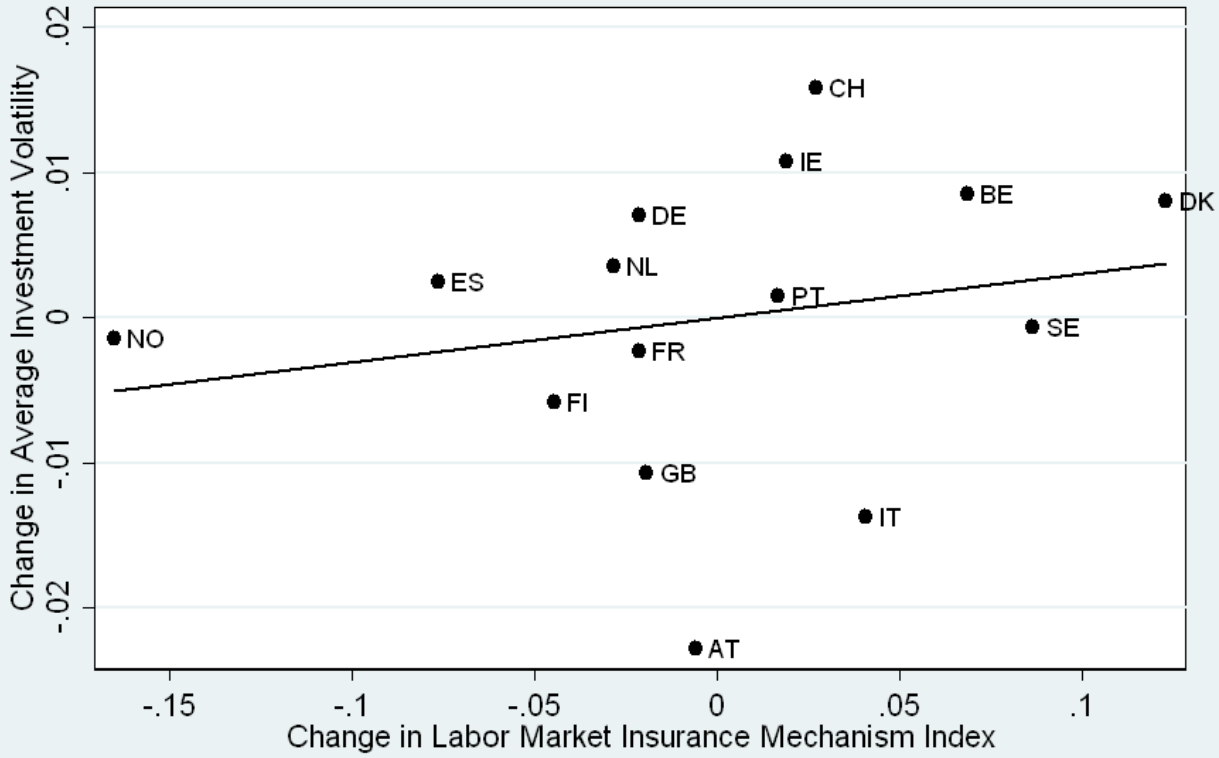

Notes: Points are Residuals from a Regression Described in Text

## App. Fig. 2a: EVCA Investment Levels




Notes: Points are Residuals from a Regression Described in Text

## App. Fig. 2b: EVCA Investment Composition




Notes: Points are Residuals from a Regression Described in Text