Financial Shocks and Labor: Facts and Theories

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Abstract

The global financial recession of 2008-9 as well as historical precedents with financial crises suggest that financial shocks do translate into the labor markets. In this paper we first document that financial recessions are different from other recessions in terms of their labor market impact, as they involve a larger employment/unemployment response conditioning on output. Second, we survey the various mechanisms linking financial shocks to employment adjustment, developing a new theory of the effects of leverage on job creation and destruction. Third, we present evidence coherent with one of such mechanisms, notably with the prediction that more leveraged firms experience larger job destruction during financial recessions, controlling for the scale of output falls.

*We would like to thank Brent Neiman and Loukas Karabarbounis for having shared with us the data that they collected on Corporate Gross Savings and Value Added in OECD countries. We are also indebted to two anonymous referees, to Amartya Lahiri and to participants in the 13th Jacques Pollak Annual Research Conference of the IMF for valuable comments. Giulia Tagliaferri provided un agging statistical assistance.

of exicurity where layo s are fairly inexpensive for employers and there are instead generous unemployment bene ts, a mix that is supposed to give rise to relatively large unemployment in ows during downturns. Yet, Denmark during the Great Recession experienced a much lower rise of unemployment than Spain.

More recent literature acknowledges that labor market institutions are not enforced uniformly across the board, and, in particular, contractual dualism between "open-ended"' and "`temporary"' contracts allows the coexistence of a \rigid" and \ exible" segments in the same labor market (Boeri 2011). This may contribute to explain why labor market response to adverse business conditions has been so large in countries displaying the strictest employment protection provisions for regular contracts. Theories of contractual dualism predict that dual labor markets, involving a large share of employment in temporary contracts, increases the responsiveness of employment and unemployment to output changes. Empirical evidence also suggests that the introduction of a exible, temporary fringe of xed-term contracts, alongside a rigid stock of open-ended contracts, increases Okun's law coe cients (Ball et al., 2012). However, even these augmented Okun's law coe cients cannot account for the cross-country asymmetries in the labor market response to the global shock and generally underpredict the rise of unemployment during the Great Recession. Contractual dualism may at best explain the increase over time of Okun's coe cients in these countries, but does not account for the cross-country variation in the response to the global shock.

One should therefore go beyond labor market institutions to understand the free fall of employment in the US and the cross-country di erences within Europe in unemployment response throughout the Great Recession. We argue in this paper that a key factor behind these asymmetric responses is likely to be in the nature of the shocks that occurred in 2008-9. In order to understand both di erences in labor market adjustment with respect to previous recessions and cross-country di erences in the dynamics of unemployment conditioning on output, one should look at the nancial markets where the crisis developed and became global in the aftermath of the Lehman bankruptcy in the Fall of 2008. Financial markets and the banking sector experienced a credit crunch well into 2009. Such a credit crunch has been documented by several authors and took place in both Europe and the U.S. (Gorton, 2010). We believe that this has been playing a key role in labor market adjustment during the downturn and in the recovery.

With respect to the nancial sector, one of the key di erences between the two sides of the Atlantic and within Europe is the degree of nancial deepening. Credit to the private sector as a share of GDP has been consistently larger in the US and in the UK than in the Euro area in the last 20 years and the gap actually increased in the years before the Great Recession (Figure 2). Another empirical measure to account for di erences in nancial deepening is stock market capitalization over GDP. In the US and UK stock market capitalization over GDP at the outset of the Great Recession was some 100 percent of GDP, whereas the same ratio in Europe was about 75 percent (Figure 3). While the size of the nancial shocks, measured in terms of losses of stock market capitalization, appear very similar in terms of timing and size, what is striking is the fact that the level of nancial deepening is indeed very di erent.

In this paper, we study the basic links and transmission mechanisms between the shocks to the nancial markets and the labor market. Financial deepening is likely to be responsible for the stronger unemployment to output response in the US and the the UK than in the Euro area in 2008 and 2009. However, such adverse links of nance to labor must be coherent with the view that nancial development is associated with output growth in the long run. In the paper we review in some details the links between nancial shocks and labor adjustment that have been proposed throughout a very dispersed and di erent literature. Imperfect nancial markets a ect labor when rms are risk averse, when labor is a quasi xed factor and when the bank borrower relationship is sticky. However, this literature does not explore how countries with di erent degrees of nancial deepening may react di erently to a nancial crisis. Furthermore, only to a limited extent do they employ search models, the workhorse model of unemployment in macro-labor. Finally, the literature does not distinguish between job creation and job destruction, and they are not coherent with the positive output e ect of nance. After surveying the literature to date, we argue that there is a need to highlight the traditional mechanisms in a model that addresses these issues. We give a verbal presentation of such a model, while the technical derivations are relegated to the Annex.

Empirically, the paper uses a variety of datasets on both the U.S. and Europe to ask whether it is possible to identify the e ects outlined by the literature on nance labor interactions. Initially we draw on two-digits sector-level data on employment, and value added over a large number of OECD countries at quarterly

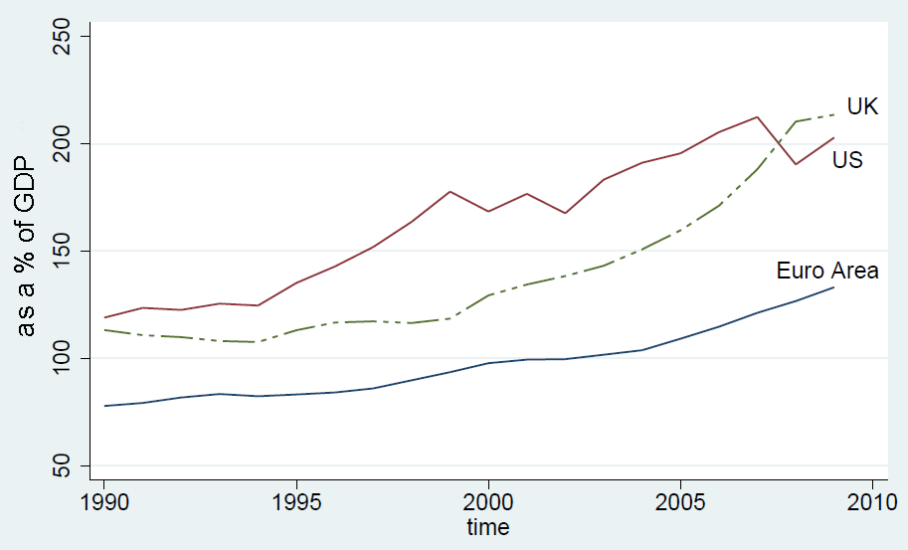
frequencies. We show that nancial recessions involve larger falls in employment than ordinary recessions, conditioning on the size of output falls. Later on we exploit matched employment-balance sheet data at the rm-level to look speci cally into the relationship between employment adjustment and leverage of rms throughout the 2008-9 nancial crisis.

The structure of the paper is as follows. We rst review the basic facts on employment and unemployment dynamics over the business cycle and the extent to which these facts can be explained by labor market institutions, and the nancial nature of the recession. Next we survey the literature on labor- nance interactions and discuss the potential mechanisms into play. We also develop a simple model (which is o ered in the Annex), generating a job destruction e ect of nance in a simple search model with endogenous leverage. The model shows that in an environment with deeper capital markets (a lower cost of credit), after an adverse liquidity shock, rms are hit disproportionally hard and experience a larger increase in unemployment. Finally, we go back to the data and nd evidence that more leveraged rms experience stronger employment declines in the midst of a nancial recession.

2 Employment adjustment, institutions and finance during the Global Recession

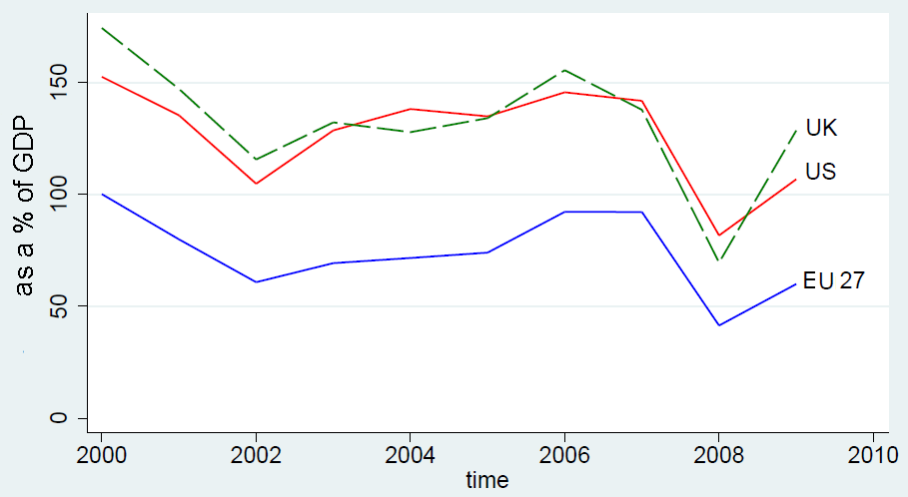
The Great Recession was a global recession. Although the size of the shocks was di erent from country to country, it occurred worldwide within the same time frame. This gives us the opportunity to evaluate di erences in the way in which labor markets respond to shocks whose propagation was largely associated to the work of nancial markets. There is a lot to potentially learn from this about the functioning of labor markets, the role of labor market institutions, and the transmission mechanism itself from nance to labor markets.

Figure 2: Credit to the private sector in US, UK and Euro Area



Notes: Credit to the private sector refers to nancial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.
Source: International Monetary Fund, International Financial Statistics for data on credit to the private sector, World Bank and OECD for GDP gures.

Figure 3: Stock market capitalization over GDP: US, UK and Euro Area



Notes: Stock market capitalisation is calculated by multiplying the volume of shares issued by companies and quoted on the stock market by their market value. Market value is determined by trading on the stock market.
Source: World Federation of Exchanges, Federation of European Securities Exchanges (FESE) - Eurostat.

2.1 Okun's Law Forecast Errors and Labor Market Institutions

Figure 4 displays the employment and unemployment-to-output response that could have been expected in Germany and the US in light of historical Okun's law elasticities. In particular, the regression line displays results from country-speci c estimates of employment and unemployment-to-output elasticities over the period 1960-2013 over data at quarterly frequencies[1] according to the following speci cation:

$$x_t = \alpha + \beta^* \quad y_t + \gamma^* RD_t + \delta^* RD_t^* \quad y_t + \varepsilon_t \tag{2}$$

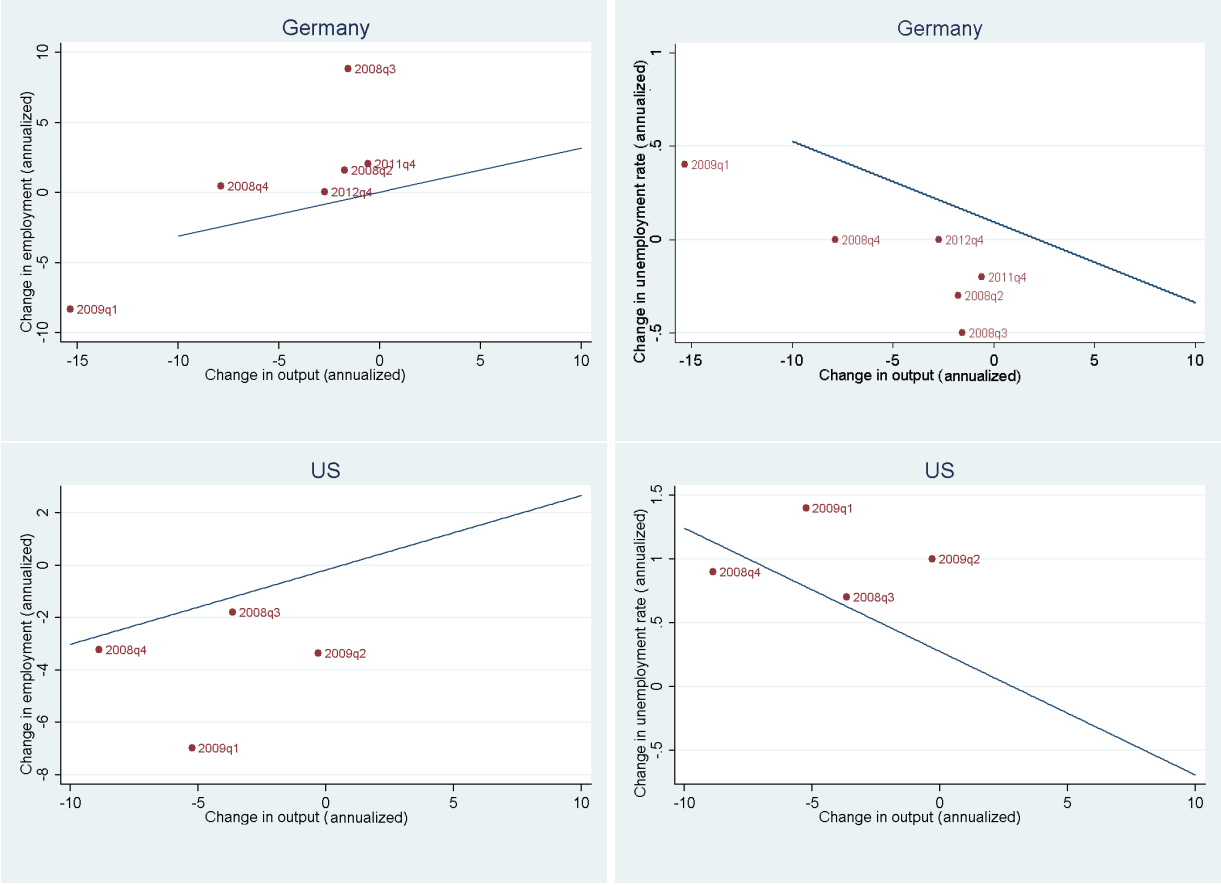
where x_t is either the unemployment rate or log employment, y is real output growth and RD a recession dummy allowed to a ect both the intercept and the Okun's law coe cient. The predictions in Figure 4 clearly consider the case in which RD=1.

Annualized quarterly employment and unemployment variations during the Great Recession are also plotted in the gure, to assess the extent to which they deviate from historical experience. Figure 4 indicates that in Germany employment has consistently been outperforming past recessions while unemployment has grown less than during previous recessions conditioning on output. The opposite happens in the US where employment fell more and unemployment increased more than under previous recessions relative to output falls. In the other G7 countries, there is not a clear pattern (the diagrams are in the Annex) but most observations deviate substantially from Okun's law estimates. Indeed there appear to be large \forecast errors" (the di erences between estimated and actual employment/unemployment variation). Table 1 compares these forecast errors with those of previous recessions indicating that they are generally larger than in previous downturns.

Our estimates capture time-invariant cross-country di erences in labor market institutions as regressions are estimated separately for each country. Yet, we do not control for the e ects of time-varying institutions and some of those institutions which potentially a ect employment and unemployment adjustment to output shocks have gone through quite relevant reforms at least since the mid 1980s (Boeri, 2011). In particular, employment protection legislation and unemployment bene ts have been repeatedly reformed, although often allowing for the creation of two-tier regimes. In order to capture the e ects of these reforms, we estimated the two regressions above over a shorter time-period (1985 to 2012 as there are no series of institutions for the

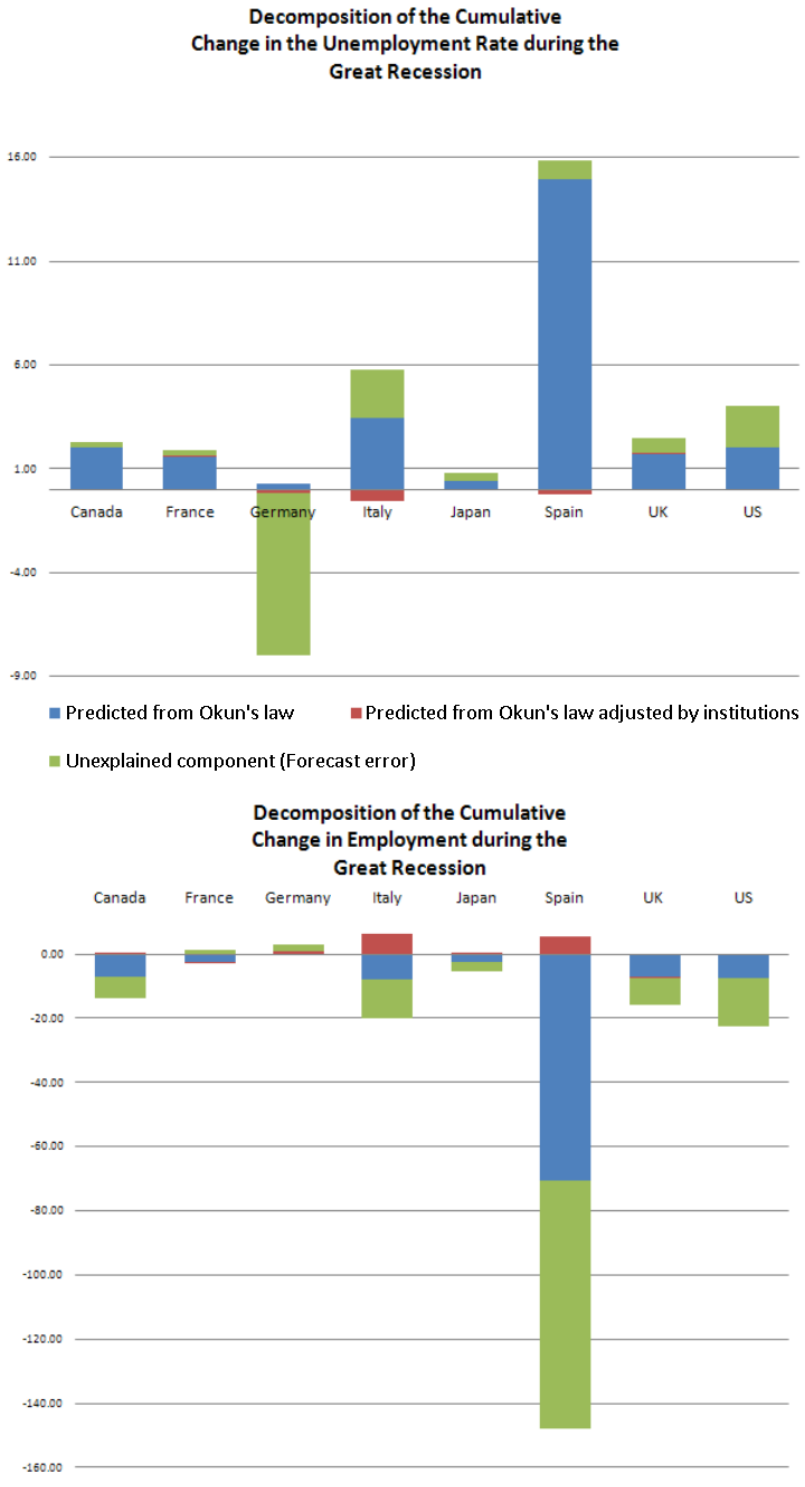
[1] Results are available upon request from the authors

Figure 4: Okun's law and the Great Recession



Notes: Actual (data points) and predicted (regression line) unemployment and employment responses to output change during the Great Recession.
Source: Estimates of Okun's law equation (see the text for details) drawing on data from OECD and IMF.

Figure 5: Explaining Employment/Unemployment response



Notes: See the text for details.
Source: Estimates of Okun's law equation (see the text for details) drawing on data from OECD and IMF on GDP, employment, unemployment and labor market institutions.

Table 1: Forecast Errors during the Great Recessions and previous recessions

EMPLOYMENT CHANGE

Country	(1) Average Forecast Error of Previous Recessions	(2) Average Forecast Error of Great Recession	(2)-(1)
France	2.02	3.02	0.99
Germany	1.44	3.99	2.55
Italy	2.92	2.89	-0.03
Japan	0.96	1.01	0.05
Spain	1.56	3.19	1.63
United Kingdom	1.48	2.31	0.83
United States	1.48	1.61	0.13

UNEMPLOYMENT RATE CHANGE

Country	(1) Average Forecast Error of Previous Recessions	(2) Average Forecast Error of Great Recession	(2)-(1)
France	0.14	0.22	0.08
Germany	0.20	0.37	0.17
Italy	0.20	0.29	0.08
Japan	0.11	0.24	0.13
Spain	0.35	0.46	0.10
United Kingdom	0.30	0.32	0.02
United States	0.25	0.39	0.14

Notes: Forecast errors are given by the di erence (in modules) between, on the one hand, the actual variation in log employment and, on the other hand, the change in the unemployment rate and the estimates from the following country speci c Okun's law regression:

$$x_t = \alpha + \beta^* \quad y_t + \gamma^* RD_t + \delta^* RD_t^* \quad y_t + \varepsilon_t \tag{1}$$

where x_t is either the (annualized) change in unemployment rate or the variation in log employment, y is real output growth and RD a recession dummy allowed to a ect both the intercept and the Okun's law coe cient, which was estimated on the period 1960q1-2013q1 excluding each time the quarters for which the forecast error is obtained.
Source: Estimates of Okun's law equation (see the text for details) drawing on data from OECD and IMF.

previous years) including time-varying indicators of the generosity of unemployment bene ts, strictness of employment protection and the share of temporary workers (a measure of contractual dualism). In particular, we draw on country-speci c series of the OECD index of strictness of employment protection (source: OECD and IMF structural reform database) and the summary measure of unemployment bene t generosity, as well as the share of temporary workers in total dependent employment, also provided by OECD and IMF.

Figure 5 displays the actual peak-to-trough unemployment and employment variation during the Great Recession in the same set of countries considered above. This variation is also decomposed into three components: i. the prediction based on equation 1 estimated over the 1985-2013 period, ii. the prediction based on estimates allowing for time varying institutions, and iii. the forecast error (the di erence between actual and predicted changes in employment and unemployment) of the latter set of estimates.

In most cases our institutionally augmented regressions appear to underestimate the decline of employment and the rise of unemployment: Germany is the only country where the prediction has the wrong sign. EPL, UB and the measures of contractual dualism appear to contribute only marginally to reducing the forecast error of country-speci c Okun's law estimates not allowing for time-varying institutions. In some countries, e.g., Italy and Spain, two countries with strong contractual dualism, they actually contribute to increase forecast errors.

2.2 Are Financial Recessions different for Labor Market Adjustment?

Given that the propagation of the Great Recession was mainly via the nancial markets, nancial-labor interactions are the obvious candidate to explain the large forecast errors of predictions based on institutionally augmented Okun's law equations. Our estimates, as documented above, in most countries underpredict employment and unemployment adjustment. Thus, it is important to consider whether recessions involving in their early stages a nancial crisis feature a stronger employment and unemployment response than non- nancial recessions.

Table 2 displays average unemployment and hours variations during nancial recessions (de ned as NBER recessions initiated by a nancial crisis, according to Reinhart and Rogo (2008) taxonomy) and other, non- nancial, recessions in Europe and the US. Financial recessions are characterized by a larger unemployment response (in terms of both changes in the unemployment rate and percentage variations) than `ordinary' recessions. The exception is Germany, but only limited to headcounts. When we focus on hours worked (third and fourth columns of the table) also Germany displays a stronger response during nancial recessions than under non- nancial recessions. Our ndings are consistent with those of OECD (OECD, 2010) and Imf (Imf, 2010), producing evidence from country-level data that nancial recessions are particularly bad for employment and unemployment.

How important is the nancial nature of the initial shock in explaining labor market adjustment during the Great Recession? Can we reduce forecast errors by accounting for this e ect over and above the role played by ordinary recessions? Unfortunately, there are too few episodes of nancial recessions before 2008-9 to be able to estimate country by country Okun's law equations augmented by dummies capturing nancial recessions. At the same time, we documented above that there is substantial heterogeneity in employment and unemployment-to-output elasticities across countries, thus imposing the same coe cient in a pooled regression framework may bias our estimates.

Fortunately, we could have access to a unique dataset of quarterly data on employment and value added by country and sector, assembled from the IMF | WDI Database and the STAN archive of the OECD. In particular, data cover 6 sectors (agriculture, construction, nance, industry, public administration, and trade) and 13 OECD countries (Australia, Canada, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, United States) in the period 1985-2008. We could therefore estimate the change in the Okun's law intercept associated with a nancial crisis, controlling for time-invariant country and sectoral characteristics as well as interactions between the two sets of dummies.

Table 3 provides information on the number and duration of *financial recessions*, that is, NBER-type recessions featuring a nancial crisis (according to Reinhart and Rogo (2008) classi cation of recessions). The overall count of *financial crises* (involving or not involving a recession) is also o ered. Reinhart and Rogo capture a relatively large set of recessions involving the nancial sector, including housing booms-bust

Table 2: Unemployment and hours adjustment during financial recessions

Country	Type of recession	du	du/u	dHW (in thousands)	dHW/HW	dy/y
France	Financial rec	1.40	19%	-225	-2.2%	-4.3%
	Other rec	1.00	11%	-181	-1.9%	-1.2%
	Difference	*0.40*	*8%*	*-44*	*-0.4%*	*-3.1%*
Germany	Financial rec	-0.40	-5%	-306	-2.1%	-6.8%
	Other rec	0.54	8%	-240	-1.5%	-1.1%
	Difference	*-0.94*	*-13%*	*-66*	*-0.6%*	*-5.7%*
Italy	Financial rec	1.30	15%	-540	-5.2%	-1.5%
	Other rec	0.43	6%	-16	0.0%	-2.2%
	Difference	*0.88*	*9%*	*-524*	*-5.2%*	*0.7%*
Japan	Financial rec	0.47	13%	-421	-1.6%	-1.8%
	Other rec	0.20	6%	-500	-2.1%	-5.9%
	Difference	*0.27*	*7%*	*79*	*0.5%*	*4.1%*
Spain	Financial rec	9.80	107%	-584	-6.8%	-5.0%
	Other rec	3.30	20%	-	-	-1.6%
	Difference	*6.50*	*87%*	-	-	*-3.4%*
UK	Financial rec	2.10	36%	-882	-2.5%	-3.2%
	Other rec	0.50	7%	-1413	-2.9%	-3.1%
	Difference	*1.60*	*28%*	*531*	*0.4%*	*0.0%*
US	Financial rec	2.65	50%	-8693	-3.6%	-3.0%
	Other rec	1.93	33%	-1667	-1.0%	-2.6%
	Difference	*0.72*	*17%*	*-7026*	*-2.6%*	*-0.4%*

Notes: Episodes of recessions with financial crises: France 2008; Germany 2008/09; Italy 1992; Japan 1993, 1987/98, 2001; Spain 2008;UK 1975, 1990, 2008; US 1990, 2008.
France: data starting from Q1-1978; GDP data starting from 1970; Germany: data starting from Q1-1991; Italy: unemployment data starting from Q1-1983; Working Hours Q1-1992; GDP data starting from 1970; Spain: unemployment data starting from Q2-1986; Working Hours Q1-1995; GDP data starting from 1970; UK: Unemployment data starting from Q1-1983; Employment Q2-1992; GDP and Working Hours yearly data starting from 1970; US: Unemployment rate and Employment data starting from Q1-1970; GDP and Working Hours yearly data from 1970.
Sources: OECD, Eurostat, Statistics Canada, Statistic Bureau of Japan, US Bureau of Labor Statistics.

Table 3: Number of nancial recessions in di erent countries

	Financial Recessions		Financial Crises	Other Recessions	
Country	av. Lenght (qrt)	nr. of Episodes	nr of Episodes	av. Lenght (qrt)	nr. of Episodes
Australia	5	1	1		
Canada				3	1
Finland	13	1	1	2.5	2
France			1	3.5	2
Germany			1	4.5	3
Italy	6	1	1	3	5
Netherlands	3	1	-		
Norway			-	3.5	2
Portugal			-	3.5	2
Spain			-	4	1
Sweden			-	4	1
UK	4.5	2	4		
US	4	1	2	3.5	6

Notes: Financial recessions are NBER recessions featuring a nancial crises (see the text for the de nition) according to Reinhart & Rogo (2008) taxonomy. Financial crises also include nancial crisis episodes in which output did not fall for at least two consecutive quarters.

sequences. A nancial crisis is, according to their de nition, one where any of the following two conditions is met:

1. there are bank runs that lead to the closure, merging, or takeover by the public sector of one or more nancial institutions;

2. there are no bank runs, but the closure, merging, takeover, or large-scale government assistance of an important nancial institution (or group of institutions), that marks the start of a string of similar outcomes for other nancial institutions.

As shown by the table, there are 7 nancial recessions and 11 nancial crises in our sample.

Table 4 displays estimates of a regression in which the dependent variable is the log variation in employment while, on the right-hand-side, we control for xed country and sector e ects, interactions between these two sets of dummies, output growth at the country level, dummies capturing nancial crises or, alternatively, nancial recessions. Formally, the equation that we estimate is as follows:

$$e_{jct} = \alpha_j + \alpha_c + \beta \quad y_{ct} + \gamma^* RD_{ct} + \gamma_1 FC_{ct} + \epsilon_{cjt} \tag{3}$$

where e_{jct} is log employment variation in sector j, country c at time t, α_j denotes the coe cients of sector and α_c those of country dummies, y is the variation of GDP, RD is a recession dummy, and FC is a dummy capturing nancial crises or, in some speci cations, nancial recessions.

Our key parameter of interest is γ_1 capturing the contribution of nancial crises (or recessions) to employment adjustment.

We nd a sizeable e ect of nancial crises (or nancial recessions) on sector-level employment adjustment over and above the e ect of non- nancial recessions. The shift of the Okun's law intercept (denoting the minimum level of output growth consistent with non-negative net job losses) for nancial crises is almost one half of that occurring during ordinary recessions; the coe cients of the nancial recession dummy is even larger, implying that in the aftermath of a nancial recession, output growth should be twice as large as during \normal recessions" to prevent job losses.

Table 4: Financial Recessions-Crises and Employment Adjustment

	(1)	(2)	(3)	(4)
VARIABLES	e	e	e	e
y	0.103***	0.103***	0.110***	0.103***
	(0.027)	(0.027)	(0.027)	(0.027)
Recession	-0.009***	-0.009***	-0.006***	-0.009***
	(0.001)	(0.001)	(0.001)	(0.001)
Financial Crisis	-0.004**	-0.004**		-0.004**
	(0.002)	(0.002)		(0.002)
Financial Recession			-0.007***	
			(0.002)	
Country dummies	YES	YES	YES	YES
Sector dummies	NO	YES	YES	YES
Country*Sector	NO	NO	NO	YES
Observations	5,270	5,270	5,270	5,270
R-squared	0.029	0.057	0.059	0.065

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

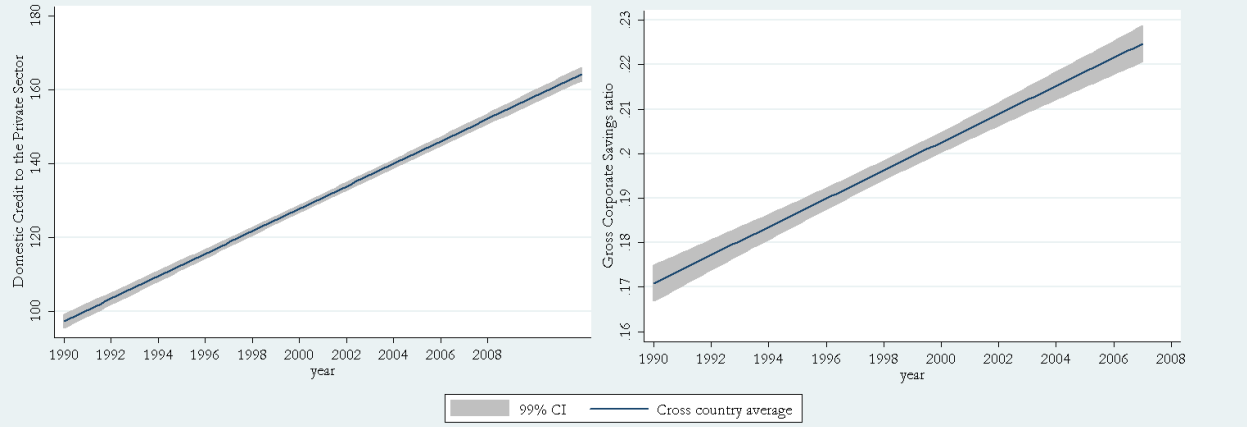
Notes: Estimates of equation (3).
Source: Estimates based on IMF-WDI database and OECD-STAN archive.

The t of the regression increases by adding sector dummies as well as interactions between country and sector dummies. This relevant cross-country and within country heterogeneity may also be related to the operation of nancial markets. As discussed in the introduction, there are major di erences in the size of nancial markets across countries. While the two decades predating the 2008-9 global recession witnessed a worldwide increase in the size of nancial markets, this increase may have preserved cross-country gaps in the depth of these markets. The left-hand-side of Figure 6 displays the cross-cuntry average of domestic credit to the private sector - de ned as loans, purchases of nonequity securities, trade credits and other accounts receivable, that establish a claim for repayment { as a share of GDP across the OECD countries for which such data are available. There is a marked trend increase in credit to the private sector without any apparent cross-country convergence in the relative size of nancial markets (there is no narrowing of the 99 per cent con dence bands). To give an example, in 2010 the US stands up as being, just like at the beginning of the 1990s, the country with the largest nancial market, with credit to the private sector being almost twice as large as in Germany.

Parallel to the increase in credits to the private sector, there has been a global trend increase (Figure 6 right panel) in gross corporate saving relative to sectoral value added (Karabarbounis and Neiman, 2012). This increase is largely related to the declining cost of capital, and may be attributed to a precautionary motive (Bates et al., 2006). It is also highly and increasingly diversi ed across countries as well as within each country. As shown by Pinkovitz et al.(2013), in the US, for instance, it was mainly multinational rms to increase their cash holdings since the end of the 1990s.

Given these large cross-country and within-country di erences in the size of nancial markets and in rms' exposure to nancial shocks, it is tempting to draw also on this cross-sectional variation in assessing the role played by nancial shocks in labor market adjustment. In doing so we need, however, some theoretical guidance. In order to identify proper covariates, we need to consider the potential mechanisms behind the transmission of nancial shocks to the labor market.

Figure 6: Domestic Credit to the Private Sector and Gross Corporate Savings as a % of Value Added



Notes: Domestic credit to private sector refers to nancial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.
Gross Corporate Savings ratio is de ned as the year average of Gross Corporate Savings divided by Gross Corporate Value Added.
Countries considered: Canada, France, Germany, Italy, Japan, Spain, United Kingdom and United States.
Source: Neiman & Karabarbounis (2012) and IMF(2013).

3 From financial shocks to the labor market: potential mechanisms

Unfortunately, there is not a well developed literature on labor- nance interactions, even though the mechanisms have been outlined within the elds of corporate nance, of labor market institutions, and of labor demand. We begin by reviewing the literature to date. Next, we focus on a simple mechanism that highlights the key trade-o between nance and labor, and the job destruction e ect in the aftermath of a nancial shock

3.1 The links of finance to labor in the literature

The links between, on the one hand, nancial market imperfections and, on the other hand, labor demand and unemployment have been investigated in a variety of settings. There are three main channels in these interactions.

The rst channel is a risk adjustment e ect and was emphasized by Greenwald and Stiglitz (1988), but perhaps rstly pointed out by Hart (1983) when studying optimal labor contracts under asymmetric information and moral hazard. Greenwould and Stiglitz argue that capital market imperfections tend to increase risk aversion on the part of rms, and consequently reduce the risk-adjusted marginal product of labor. The reduction in the marginal product of labor in turn negatively a ects employment and labor demand. Furthermore, Greenwould and Stiglitz (1988) argue that imperfections in capital markets can give rise to potentially large uctuations in the e ective marginal product of labor in a way that would not happen if the capital markets were perfect. If rms pay e ciency wages, these risk adjustment e ects turn out to be ampli ed, so that there is a complementarity between imperfect capital markets and imperfect labor markets.

The second channel is the quasi- xed investment e ect of labor demand. In-as-much as labor involve some ex-ante costs, e.g., training and hiring costs (Oi, 1962), the nancing of such investment costs within imperfect capital markets a ects the demand for labor. The best indirect rigorous application of this simple

mechanism can be found in Farmer (1985). In Farmer model, rms have to nance a machine in order to hire labor. The presence of limited liability induces an equilibrium relationship between interest rate shocks and labor demand. Limited lliability implies that a creditor receives a low return if the rm goes bankrupt, and hence requires a higher return if the rm does not go bankrupt. In Farmer model, an increase in interest rates reduces employment even in a frictionless labor market, since the optimal contract then guarantees a higher interest rate if the lender does not go bankrupt, and as a result more rms choose to le for bankruptcy. This drives up unemployment.

A third channel linking nance to employment emphasizes the stickiness of the bank-borrower relationship resulting from asymmetric information. On the one hand, long term bank-borrower relationships can be the result of adverse selection in the market for borrowers that switch lenders (Sharpe, 1990). On the other hand, long term bank-borrower relationships act as signaling mechanism to overcome the moral hazard problem (Holmstrom and Tirole, 1997). The presence of sticky relationships implies that speci c shocks to nanciers transmit quickly to hiring rms, and thus to labor adjustment. Wasmer and Weil (2004) use such a stickiness to integrate capital market imperfections and equilibrium unemployment theories. This strand of literature argues that labor market deregulation goes hand in hand with nancial market liberalization (Bertola and Rogerson, 1997, Wasmer and Weil 2004; Koskela and Stebacka 2002). Greater access to nancial markets by both rms and workers makes it possible to partly self-insure against labor market risk, reducing the demand for employment protection.

Beyond the three channels outlined above, within the literature of labor market institutions and regulation some studies view a relatively easy access by rms to nancial markets as a substitute for labor market exibility. Caggese and Cunat (2008) show that interactions between nancing constraints and the employment decisions of rms when both xed-term and open-ended contracts are available. In particular, they show that the tighter the borrowing constraints, the larger is the share of workers employed under xed-term contracts. Other papers have looked at interactions between nancial variables and collective bargaining institutions, particularly the role played by rms' leverage decisions in coping with collective bargaining (Gatti et al. 2010; Monacelli et al. 2011). A general implication of these models is that leverage is a way to contain labor costs or at least contain the e ects that wage increases have on hiring policies. Other studies focus on the business cycle, and show that during downturns, rms that have better access to credit can a ord the cost of labor hoarding (Rendon, 2000; Belke and Fehn, 2001; Belke et al. 2002). In other words, well developed nancial markets make labor market rigidity sustainable for rms.

A nal strand of literature that o ers some insights into employment adjustment during recessions is the research on nancial distress in the context of Chapter 11 bankruptcy procedures. Aghion, Hart, and Moore (1994) and Wruck (1990) argue that nancial distress can lead to excessive management control and excessive restructuring even when liquidation could be optimal. Empirical evidence provided by Gilson, John, and Lang (1990) is coherent with such a view.

These variety of channels are certainly very important in understanding how nancial frictions may be a propagation mechanism for productivity shocks. Yet, as pointed out in the introduction, they do not adequately address a number of relevant issues. The literature does point out that nancial frictions may make unemployment more volatile in the presence of real shocks, but it does not explain why countries with di erent degrees of nancial deepening may react di erently to a nancial crisis. Furthermore, the standard model of unemployment in modern macro is the Diamond-Mortensen-Pissarides search model. Most of the papers above do not link unemployment to search, and this calls for models that link nancial frictions and search-based unemployment. Some models, most notably Wasmer and Weil (2004), do exactly this. However, they do not address how nancial shocks will a ect unemployment. Finally, the literature does not distinguish between job creation and job destruction, and it's not coherent with a positive output e ect of nance in the long run. Indeed, the correlation between nancial development and output growth is very robust and can be given a causal interpretation (Rajan and Zingales 1998). (Pagano and Pica 2012) represent an exception in this respect. They lay out a simple model where the degree of nancial development is determined by the ability of nancial intermediaries to verify the cash ows of rms, and nancial development results in greater availability of external nance to rms. In particular, a higher degree of nancial development raises the demand for labor and thereby employment and/or real wages, though its impact is non-linear: it diminishes and eventually vanishes as nancial development increases, since the fraction of nance constrained rms

shrinks. Yet, the model by Pagano and Piga belongs to the corporate nance literature and completely ignores labor market imperfections.

Overall, while many insights on labor- nance interactions are o ered by the literature, what is lacking is a model framing large employment-unemployment variations during nancial recessions and possibly a positive role of nance in job creation in the long-run. Moreover, the existing channels do not distinguish between how nance di erently a ects the job creation and job destruction margins. We thus feel useful to frame some of the existing channels within the context of labor market imperfections, in a simple model that properly distinguishes between the hiring and ring margins. The technical annex provides a simple model with these features, which yields testable implications on labor- nance interactions under nancial recessions. We con ne ourselves below to present the key intuitions and insights of the model.

3.2 New perspectives: financial shocks in a search model

The appendix proposes and solves a simple model of labor and nance. We show that an economy more dependent on nance is i) more productive on average but, at the same time, ii) more vulnerable to aggregate nancial shocks. Hence, and in contrast with the existing literature, our simple model explains why unemployment responds more to aggregate nancial shocks in economies which initially rely more on credit than economies that don't.

In our framework, production requires an entrepreneur, a worker and, potentially, nance or credit. In other words, nance or credit (used interchangeably) is akin to an input in production. All agents are risk neutral and discount the future at a constant rate. Entrepreneurs must choose ex-ante the nance intensity of their production, that is, the leverage of the rm. In *normal times*, more leverage guarantees more output, although its marginal e ect is subject to decreasing marginal returns. While we assume that nance is readily available at a given \liquidity cost" at the time of job creation, it can be suddenly pulled back to the rm as a result of an idiosyncratic nancial shock. If such a shock occurs, production can still continue without credit, but the rm operates in *financial distress*.

We thus model nancial shocks as events making nancial inputs no longer productive. When these events materialize, leveraged rms nd themselves in a position in which their liquidity is suddenly called back by the lender. Such a sudden call back in liquidity has direct consequences on a rm's ability to run and manage existing jobs. As a result, rms may be obliged to shut down part of their operations and destroy existing jobs. In this sense, the job destruction e ect of the credit crunch is essentially a labor demand driven channel of adjustment.

Thus, more leverage increases production in normal times, but it reduces production during nancial distress. This basic technological trade o of nance is coherent with the *stickiness of bank borrower relationship* outlined above in the literature review, as well as with the literature on liquidity (Holmostron and Tirole, 2011).

The labor market is imperfect and is characterized by a standard equilibrium search unemployment model (Blanchard and Diamond, 1992; Mortensen and Pissarides, 1999). Entrepreneurs post vacancies at a cost and search for workers. Search is random. Wages are the outcome of Nash Bargaining between workers and rms, subject to a participation constraint.

The key novel economic decision is the choice of optimal leverage as well as the job destruction decision conditional on a nancial shock. After a negative nancial shock, a rm has to decide whether or not to continue operating. If the rms are su ciently dependent on credit, they nd it optimal to close down and re the worker. If the rms are somehwhat less dependent on credit, they may nd it optimal to carry on.

With respect to the rms' choice of leverage, we distinguish between two di erent equilibrium con gurations. The rst is one where rms use relatively little credit and operate when in nancial distress. The second is one where rms are more dependent on credit, and close down (and destroy the job) when hit by nancial distress. We call the rst a *low credit equilibrium* while the second is a *high credit equilibrium*. The two equilibrium con gurations can easily be rationalized in terms of an exogeneous cost of credit, with the high (low) credit equilibrium associated to low (high) cost of credit. Nevertheless, we show that even in a neighbour of approximately identical costs of credit, total output is higher in the high credit equilibrium, but output and labor are more responsive to a situation of nancial distress.

A key prediction of the model is that aggregate nancial shocks (modelled as an increase in the frequency of nancial shocks) have di erent e ects on the unemployment rate depending on whether the economy is in the high-credit or the low-credit equilibrium. We show that the high-credit equilibrium is more vulnerable: after an aggregate nancial shock, job creation falls more and job destruction increases more in the high-credit equilibrium than in the low-credit equilibrium.

We also extend the model and allow for heterogeneous rms, which di er in their cost of credit. In equilibrium, rms with a low cost of credit choose to become credit dependent, in the sense that they stop operating if credit is withdrawn. Firms with a higher cost of credit choose instead to be less credit-dependent, and will continue to operate if credit is withdrawn. We show that after an aggregate shock, the credit-dependent rms will reduce employment more than the other rms, and again the e ects work both through the hiring and the ring margins. In the next section we will confront these predictions with data.

4 Back to the Data

Is nance a candidate to explain not only the time-series variation, but also the cross-sectional variation in the responsiveness of employment and unemployment to output changes? The model sketched above (and presented in the Technical Annex) rationalizes why nancial recessions originate larger employment variations than non- nancial recessions. This is because there is an additional e ect on productivity than during \ordinary" recessions, coming from the forced reduction in the use of the nance-input in the production process. It is the nature of the shock, more than the labor input role played by nance in the model, that makes nancial shocks di erent from ordinary productivity shocks. The model also yields some testable empirical implications. In particular, it implies that high leveraged rms should experience larger variations in employment during nancial crises than low leveraged rms because in the former the e ect is felt both on the job creation and the job destruction margins, while in the latter only on job creation.

In this section we test the posited links between rm-level employment adjustment and leverage as well as the above empirical implications of the model.

We rely on a dataset of rm-level employment adjustment and leverage during the Great Recession (it covers the period 2007-9). It is obtained by combining data from the EFIGE survey of European rms with balance sheet data from the Amadeus archive. E ge samples some 16,000 European rms: 3,000 in large countries (Germany, France, Italy, Spain and the UK), and 500 rms in smaller countries (Austria and Hungary). The questionnaire is very detailed on a number of structural characteristics of rms such as organization, job composition, innovation activities, nance as well as product and labor market strategies. This dataset was matched to the Amadeus archive providing nancial and business data on Europe's biggest 500,000 companies by assets. Hence, the matched sample covers only large rms (the average rm size in terms of employees is 81) and data are not cross-country comparable.

Table 5 provides some descriptive statistics on the measures of leverage used in the empirical analysis in 2007, the year before the Great Recession. In particular, the *Gearing ratio* is the debt to equity ratio measuring the extent to which the rm is using creditor's vs. owner's funds. The *Solvency Ratio* measures the ratio of after tax net pro t (excluding non-cash depreciation expenses) over debt and is a measure of one company's ability to meet long-term obligations. Finally, the long-term debt to assets ratio evaluates the importance of the debt having a longer duration and therefore being less exposed to a liquidity crisis: it measures loans and nancial obligations lasting more than one year over total assets of the rm. As shown by the table there is signi cant cross-country and within country (across sectors) variation. At the same time, there are large di erences in the average size of rms across countries, which suggests that data are not cross-country comparable.

The key variable of interest relates to employment adjustment during the Great Recession. in particular, at the beginning of 2010 the following question was asked to employers: *During the last year (2009) did you experience a reduction or an increase/decrease of your workforce in comparison with 2008?* . For those stating to have changed employment levels, a second question asked speci cally the percentage change in the workforce. We imputed a zero value to rms declaring that they did not experience any change in

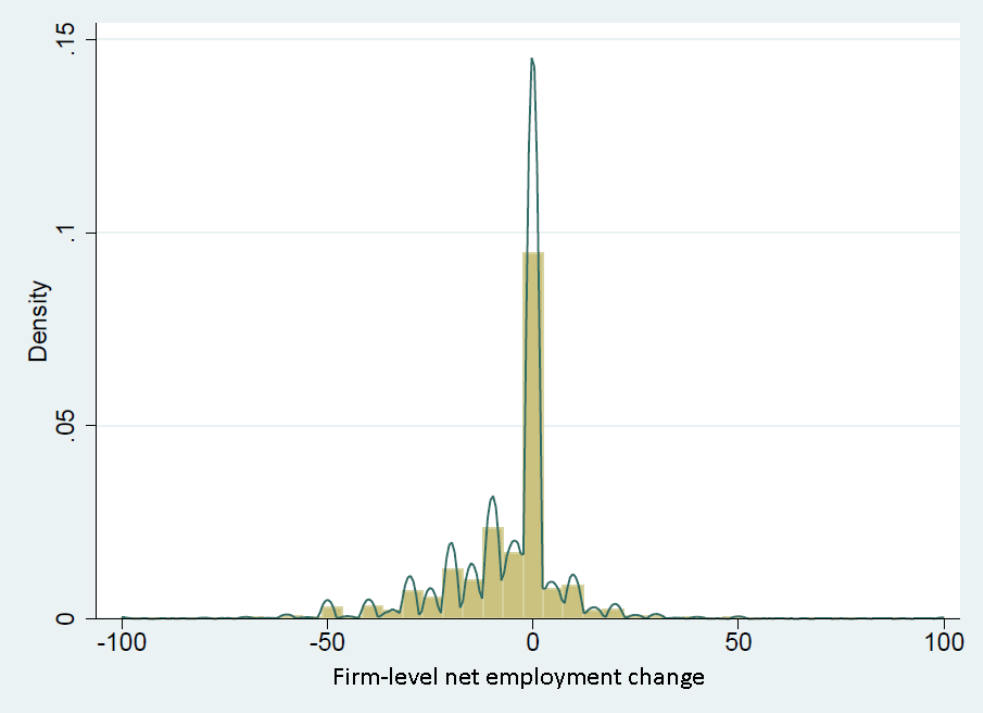
Table 5: Measures of Leverage, Descriptive Statistics

Country	N of Firms	Average Size of Firms	St Dev	Gearing Ratio 2007 (%)	St Dev	Solvency Ratio 2007 (%)	St Dev	Long-term Debt to Asset Ratio 2007 (%)
AUT	443	100	33	84.29	6.85	30.22	1.61	.
FRA	2,973	50	8	68.56	2.27	37.44	0.45	6.48
GER	2,935	96	11	172.41	5.80	28.89	0.60	31.81
HUN	488	68	9	51.28	4.74	48.65	1.27	2.78
ITA	3,021	40	2	224.82	4.48	24.02	0.37	7.40
SPA	2,832	45	3	92.29	2.84	37.54	0.46	11.11
UK	2,067	180	20	71.72	3.21	39.73	0.72	6.89

Sector	N of Firms	Average Size of Firms	St Dev	Gearing Ratio 2007 (%)	St Dev	Solvency Ratio 2007 (%)	St Dev	Long-term Debt to Asset Ratio 2007 (%)
1	3,430	40	2	139.17	3.65	31.93	0.43	13.29
2	1,520	57	7	153.48	6.14	29.98	0.75	22.56
3	937	90	27	132.07	6.82	32.98	0.91	13.38
4	1,966	47	4	145.43	5.23	30.47	0.64	15.11
5	1,038	43	5	162.84	7.58	31.13	0.82	11.25
6	563	100	9	125.23	8.01	35.41	1.15	11.25
7	424	130	32	127.16	9.31	31.31	1.33	11.38
8	705	36	3	131.23	7.22	30.81	1.00	16.31
9	21	96	59	110.53	36.12	41.24	5.49	10.53
10	2,353	70	9	135.50	4.45	33.30	0.57	14.37
11	1,802	67	6	131.92	5.06	31.82	0.63	1.01

Source: EFIGE Survey of European Firms.

Figure 7: Firm-level net employment change, Distribution of rms



Source: EFIGE Survey of European Firms.

employment in the rst question. Figure 7 plots the distribution of rms in the -100(%) to +100 (%) range. As we are dealing with a global recession year, most rms appear to be downsizing: the median is 0, the mean is -6. In addition to the mode at 0, there are also some spikes at -10, -20 and -30. This may indicate that respondents answered doing some rounding.

In order to obtain preliminary insights as to the importance of nance in employment adjustment, Figure 8 plots the same distribution for rms that successfully applied for credit (top panel), rms that did not apply for credit (lower panel) and rms that applied, but were not successful (panel on the right-hand-side). This suggests that the rms that were un-successful in re nancing operations were, on average, heavily downsizing (on average by almost 20 %) while the distribution of employment adjustment among successful debtors and rms that did not apply for credit is remarkably similar. The concentration of employment losses (about 30 per cent of the total) among rms experiencing di culties in re nancing operations is not informative as to causality: it may well be that rms did not obtain credit because they were downsizing and hence considered not be viable creditors by banks than the other way round.

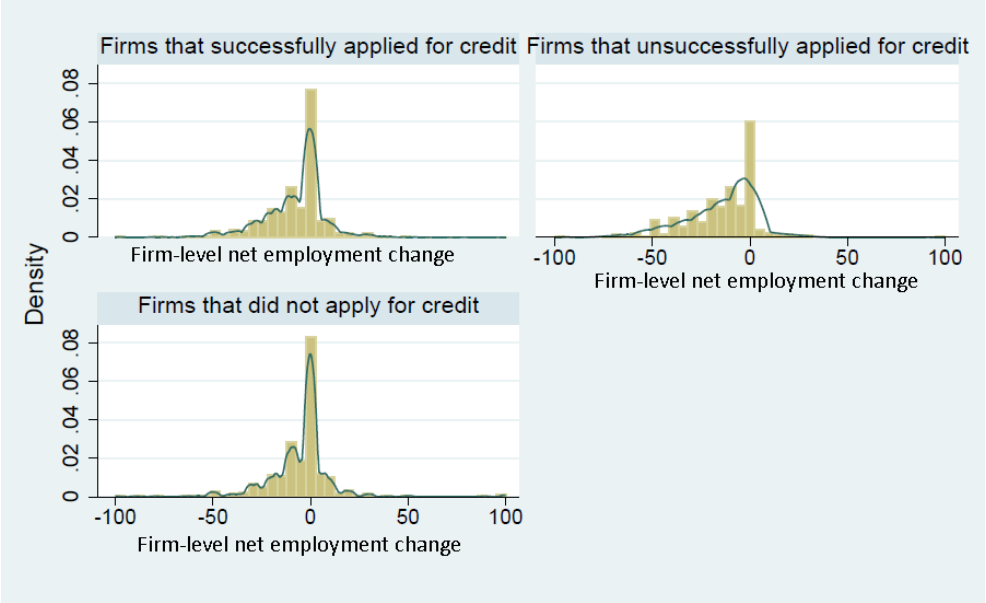
Table 4 reports estimates of the following equation

$$e_{ijc} = \alpha_j + \alpha_c + \beta \quad y_{jc} + \gamma Lev_{ijc} + \delta S_{ijc} + \epsilon_{ijc} \tag{4}$$

where e is the reported employment growth rate $during$ the period 2008-9, i denotes the rm, j the sector and c the country, S is set of size dummies (employment or turnover) and Lev is either the Gearing Ratio, the Solvency Ratio or the Long-term Debt to Asset ratio all measured $before$ the Great Recession (according to 2007 balance sheet data). We also include country and sector dummies as well as interactions between the two sets of dummies.

As shown by Table 4, the gearing ratio is negatively associated with plant-level employment change

Figure 8: Firm-level net employment change, Distribution of rms by access to credit



Source: EFIGE Survey of European Firms.

while for the solvency ratio it is the opposite. Long-term debt instead does not seem to signi cantly a ect plant level job creation and destruction. The correlation between leverage and employment adjustment is non-negligible: bringing, say, a typical Austrian rm to the average gearing ratio of a German rm involves employment losses of the order of 4 per cent during a nancial recession; increasing by 10 basis points the solvency ratio (like moving an average Italian rm to France) involves a 2.3 increase of employment at times of nancial crises.

Table 7 and 8 display estimates of equation (4) when only rms downsizing or only rms upsizing are considered, respectively. The results suggest that the correlation between leverage and rm-level employment adjustment is driven by rms that are downsizing. When the analysis is con ned to rms upsizing, only the gearing ratio is signi cant (at 90 per cent con dence levels).

The e ects of leverage survive when we put on the left-hand-side a categorical variable [2] (0 for downsizing, 1 for rms keeping the same employment level, 2 for those upsizing) in order to cope with the heaping problems mentioned above (Table 9). There is still a statistically signi cant e ect, which is in line with the model's predictions. We also run regressions (reported in the Annex) including rm-level output growth (rather than the average growth rate at the sectoral level) as right-hand-side variable. Such a speci cation clearly creates a problem of endogeneity, but potentially captures idiosyncratic shocks unrelated to the nancial recession. Also in this case, there is still an e ect of leverage on employment growth. Coe cients are remarkably stable across these di erent speci cations.

Overall, rm-level data suggest that leverage matters for employment adjustment during a nancial recession and a ects mainly job destruction. Ceteris paribus, more leveraged rms destroy more jobs than rms with a higher solvency ratio. 5 This result is robust to alternative speci cations. It is also consistent with previous literature suggesting that leveraged rms experience larger employment variations than less leveraged rms during nancial recessions.[3]

[2] Table 9 reproduces OLS estimates. Similar results are obtained using ordered logit and probit

[3] For instance, Bernanke and Gertler (1989), found that more leveraged rms su er more under a credit crunch. Similarly Sharpe (1994) documented that rms more leveraged before a recession face a greater need to de-leverage, and hence reduce employment.

Table 6: All Firms

VARIABLES	(1) $\Delta e(\%)$	(2) $\Delta e(\%)$	(3) $\Delta e(\%)$
$\Delta \bar{y}$	1.107	1.049	1.040
	(0.910)	(0.901)	(0.910)
Gearing	-0.00426***		
	(0.000855)		
Solvency		0.0396***	
		(0.00640)	
LT DA			-0.133
			(0.607)
Constant	-8.123***	-10.73***	-10.02***
	(2.594)	(2.630)	(2.555)
Country	YES	YES	YES
Sector	YES	YES	YES
Country*Sector	YES	YES	YES
Size	YES	YES	YES
Observations	8,596	9,649	8,064
R-squared	0.078	0.074	0.061

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates of equation (4) - All Firms.

Table 7: Only Firms Downsizing

VARIABLES	(1) $\Delta e(\%)$	(2) $\Delta e(\%)$	(3) $\Delta e(\%)$
$\Delta \bar{y}$	0.547	1.322	1.378
	(1.243)	(1.209)	(1.243)
Gearing	-0.00308**		
	(0.00120)		
Solvency		0.0573***	
		(0.00926)	
LT DA			-2.449*
			(1.474)
Constant	-20.23***	-23.08***	-21.95***
	(3.314)	(3.324)	(3.268)
Country	YES	YES	YES
Sector	YES	YES	YES
Country*Sector	YES	YES	YES
Size	YES	YES	YES
Observations	4,151	4,677	3,783
R-squared	0.071	0.071	0.057

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates of equation (4) - Only rms reporting a decrease in employment.

Table 8: Only Firms Upsizing

VARIABLES	(1) $\Delta e(\%)$	(2) $\Delta e(\%)$	(3) $\Delta e(\%)$
$\Delta\bar{y}$	-0.0915	3.051	0.734
	(3.048)	(2.029)	(3.557)
Gearing	-0.00405*		
	(0.00226)		
Solvency		-0.00746	
		(0.0166)	
LT DA			0.0252
			(0.727)
Constant	16.84***	17.36***	16.75***
	(5.979)	(6.126)	(6.154)
Country	YES	YES	YES
Sector	YES	YES	YES
Country*Sector	YES	YES	YES
Size	YES	YES	YES
Observations	1,060	1,181	1,033
R-squared	0.116	0.103	0.105

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates of equation (4) - Only rms reporting an increase in employment.

Table 9: All rms (e categorical)

VARIABLES	(1) Δe	(2) Δe	(3) Δe
$\Delta\bar{y}$	-0.0157	-0.0165	-0.0201
	(0.0420)	(0.0411)	(0.0426)
Gearing	-0.000160***		
	(3.95e-05)		
Solvency		0.00104***	
		(0.000293)	
LT DA			0.0249
			(0.0286)
Constant	0.589***	0.522***	0.541***
	(0.120)	(0.120)	(0.119)
Country	YES	YES	YES
Sector	YES	YES	YES
Country*Sector	YES	YES	YES
Size	YES	YES	YES
Observations	8,693	9,757	8,161
R-squared	0.078	0.076	0.072

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates of equation (4) - e categorical (e = 0 if rms' employment decreases, e = 1 if employment is constant, e = 2 if rms' employment grows).

5 Final Remarks

Empirical evidence suggests that nancial shocks have important implications on labor market adjustment. This paper reviews the di erent mechanisms that have been put forward by the literature to explain these links between labor and nance. It also develops a simple model indicating that in highly leveraged equilibria there is not only a negative e ect of recessions on job creation, but also an additional e ect of nancial shocks acting on the job destruction margin. Firm-level data during the Great Recession are consistent with the model prediction that highly leveraged rms are characterized by higher job destruction rates during nancial recessions and that this association operates mainly along the job destruction margin.

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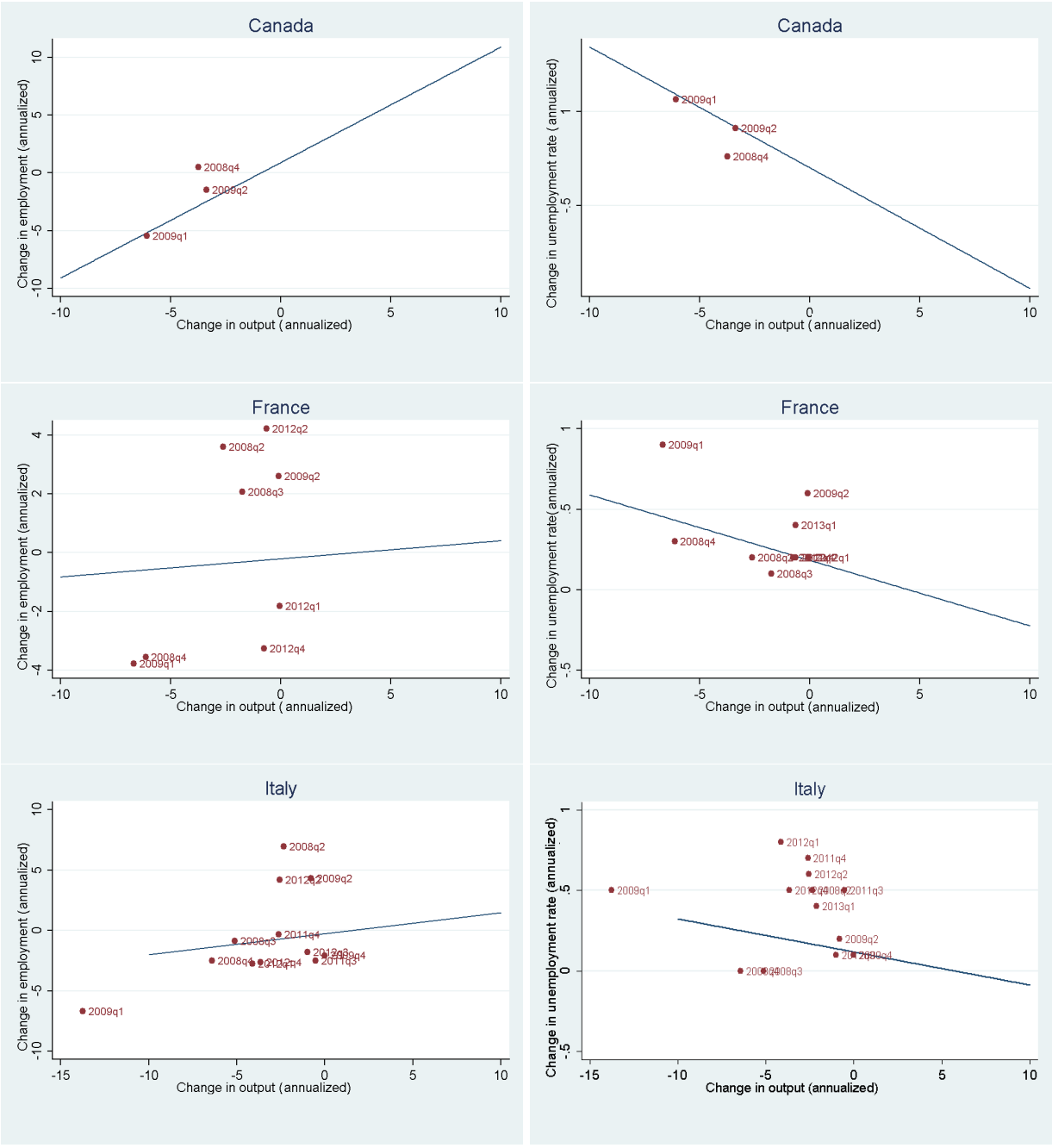
6 Annex

6.1 Okun's law and the Great Recession

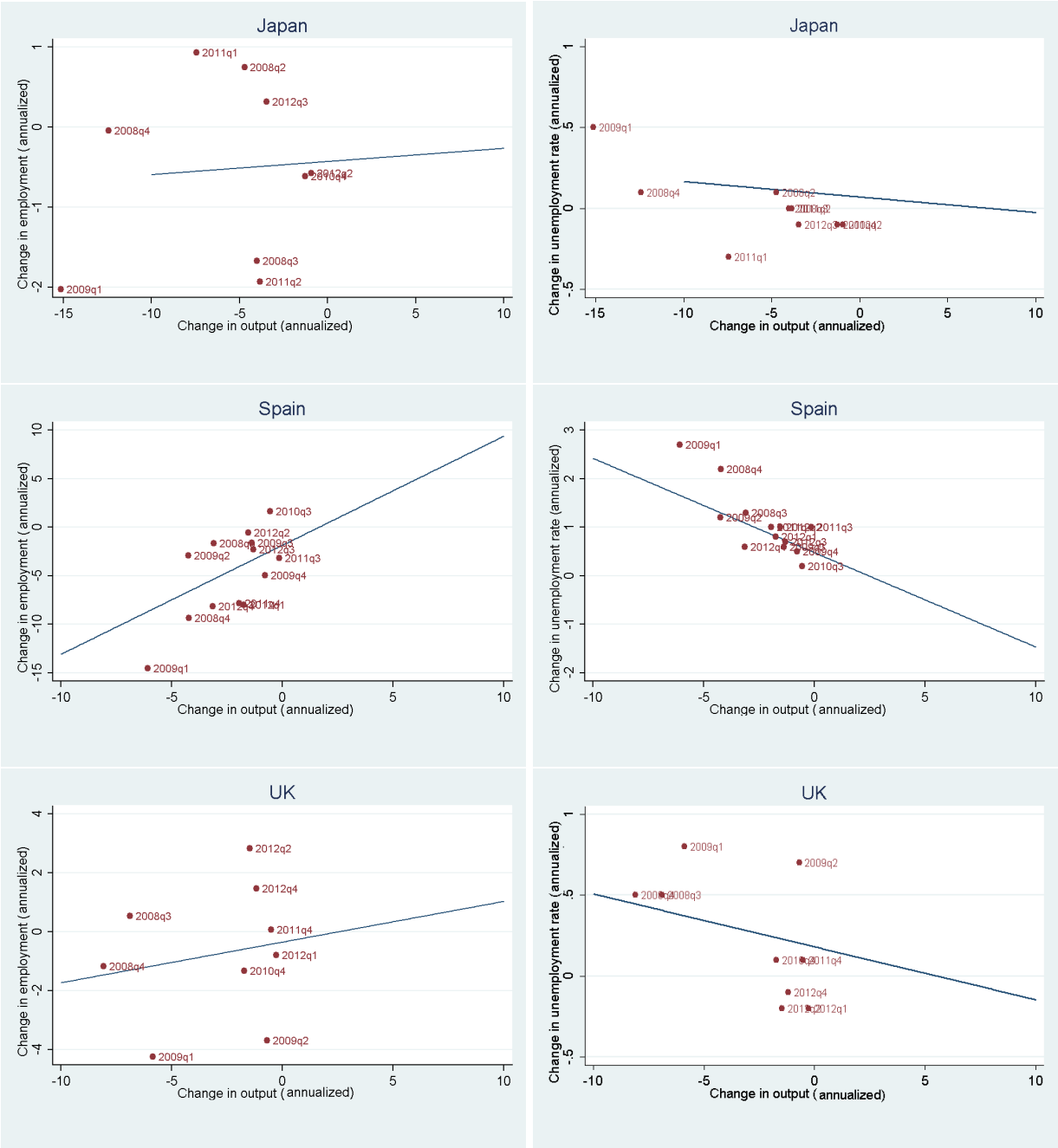
Figure 9: Okun's law and the Great Recession I



Notes: Actual (data points) and predicted (regression line) unemployment and employment responses to output change during the Great Recession.

Source: Estimates of Okun's law equation (see the text for details) drawing on data from OECD and IMF.

Figure 10: Okun's law and the Great Recession II



Notes: Actual (data points) and predicted (regression line) unemployment and employment responses to output change during the Great Recession.
Source: Estimates of Okun's law equation (see the text for details) drawing on data from OECD and IMF.

6.2 Estimates with firm-specific output variation

The following table displays the estimates of equation (4) when allowing for firm-specific output variation.

Table A.1: All Firms

VARIABLES	(1) e(%)	(2) e(%)	(3) e(%)
y_i	4.527***	4.779***	4.074***
	(0.315)	(0.310)	(0.314)
Gearing	-0.00417***		
	(0.000891)		
Solvency		0.0422***	
		(0.00693)	
LT DA			0.349
			(0.640)
Constant	-11.17***	-13.86***	-13.02***
	(3.179)	(3.192)	(3.118)
Country	YES	YES	YES
Sector	YES	YES	YES
Country*Sector	YES	YES	YES
Size	YES	YES	YES
Observations	7,571	8,375	6,882
R-squared	0.103	0.101	0.084

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Estimates of equation (4) - Firm-specific output variation allowed.

6.3 A Simple Model of Finance and Job Matching

Production requires an entrepreneur, a worker and, potentially, finance or credit. In other words, finance or credit (used interchangeably) is akin to an input in production. All agents are risk neutral and discount the future at rate r. Entrepreneurs must choose ex-ante the finance intensity of their production. We call the finance intensity, the leverage of the firm and we indicate it with l. Finance is pulled back at rate λ_o, in which case the firm is in *financial distress*. Financial distress is an absorbing state.

Formally, the production level y can be written as

$$y(l) = \begin{cases} y(l) = \Delta + l^{\alpha} - \rho l & \text{if finance is available} \\ y^{d}(l) = \Delta - \rho l & \text{if the firm is in financial distress} \end{cases}$$

Where the superscript d refers to the financial distress function. More leverage increases production in normal times, but it reduces production during financial distress.

The labor market is imperfect and is characterized by a standard equilibrium search unemployment model (Blanchard and Diamond, 1992; Mortensen and Pissarides, 1999). Entrepreneurs post vacancies and search for workers. Search is random and the meeting between entrepreneurs and workers is described by a traditional matching function $x(u, v)$ where u is the unemployment rate and v is the stock of vacancies also normalized by the labor force. We let $\theta = \frac{v}{u}$ denotes market tightness, $q(\theta)$ is the firm arrival rate while $\alpha(\theta) = \theta q(\theta)$ is the worker meeting rate of vacancies.

Wages are the outcome of Nash Bargaining between workers and firms, subject to a participation constraint. We assume that workers obtain a fraction β of the total surplus. Entrepreneurs post vacancies at a marginal cost c and there is free entry of firms. Jobs are exogenously destroyed at rate s.

Value Functions, Stocks and Equilibrium Definition

Conditional on leverage l, the value of a vacancy $V(l)$ reads

$$rV(l) = -c + q(\theta)[J(l) - V(l)]$$

where $J(l)$ is the value of production when finance is available. The value of production in normal times is

$$rJ(l) = \Delta + l^{\alpha} - \rho l - w(l) + \lambda_o \left\{ Max[J^d(l); V(l)] - J(l) \right\} + s[V(l) - J(l)]$$

where $\Delta + l^{\alpha} - \rho l - w(l)$ are simply net operational profits while the max operator conditional on a finance shock is the key decision of the entrepreneurs, involving the trade-off between operating in distress at value J^d or destroying the job and getting the value of a vacancy $V(l)$. The value of the firm in financial distress reads

$$rJ^d(l) = \Delta - w^d(l) - \rho l + s[V(l) - J^d(l)]$$

The corresponding value functions for the workers are readily obtained. Unemployment workers receive income b, so that $rU = b + \theta q(\theta)[W(l) - U]$, where W^i is the value functions of workers and S^i is total surplus

Wages are set by Nash bargaining and workers obtain a fraction β of the total surplus from the job, so that

$$W^i(l) - U = \beta[J^i(l) + W^i(l) - V(l) - U] = \beta S^i(l) \tag{5}$$

Job destruction takes place when the surplus from the job is zero. Free entry of the entrepreneur in the financial market implies that $V(l) = 0$ so that for the chosen degree of leverage, the value of a vacancy is zero. Since $J(l) = (1 - \beta)S(l)$ from the Nash bargaining condition, the zero profit condition writes

$$\frac{c}{q(\theta)} = (1 - \beta)S(l) \tag{6}$$

The optimal leverage l^* is chosen by the entrepreneur before entering the market and is set so as to maximize the value of a vacancy. In other words $l^* = \arg\max_l V(l)$ so that

$$l^* = \arg\max_l \frac{-c + q(\theta)J^h(l)}{r + q(\theta)} \tag{7}$$

In steady state, unemployment inflows are equal to unemployment outflows, and the same for distressed firms. As before let u denote the stock of unemployed workers, and N^d the stock of workers employed by firms in distress. Employment in ordinary firms (not in distress) is then $N^1 = 1 - N^d - u$ Job creation is given by $\theta q(\theta)u$ while job destruction is exogenously given by the separation rate plus the financial shock λ_o conditional on the optimal job destruction. This suggests that the balance flow condition is

$$\begin{aligned} \theta q(\theta)u &= s(1-u) + \Phi\lambda_0 N^1 \\ sN^d &= (1-\Phi)\lambda_0 N^1 \end{aligned}$$

where Φ is an indicator function that takes the value 1 when $J^d(l) < 0$. From the second equation it follows that $N^d = N^1(1 - \Phi)\lambda_0/s$. For $\Phi \in \{0, 1\}$ the equilibrium unemployment rate reads

$$u = \frac{s + \Phi\lambda_0}{s + \Phi\lambda_0 + \theta q(\theta)} \tag{8}$$

Hence, for a given θ, the equilibrium unemployment rate is higher if firms in distress destroy their job.

Definition 1 *The equilibrium is a set of asset values $[J, J^d, V, W, W^d, U]$, a market tightness θ, leverage l and aggregate quantities u satisfying i) Optimal Job Destruction, ii) Job Creation iii) Wage determination, iv) Optimal Leverage, v) Equilibrium unemployment*

Solving the Model

The central issue is the firms' choice of l. One can show that although $S(i)$ is continuous, it is not smooth everywhere, as $S'(l)$ is undefined at the point were $S^d(l) = 0$. We refer to the corresponding value of l as $\widetilde{l}$. For $l < \widetilde{l}$, the firm operates in financial distress. Hence $dS^d/dl < 0$, and this shifts down the marginal value of credit. For $l > \widetilde{l}$, the firm is closed down when hit by financial distress and the surplus is zero. Hence the cost of increasing l in terms of lower output when facing distress is irrelevant. In what follows, we say that we are in a low-credit equilibrium whenever $l^* < \widetilde{l}$ (firms don't fire after a negative shock) and in a high-credit equilibrium whenever $l^* > \widetilde{l}$ (firms do fire after a negative shock).

In the *high credit equilibrium*, firms destroy jobs in financial distress. The value of the surplus in normal condition determines immediately the optimal leverage l^* equating the marginal benefits of an additional unit of leverage to its marginal cost so that $\rho = \alpha l^{\alpha-1}$ and

$$l^{*h} = \left(\frac{\alpha}{\rho}\right)^{\frac{1}{1-\alpha}} \tag{9}$$

In the *low credit equilibrium* firms operate in financial distress, and the net difference between the two surplus is proportional to leverage so that

$$S(l) - S^d(l) = \frac{l^\alpha}{r+s+\lambda_o} \tag{10}$$

Making use of the previous expression, the optimal leverage in the low credit equilibrium is

$$l^{*l} = \left(\frac{\alpha\phi}{\rho}\right)^{\frac{1}{1-\alpha}} \tag{11}$$

where $\phi = \frac{r+s}{r+s+\lambda_o}$

Proposition 2 *There exists a unique $\rho^* > 0$ so that the equilibrium is a low-credit equilibrium whenever $\rho > \rho^*$, and high credit whenever $\rho < \rho^*$.*

For a proof we refer to the working paper version of the paper.

Financial Shocks in High and Low Credit Economy

We compare two economies, a high-credit economy and a low-credit economy. To get a straight comparison we assume that ρ^1, the cost of finance in the high credit equilibrium, is just below ρ^*, while ρ^2, the cost of finance in the low credit equilibrium, is just above ρ^*. It follows that $\rho^1 \approx \rho^2$. Due to the continuity of the value functions S in ρ, it follows that $S^1 \approx S^2$, and hence that $\theta^{*1} \approx \theta^{*2} = \theta^*$ (where again superscript 1 and 2 indicate high-and low credit equilibrium values, respectively). However, due to the discontinuity of l, it follows that $l^1 > l^2$ and that $S^d > 0$ (not approximately equal).

We define total output in the economy as $Y = N^1 y(l) + N^d y^d(l)$.

Proposition 3 *In the high credit equilibrium, total output is higher*

We do not provide an algebraic proof for the proposition, but will give a heuristic argument. Since $S^{*1} \approx S^{*2}$ and $\theta^{*1} \approx \theta^{*2}$, it follows that $U^{*1} \approx U^{*2}$. Since firms obtain zero profits, U is equal to the net present value of the output flow of the worker (net of credit costs) less the search cost incurred by the firm in order to employ him. In the high-credit-equilibrium, a worker experiences more frequent unemployment spells, hence the NPV of future search costs is higher than in the low-credit equilibrium. Accordingly, the NPV of future output is also higher in the high-credit-equilibrium than in the low-credit equilibrium. Since this is true for all workers, and the economy is in steady state, the result follows.

While the model is static in nature, we can use an increase in the shock arrival rate as a way to study aggregate dynamics. An increase in λ_o is akin to an aggregate financial shock. The idea is that in the aftermath of an increase in λ_o the high credit market equilibrium features a larger response in unemployment.

Note that, generically we can write (by using that $rU = \beta\theta q(\theta)S$)

$$(r+s)S(l) = \Delta + l^\alpha - \rho l - b - \lambda_o \min[S(l), \frac{l^\alpha}{r+s+\lambda_o}] - \beta\theta q(\theta)S(l)]$$

Inserted into (6) this gives that

$$\frac{c(r+s)}{q(\theta)} + c\theta\beta = (1-\beta)[\Delta + l^{\alpha} - \rho l - b - \lambda_o \min[S(l), \frac{l^{\alpha}}{r+s+\lambda}]] \tag{12}$$

Consider now the effect of an increase in λ_o on the two equilibria (assuming that the change is sufficently small so that the equilibrium constellation does not change).

Proposition 4 *The adverse effect of an increased arrival rate of financial shocks on the labor market tightness is greater in the high-credit equilibrium than in the low-credit equilibrium.*

By definition, we have that

$$\frac{l^{1\alpha}}{r+s+\lambda_o} > S^1(l^1) \approx S^2 > l^{\alpha 2}/(r+s+\lambda_o),$$

Hence it follows from (12) that

$$|\frac{d\theta^1}{d\lambda_o}| > |\frac{d\theta^2}{d\lambda_o}| \tag{13}$$

The result immediately follows

Finally, the total effects on the unemployment rate can be found by taking the derivative of (8) and get that (for $i = 1, 2$)

Proposition 5 *In the high credit market equilibrium, unemployment responds more to an adverse financial shock. This is caused both through the job creation margin and the job destruction margin.*

$$\begin{aligned} \frac{\partial u^i}{\partial \lambda_o}\Big|_{High\ Credit} &= \frac{\theta^* q(\theta^*)\Phi^i}{[s+\Phi^i\lambda_o+\theta^* q(\theta^*)]^2} \quad - \quad \frac{\partial \theta^i q(\theta^i)}{\partial \lambda_o}\frac{s+\Phi^i\lambda}{[s+\Phi^i\lambda_o+\theta^* q(\theta^*)]^2} > 0 \\ &= \text{[Increase Job Destruction]+[Decrease Job Creation]} \end{aligned}$$

where $\Phi^1 = 1$ and $\Phi^2 = 0$. The first term, increase in job destruction, is strictly positive in the high-credit equilibrium, and zero in the no-credit equilibrium. In the second term, the first factor is strictly higher in the high-credit equilibrium than in the low-credit equilibrium (because of (13)), the adverse effect on the labor market tightness of an increase in λ is higher in the high-credit equilibrium. The second factor in the second term is a level effect of the unemployment rate, and is also higher in the high-credit equilibrium under the reasonable assumption that $\theta^* q(\theta^*) > s$ (the arrival rate of jobs is higher than the arrival rate of firm-specific negative shocks. Hence we have shown the following

The Model with Heterogeneous ρ

To take the model closer to the data, let us consider a simple extension of the model, and allow firms to have different costs of credit. Firms are characterized by a value of $\rho_i \in [\rho_{\min}, ...\rho_{\max}]$. The value of ρ is learned by the firm (and the worker) only after meeting the worker and before having access to credit.

As above, define the match surplus as of a new match as

$$\begin{aligned} (r+s)S(\rho,) &= \max_l[\Delta + l^{\alpha} - \rho l] + \lambda(S^d(\rho, l) - S(\rho)) - rU \\ (r+s)S^d(\rho, l) &= \Delta - \rho l - rU \end{aligned}$$

We assume that $S(\rho_i) > 0$ for all i. Note that the workers' outside option is independent of the employer's draw of ρ. It follows that the expected value of $S(\rho)$, denoted ES, can be written as

$$(r+s)ES = \sum_i S(\rho_i)g(\rho_i)$$

where $g(\rho_i)$ is the probability that $\rho = \rho_i$.

The lower is ρ, the more valuable is a high l. We assume that the parameter values of the model are such that the firms with $\rho = \rho_{\min}$ strictly prefer to go for the high-credit solution and fire workers after a negative credit shock, while firms with $\rho = \rho_{max}$ prefer the low-credit solution and not firing the worker after a negative financial shock. It

is then straight-forward to show that there exists a threshold value ρ^* so that the firm chooses a high l and fires the worker after a negative financial shock if and only if $\rho < \rho^*$. The two following equations close the model

$$\begin{aligned} rV &= -c + q(\theta)(1-\beta)ES \\ rU &= b + \theta q(\theta)\beta ES \end{aligned}$$

Given θ, the equilibrium unemployment rate can be derived as follows: First

$$u + e^{hc} + e^{lc} = 1$$

where e^{hc} and e^{lc} are respectively employment in high and low credit firms (i.e., with ρ_i below and above ρ^*, respectively. The additional flows conditions are

$$\begin{aligned} \theta q(\theta) u[1 - G(\rho^*)] &= s e^{lc} \\ \theta q(\theta) G(\rho^*) u &= (s + \lambda_o) e^{hc} \end{aligned}$$

where $G(\rho^*)$ is the fraction of firms that draw a value of ρ below ρ^*. The equilibrium unemployment level is then obtained by solving the last 3 equations and reads

$$u = \frac{s + g\lambda\Phi_i}{s + \lambda_o + \theta q(\theta)[G(\rho^*)] + [1 - G(\rho^*)]\frac{(s+\lambda_o)}{s}]}$$