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The Labor Market Consequences of Adverse Financial Shocks

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Abstract

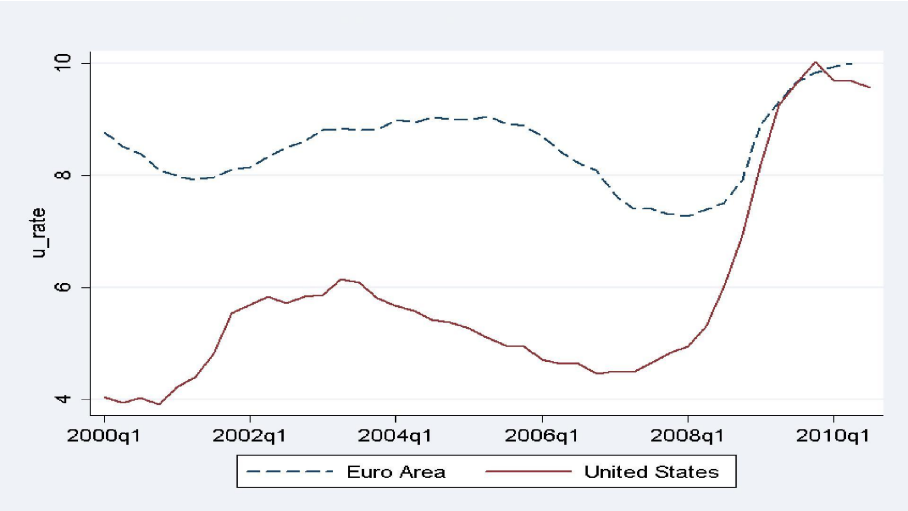
The global financial recession of 2008-9 as well as historical precedents with financial crises suggest that financial shocks do translate into the labor markets. In this paper we first document that financial recessions are different in terms of their labor market impact. Second, we highlight a key mechanisms linking financial shocks to job destruction, presenting and solving a simple model of labor market search and endogenous finance. While finance increases job creation and net output in normal times, it also augments their aggregate response in the aftermath of a financial shock. Third, we present evidence coherent with the idea that more leveraged firms and sectors experience larger employment adjustment during financial recessions.

Theoretically, the job destruction effect of finance works as follows. Leveraged firms may find themselves in a position in which their liquidity is suddenly called back by the lender. This has direct consequences on a firm ability to run and manage existing jobs. As a result, firms may be obliged to shut down part of their operations and destroy existing jobs. We argue that with well developed capital markets, firms will have an incentive to be more leveraged, and in normal times deep capital markets lead to tight labor markets. After an adverse liquidity shock, firms that rely much on liquidity, are hit disproportionally hard. This may explain why the unemployment rate in the US at the beginning of the Great Recession increased much more than in European countries experiencing larger output losses.

Empirically, the paper uses a variety of datasets to test the implications of the model.[1] At first we draw on firm-level data on employment adjustment and balance sheets throughout the Great Recession. Next we draw on sector-level data on employment and leverage in a number of OECD countries at quarterly frequencies to assess whether highly leveraged equilibria originate more employment adjustment under financial recessions. We find that highly leveraged firms and sectors are associated with higher job destruction during financial recessions and. more broadly, financial crises. We also argue that the effect of leverage on employment adjustment can be interpreted as a causal effect, if our identification assumptions are considered plausible. All this amounts essentially for a test of the labor demand channel of adjustment.

[1]We would like to thank Carlo Altomonte for his support in data collection and participants to a seminar at Cemfi in Madrid for valuable comments on an initial draft.

Figure 1: Unemployment in the U.S. and the Euro area



1 Introduction

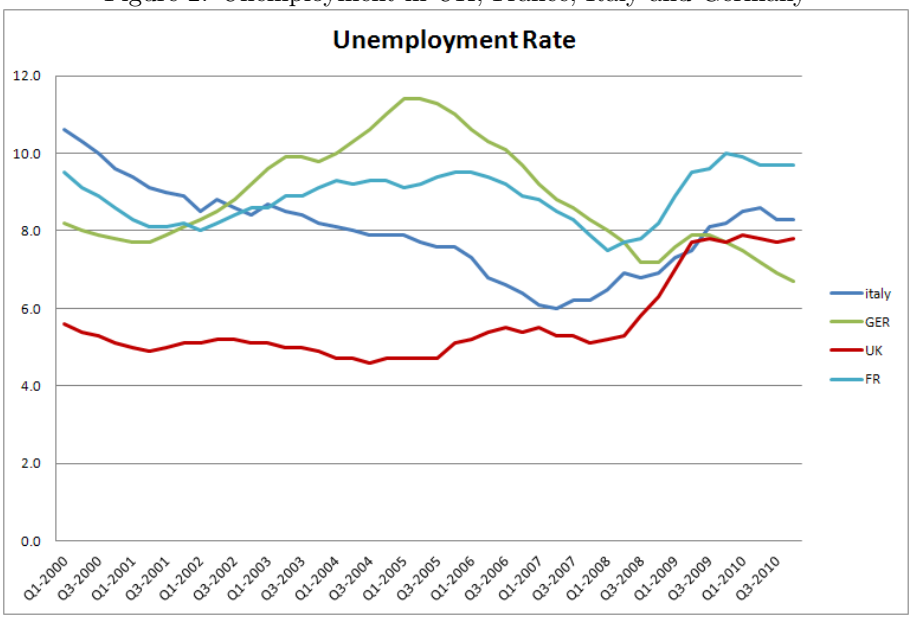
At the beginning of the Great Recession, unemployment in the US doubled from peak to trough, jumping well above levels in the Euro area (Figure 1), some 6 million jobs were destroyed over just 6 quarters, roughly one million per quarter. This is not the first time that a financial recession hits so badly employment. Recessions involving in their early stages a financial crisis, as tracked by Reinhart and Rogoff (2008), typically involve a stronger employment and unemployment response than non-financial recessions (OECD, 2010). This happens also when conditioning on the scale of output falls: Okun's elasticities are typically larger when estimated over four-year intervals including a financial recession than over periods including non-financial recessions (Imf, 2010).

The Great Recession was a global recession. As it occurred worldwide, we can learn also by comparing employment-unemployment response across countries rather than over time. Not only the US, but also the UK unemployment response was much stronger than in the Euro area. In the UK, there was a 1/4 increase in the unemployment rate over 7 quarters, jumping over Italian levels, while unemployment in Germany was actually declining (figure 2).

Some of the differences in response across the two sides of the Atlantic or between the UK and the Euro area are arguably linked to the different labor market institutions. According to an institutional approach and economic analysis fashionable in the mid nineties, one could argue that strict employment protection legislation (EPL) in Europe is the smoking gun. High costs of dismissals, according to this perspective, are associated with lower labor market volatility. However, the countries with the strictest EPL, like Spain, this time experienced the largest increase in unemployment. The fact of the matter is that European labor markets are today much more flexible on average than a couple of decades ago, and are characterized by a dual structure. Such a dual structure, with a flexible temporary fringe alongside a rigid stock of regular contracts, increased labor market response to adverse business conditions precisely in those countries displaying the strictest employment protection provisions for regular contracts.

One should therefore go beyond labor market institutions to understand the free fall of employment in the US and the cross-country differences in unemployment response throughout the Great Recession. A key factor behind these asymmetric responses is likely to be in the nature of the shocks that occurred in 2008-9. In particular, one should look at the financial 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). This global credit crunch is likely to have been

Figure 2: Unemployment in UK, France, Italy and Germany



playing a key role in labor market adjustment during the downturn and in the recovery.

With respect to the financial sector, one of the key differences between the two sides of the Atlantic and between the UK and the Euro area is the degree of financial 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 3). Another empirical measure to account for differences in financial 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 4). While the size of the financial 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 financial deepening is indeed very different.

In this paper, we study theoretically and empirically the basic links and transmission mechanisms between the shocks to the financial markets and the labor market. The questions addressed by our line of research are the following. How does a credit crunch translate into job destruction and larger unemployment? Is financial deepening – larger as we have seen in the U.S. and the UK than in the Euro area – responsible for the acceleration and increase of the unemployment to output response in the U.S. and the UK to the financial shocks of 2008 and 2009? How does this explanation cope with the view (and empirical evidence) that financial market development is good for growth and job creation in the long-run?

The focus is on the job destruction effect of finance. Leveraged firms may find themselves in a position in which their liquidity is suddenly called back by the lender and they have no liquidity buffer, no war chest, to be used. Such a sudden call back in liquidity has direct consequences on a firm ability to run and manage existing jobs. As a result, firms may be obliged to shut down part of their operations and destroy existing jobs. In this sense, the job destruction effect of the credit crunch is essentially a labor demand driven channel of adjustment.

We argue that with deep capital markets, firms will have less of an incentive to create a buffer stock of liquidity, and in normal times deep capital markets lead to tight labor markets. However, after an adverse liquidity shock, firms without a war chest are hit disproportionally hard. This may explain why the unemployment rate in the US and the UK increased more than in the Euro area in the aftermath of the Great Recession.

Empirically, the paper uses a variety of datasets on both the U.S. and Europe to ask whether it is possible to identify the effects outlined by the model. We test both the assumptions and the implications

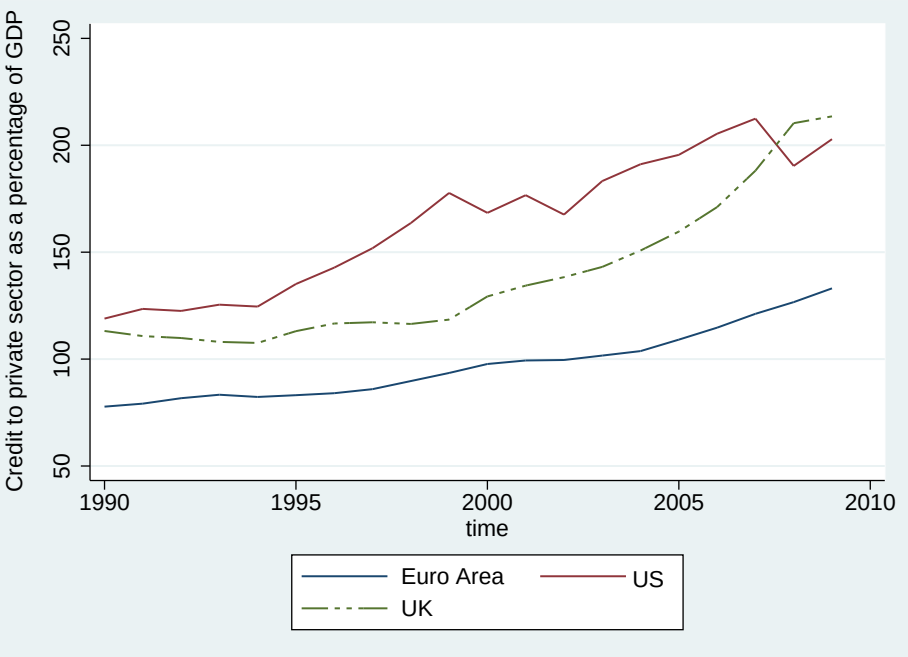
of the model. First of all, we exploit matched employment-balance sheet data at the firm-level to look into the relationship between employment adjustment and leverage throughout the 2008-9 financial crisis. Next, ee draw on two-digits sector-level data on employment and financial market conditions over a large number of OECD countries at quarterly frequencies. We take the US as a benchmark and find that sectors with significantly lower leverage ratios vis-à-vis the same sector in the US (part of the cross-industry differences in leverage ratios can be related to the specific technological or product-demand characteristics of the different sectors) experience lower employment adjustment during financial recessions.

The structure of the paper is as follows. We first review the basic facts on unemployment dynamics, financial shocks and Okun's elasticity over the business cycle. Second, we highlight the job destruction effect of finance in a simple search model with endogenous leverage. We show that in an environment with deeper capital markets (a lower cost of credit) firms will have an incentive to increase leverage, and in normal times deep capital markets lead to tight labor markets. In such a high credit equilibrium, after an adverse liquidity shock, firms are hit disproportionally hard and experience a larger increase in unemployment. Third, we go back to the data and find evidence that more leveraged firms and sectors experience stronger employment declines in the midst of a financial recession.

2 Labor Markets under Financial Recessions

Table 1 displays average unemployment and hours variations during financial recessions (defined as NBER recessions initiated by a financial crisis, as tracked by the Reinhart and Rogoff (2008) taxonomy) and other, non-financial, recessions in Europe and the US. Financial recessions are characterised by a larger unemployment response (in terms of both changes in the unemployment rate and percentage variations) than 'ordinary' recessions. The exception is Germany that made a large use throughout the Great Recession of Short-time Work (within the so-called Kurzarbeit scheme). Indeed, when we look at hours worked (third and fourth columns of the table) also Germany displays a stronger response than under non-financial recessions.

Figure 3: Credit to the private sector in US, UK and Euro Area



Source: International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.

Table 1: Unemployment and hours adjustment during financial recessions

Country	Type of recession	du	du/u	dHW	dHW/HW	dy/y
France	Financial rec	1.40	19%	-225240	-2.2%	-4%
	Other rec	1.00	11%	-180796	-1.9%	-1%
	Difference	*0.40*	*8%*	*-44444*	*-0.4%*	*-3%*
Germany	Financial rec	-0.40	-5%	-306000	-2.1%	-7%
	Other rec	0.54	8%	-240200	-1.5%	-1%
	Difference	*-0.94*	*-13%*	*-65800*	*-0.6%*	*-6%*
Italy	Financial rec	1.30	15%	-539909	-5.2%	-1%
	Other rec	0.43	6%	-15992	0.0%	-2%
	Difference	*0.88*	*9%*	*-523917*	*-5.2%*	*1%*
UK	Financial rec	2.10	36%	-26	-1.4%	-3%
	Other rec	0.50	7%	-34	-1.8%	-3%
	Difference	*1.60*	*28%*	*7*	*0.4%*	*0%*
US	Financial rec	2.65	50%	-29	-1.7%	-3%
	Other rec	1.93	33%	-20.12	-1.1%	-3%
	Difference	*0.72*	*17%*	*-9*	*-0.6%*	*0%*

France: data starting from Q1-1978; GDP data starting from 1970

Germany: data starting from Q1-1991

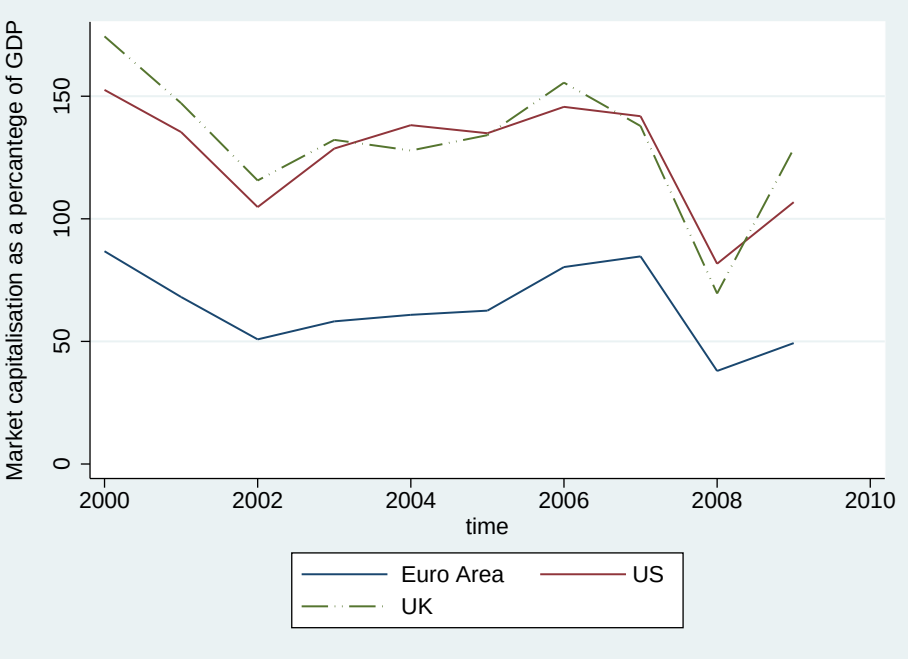
Italy: unemployment data starting from Q1-1983; Working Hours Q1-1992; GDP data starting from 1970

UK: Unemployment data starting from Q1-1983; GDP and Working Hours yearly data starting from 1970;

US: Unemployment rate starting from Q1-1970;GDP and Working Hours yearly data from 1970

Episodes of recessions with financial crises: France 2008; Italy 1992; Germany 2008; UK 1975, 1990, 2008; US 1990, 2008

Figure 4: Stock market capitalization over GDP: US, UK and Euro Area



Source: World Federation of Exchanges, Federation of European Securities Exchanges (FESE) - Eurostat

One of the reasons why financial recessions are so bad for employment is that they may involve larger falls in output than non-financial recessions. The last column on the right-hand-side of Table 1 displays average GDP percentage variation under the two types of recessions. While financial recessions in France and Germany, on average, involved deeper output falls than non-financial recessions, this is not necessarily the case. In the UK and the US financial recessions involving, on average, comparable output losses than non-financial recessions, display a larger unemployment adjustment.Financial recessions also typically have longer durations than non-financial recessions. However, as documented by (Imf, 2010), they display a larger unemployment response than non-financial recessions at all durations of GDP decline.

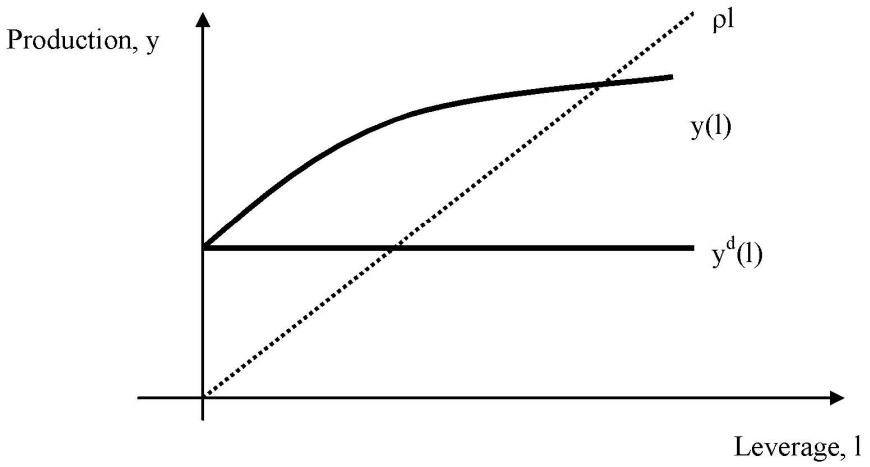
The strong response of unemployment during financial recession in countries with deep capital markets is consistent with Bernanke and Gertler (1989), who found that more leveraged firms suffer more under a credit crunch. Similarly Sharpe (1994) documented that firms more leveraged before a recession face a greater need to deleverage, and hence reduce employment. There can also be relatively large layoffs in firms relying on working capital to finance their operations, due to the relatively large decline in net worth typically observed under financial recessions.

To our knowledge, there is no model of labor-finance interactions framing large employment-unemployment variations during financial recessions and possibly a positive role of finance in job creation in the long-run. We will now develop a simple model capable of explaining this feature of financial recessions, offering insights as to the relevant margin of adjustment (increase in job destruction vs. fall in job creation) and yielding testable implications on labor-finance interactions.

3 A Model of Search and Finance

In this section, we present and solve a simple, reduced-form, model of labor and finance that can show that an economy more dependent on finance is i) more productive on average but, at the same time, ii) more vulnerable to aggregate financial shocks. The simple model can quickly rationalize why unemployment response is larger in markets relying more on credit to the private sector.

Figure 5: Output and leverage



3.1 The Environment

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

While we assume that finance is readily available at the time of job creation, it can be suddenly pulled back to the firm as a result of an idiosyncratic shock λ_o Conditional on a financial shock, production can still continue without credit and we say that a firm in this condition is in *financial distress*. Firms in financial distress can obtain credit back at an exogenous rate λ_1. Formally, the production level y can be written as

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

Where the superscript d refers to the financial distress function. The previous conditions suggest that more leverage increases production in normal times, but it reduces production during financial distress. This basic technological trade off of finance assumed above is consistent with a large body of theoretical literature on liquidity (Holmostron and Tirole, 2011). The cost function $c(l)$ is proportional to leverage and we simply assume that

$$c(l) = \rho l$$

where ρ is the marginal cost of leverage and it will play an important role in characterizing different outcomes of the model. Figure 5 describes the relationship between output and leverage.

The labor market is imperfect and is characterized by a standard equilibrium search unemployment model. 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 follow the traditional matching literature and assume that $\theta = \frac{v}{u}$ denotes market tightness while $q(\theta)$ is the firm arrival rate while $\theta q(\theta)$ is the worker meeting rate of vacancies. Entrepreneurs post vacancies at a marginal cost c and there is free entry of firms. Jobs are exogenously destroyed at rate s.

Wages are obtained as a fraction of the output produced as long as the worker participation's constraint is binding. Formally, the wage is the result of

$$w^{i}(l) = \max\left\{\beta y^{i}(l); rU\right\} \qquad \text{WAGE DETERMINATION} \tag{1}$$

where i refers to the financial conditions of the firm, either normal or distress. The wage equation 1 is fully coherent with the Hall (2005) wage conditions and was previously used by Acemoglu (1999). In particular, such a wage rule satisfies the worker's participation constraint and is also linked to the firm's productivity. Unemployed workers receive a specific income equal to b.

With respect to a purely standard search unemployment model, the key novel economic decisions of the model are the job destruction decision conditional on a financial shock λ_0, and the choice of the optimal leverage.

3.2 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 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 $V(l)$. In what follows we let the max condition be the optimal job destruction decision so that we can write

$$Max[J^d(l); V(l)] \qquad \text{OPTIMAL JOB DESTRUCTION} \tag{2}$$

The value of the firm in financial distress reads

$$rJ^d(l) = \Delta - w^d(l) - \rho l + \lambda_1 \left\{ J(l) - J^d(l) \right\} + s[V(l) - J^d(l)]$$

The corresponding value functions for the workers are readily obtained. If we let $W(l)$ be the value of a job to a worker in normal conditions and $W^d(l)$ the value in distress, the value functions read

$$rW(l) = w(l) + \lambda_o \left\{ Max[W^d(l); U] - W(l) \right\} + s[U - W(l)]$$

and

$$rW^d(l) = w(l) + \lambda_1 [W(l) - W^d(l)] + s[U - W^d(l)]$$

respectively.

The value of unemployment is also standard. Workers search for vacant jobs and obtain an unemployment income equal to b.

$$rU = b + \theta q(\theta)[W(l) - U]$$

The job destruction decision is fully in the hand of the firm. As it is clear from equation2, the entrepreneur will keep open a firm in financial distress as long as its value function $J^d() > V$. Since the wage can not fall below the worker participation constraint, the wage rule ensures that the job destruction decision is jointly privately efficient.[2]

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

$$V(l) = 0 \Longrightarrow J(l) = \frac{c}{q(\theta)} \qquad \text{JOB CREATION} \tag{3}$$

[2]The surplus from the job is traditionally defined as $S = [J - V] + [W - U]$. Since the wage falls at most at $rU_,$, separation takes place when the worker's net surplus $[W - U]$ is binding and total surplus is thus negative.

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

$$l^* = \arg\max_l V(l)$$
$$l^* = \arg\max_l \frac{-c + q(\theta)J^h(l)}{r + q(\theta)} \qquad \text{OPTIMAL LEVERAGE} \tag{4}$$

In steady state, unemployment inflows are equal to unemployment outflows. 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 condition of (2). This suggests that the balance flow condition is

$$\theta q(\theta)u = [s + \Phi\lambda_0]u$$

where Φ is an indicator function that takes the value 1 when $J^d(l) < 0$. The equilibrium unemployment rate is then

$$u = \frac{s + \Phi\lambda_0}{s + \Phi\lambda_0 + \theta q(\theta)} \qquad \text{EQUILIBRIUM UNEMPLOYMENT} \tag{5}$$

Definition 1 *The equilibrium is a set of value functions $[J(l), J^d(l), V(l), W(l), W^d(l), U.]$, unemployment stock [u], market tightness θ and leverage l satisfying i) Optimal Job Destruction (equation 2, ii) Job Creation (equation 3) iii) Wage determination (equation 1)iv) Optimal Leverage (equation 4) v) Equilibrium Unemployment (equation 5)*

3.3 Solving the Model

To solve the model we need to obtain the value functions of the firm $S(l)$. Since $V(l) = 0$ at the optimal leverage, adding the value functions for the firms in using the wage determination rule, one obtains

$$(r + \lambda_o + s)J(l) = (\Delta + l^\alpha)(1 - \beta) - \rho l + \lambda_o[Max(J^d(l); 0)]$$
$$(r + \lambda_1 + s)S^d(l) = \Delta(1 - \beta) - \rho l + \lambda_1[S(l) - S^d(l)] - \theta q(\theta)\beta S(l)$$

The value of leverage, reads

$$l^* = \arg\max \frac{-c + q(\theta)J(l)}{r + q(\theta)}$$

while job creation is simply

$$\frac{c}{q(\theta)} = J(l)$$

The solution of the model crucially depends on the optimal job destruction threshold, conditional on an adverse financial shock λ_o. We define two types of equilibria depending on whether the firm operates or not in financial distress. In particular we let

$$J^d(l) = Max[0; J^d(l)] \qquad \text{Low credit equilibrium}$$
$$0 = Max[0; J^d(l)] \qquad \text{High credit equilibrium}$$

and the characterization of the two equilibria will be determined in terms of ρ, the cost of credit. The key parameter for discriminating between the two equilibria will be the marginal cost of credit.

3.4 High Credit Equilibrium

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

$$\rho = \alpha l^{\alpha - 1}$$

as

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

Proposition 2 *In a high credit market equilibrium, optimal leverage is independent of the arrival rate of financial shocks and it depends only on its marginal cost and its marginal impact on productivity.*

The optimal job creation is

$$\frac{c}{q(\theta)} = J(l)$$
$$\frac{c}{q(\theta)} = \left[\frac{(1-\beta)(\Delta + l^\alpha) - \rho l}{r + \lambda_o + s}\right]$$

where in the last condition we substituted for the value of the job in normal conditions.

Proposition 3 *A higher cost of credit and a higher arrival rate of financial shocks reduce market tightness and job creation*

Proof: $\frac{\partial \theta}{\partial \rho} < 0$; $\frac{\partial \theta}{\partial \lambda_0} < 0$
The unemployment rate is

$$u = \frac{s + \lambda_o}{s + \lambda_o + \theta q(\theta)}$$

Proposition 4 *In the high credit equilibrium an increase in λ_0 has an adverse direct impact on unemployment (through an increase in job destruction) and an adverse indirect impact through job creation (the reduction in market tightness)*

Let us assume that the parameters of the model are such that the high credit equilbrium exists. The characterization in terms of ρ is outlined in section 3.6.

3.5 Low Credit Equilibrium

In the low credit equilibrium firms operate in financial distress,

$$J^d(l) = Max[J^d(l); 0]$$

The value of the job in the two states- making use of the wage equation- reads

$$(r+s)J(l) = (\Delta + l^\alpha)(1-\beta) - \rho l + \lambda_o[J^d(l) - J(l)]$$
$$(r+s)J^d(l) = \Delta(1-\beta) - \rho l + \lambda_1[J(l) - J^d(l)]$$

From which it immediately follows that the net difference between the two values of the job is proportional to leverage

$$J(l) - J^d(l) = \frac{l^\alpha}{r + s + \lambda_o + \lambda_1}$$

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

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

where $\phi = \frac{r+s+\lambda_1}{r+s+\lambda_o+\lambda_1}$. Two simple propositions immediately follow.

Proposition 5 *For a given set of parameters, leverage in the low credit equilibrium is lower than in the high credit equilibrium.*

Proposition 6 *Financial parameters affect optimal leverage in the low credit equilibrium. In particular, a higher arrival rate of financial shocks reduces leverage* ($\frac{\partial l^*}{\partial \lambda_o} \leq 0$) *while a shorter duration of distress increases leverage* $\frac{\partial l^*}{\partial \lambda_1} \geq 0$

The condition for optimal job creation is

$$\frac{c}{q(\theta)} = \left[\frac{(1-\beta)(\Delta + l^\alpha) - \rho l - \bar{\lambda}_o l^\alpha}{r+s+\lambda_0}\right]$$

where $\bar{\lambda}_0 = \frac{\lambda_o}{r+s+\lambda_1+\lambda_o}$

Proposition 7 *In a low credit equilibrium, a larger financial shock and a shorter financial distress reduce job creation:* $\frac{\partial \theta}{\partial \lambda_o} < 0$; *and* $\frac{\partial \theta}{\partial \lambda_1} > 0$

Unemployment in the low credit equilibrium is given by

$$u = \frac{s}{s + \theta q(\theta)}$$

This has two important implications.

Proposition 8 *An increase in the intensity of the financial crisis* λ_o *has no direct impact on unemployment in the low credit equilibrium, since it only operates through job creation.*

Proposition 9 *In the low credit equilibrium, financial market variables operate only through job creation and have no direct impact on job destruction.*

Finally, we can establish an important result in terms of job creation in the two equilibria, namely that in the high credit market equilibrium $\theta^{hc} > \theta^{lc}$.

Proposition 10 *In the high credit market equilibrium job creation is higher and the labor market is tighter.*

To prove the proposition compare the two job creation conditions

$$\begin{aligned} J^{hc}(l^{hc}) &> J^{lc}(l^{lc}) \\ (1-\phi^{\frac{1}{1-\alpha}})[(1-\beta)l^{hc} - \rho l^{hc}] &> -\bar{\lambda}_o l^\alpha \end{aligned}$$

Since the l.h.s is positive, it immediately follows that $\theta^{hc} > \theta^{lc}$.

3.6 Characterization

We now establish the restrictions on the parameters that ensure that the two equilibria exist. Let's consider the low equilibrium first. To ensure that a **low equilibrium** exists we need to make sure that

$$\begin{aligned} \text{Low credit equilibrium if } J^d(l^*) &> 0 \\ \frac{(1-\beta)\Delta - \rho l^* + \bar{\lambda}_o l^{*\alpha}}{r+s+\lambda_o} &> 0 \end{aligned}$$

where $l^* = \left(\frac{\alpha\phi(1-\beta)}{\rho}\right)^{\frac{1}{1-\alpha}}$. Substituting optimal leverage in the previous condition, and solving for ρ one obtains

$$\rho > \rho^*$$

where

$$\rho^* = \Gamma^{-\frac{\alpha}{1-\alpha}}$$

and

$$\Gamma = \frac{(1-\beta)\Delta}{[(1-\beta)\alpha\phi]^{\frac{1}{1-\alpha}}\left\{1+\bar{\lambda}_o[(1-\beta)\phi\alpha]^{\alpha}\right\}}$$

The previous conditions suggests that we are in a low credit equilibrium if the marginal cost of credit is sufficiently large.

The condition on the high equilibrium requires that

$$\begin{aligned} \text{High credit equilibrium if } J^d(l^*) &< 0 \\ \frac{(1-\beta)\Delta - \rho l^* + \bar{\lambda}_o l^{*\alpha}}{r+s+\lambda_o} &< 0 \end{aligned}$$

where the optimal leverage to be considered is the leverage in the low credit equilibriun, which is the first best alternative to the firm. Substituting for $l^* = \left(\frac{\alpha\phi(1-\beta)}{\rho}\right)^{\frac{1}{1-\alpha}}$ the condition for the high credit equilibrium is

$$\rho < \rho^*$$

The following proposition immediately follows

Proposition 11 *For a given set of parameters, there is a unique marginal cost of credit ρ^* such that for values $\rho > \rho^*$ (or $\rho < \rho^*$) the economy is in the low (high) credit equilibrium.*

3.7 An Increase in the Frequency of Financial Shocks in the Two Regimes

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. The result is easily established by the following proposition.

Proposition 12 *In the high credit market equilibrium unemployment responds more to an adverse financial shock, or to an increase in λ_0*

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

$$\begin{aligned} \left.\frac{\partial u}{\partial \lambda_o}\right|_{Low\ Credit} &= \frac{-\frac{\partial \theta q(\theta)}{\partial \lambda_o}}{[s+\theta q(\theta)]^2} > 0 \\ &= \text{[Decrease Job Creation]} \end{aligned}$$

3.8 The Model wih Heterogeneous ρ

- To take the model closer to the data, let us consider an economy with heterogenous cost of credit.
- Firms are ex-post heterogenous in their cost of credit. Firms are characterized by a value of $\rho_i \in [\rho_{\min}, ...\rho_{\max}]$. The value of ρ is learnt by the firm only after meeting the worker and before having access to credit.
- Matching is random and workers do not observe the ρ specific value of the firm. We also assume that $\rho_{\max}$ is consistent with a non binding participation condition according to our wage determination rule.

- Under the previous conditions, the key aggregate job condition is the result of

$$rV = -c + q(\theta)[\int_{\rho_{min}}^{\rho^*} J(\rho)dG(\rho) + \int_{\rho^*}^{\rho_{max}} J(\rho)dG(\rho)] \tag{6}$$

where free entry ensures that

$$\frac{c}{q(\theta)} = \int_{\rho_{min}}^{\rho^*} J(\rho)dG(\rho) + \int_{\rho^*}^{\rho_{max}} J(\rho)dG(\rho) \tag{7}$$

Where ρ^* is the cut-off point of the two equilibria and $G(.)$ is the weighted function providing the contribution of each ρ type of firm to the aggregate value of a job for employers In other words, job creation is the expected average value of the firm in the two regimes.

- Further, the aggregate labor market is such that

$$1 = u + e^{hc} + e^{lc} \tag{8}$$

where e^{hc} and e^{lc} are respectively employment in high and low credit.
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 the outflows from unemployment depend on the type of firms that the worker will face. The equilibrium unemployment level is then obtained by solving the last 3 equations and reads

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

- In this economy firms sort along the two types of equilibria described above.

4 Back to the Data

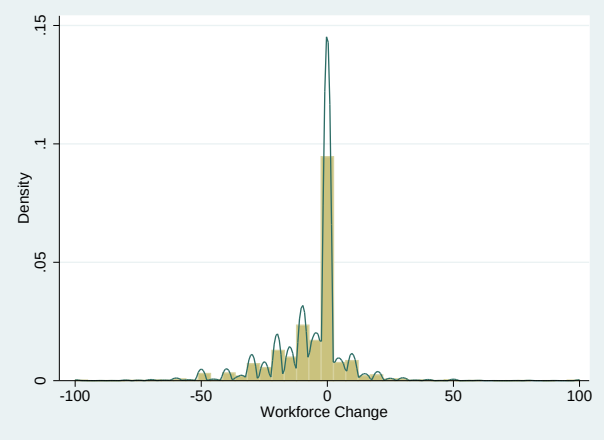
The model above explains why financial recessions originate larger employment variations than non-financial recessions. This is because there is an additional effect on productivity than during "ordinary" recessions, coming from the forced reduction in the use of the finance-input in the production process. The model also yields some testable empirical implications. In particular, it implies that high leverage equilibria involve larger variations in employment during financial crises than low leverage equilibria because in the former the effect 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 firm-level employment adjustment and leverage as well as the above empirical implications of the model.

We rely on two sources of data.

The first is a dataset of firm-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 firms and balance sheet data from the Amadeus archive. Efige samples some 16,000 European firms (3,000 in large countries, such as Germany, France, Italy, Spain and the UK, and 500 firms in smaller countries, such as Austria and Hungary). The questionnaire is very detailed on a number of structural characteristics of firms such as organisation, job composition, innovation activities, finance as well as product and labor market strategies. This dataset was matched to the Amadeus archive providing financial and business data on Europe's biggest 500,000 companies by assets. Hence, the matched sample covers only large firms (the average

Figure 6: Firm-level net employment change, Distribution of firms



firm size in terms of employees is 81) and data are not cross-country comparable.

The second dataset is based on sector-level data on employment and leverage ratios (debt-to-sales and debt-to-assets ratios) in 6 sectors (agriculture, construction, finance, industry, public administration, and trade) in 11 OECD countries (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, United States) in the period 1985-2008. Data come from the IMF—WDI Database and from the STAN archive of the OECD.

The first dataset is useful to assess the key assumptions of the model and the underlying mechanism, while the second is best suited for testing the reduced form results, notably the effects of leverage on segments of the economy operating under different financial market conditions.

4.1 Firm-level data

Table 2 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 firm is using creditor's vs. owner's funds. The *Solvency Ratio* measures the ratio of after tax net profit (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 less exposed to a liquidity crisis: it measures loans and financial obligations lasting more than one year over total assets of the firm. As shown by the table there is significant cross-country and within country (across sectors) variation. At the same time, there are large differences in the average size of firms 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 specifically the percentage change in the workforce. We imputed a zero value to firms declaring that they did not experience any change in employment in the first question. Figure 6 plots the distribution of firms in the -100(%) to +100 (%) range. As we are dealing with a global recession year, most firms 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.

Table 2: Measures of Leverage, Descriptive Statistics

Country	N of Firms	Average Size of Firms	St Dev	Gearing 2007 (%)	St Dev	Solvency 2007 (%)	St Dev	LT DA 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 2007 (%)	St Dev	Solvency 2007 (%)	St Dev	LT DA 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

Figure 7: Firm-level net employment change, Distribution of firms by access to credit

In order to obtain preliminary insights as to the importance of finance in employment adjustment, digram 7 plots the same distribution for firms that successfully applied for credit (top panel), firms that did not apply for credit (lower panel) and firms that applied, but were not successful (panel on the right-hand-side). This suggests that the firms that were unsuccesfull in refinancing operations were, on average, heavily downsizing (on average by almost 20 %) while the distribution of employment adjustment among successful debtors and firms that did not apply for credit is remarkably similar. The concentration of employment losses (about 30 per cent of the total) among firms experiencing difficulties in refinancing operations is not informative as to causality: it may well be that firms did not obtain credit because they were downsizing and considered not be viable creditors by banks.

Table 4.1 reports estimates of the following equation

$$\Delta e_{ijc} = \alpha + \alpha_j + \alpha_c + \beta \Delta y_{jc} + \gamma Lev_{ijc} + \delta S_{ijc} + \epsilon_{ijc} \tag{9}$$

where Δe is the reported employment growth rate*during* in the period 2008-9, i denotes the firm, 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.

The odd columns of table 4.1 report the OLS estimates of the above equation. The gearing ratio is negatively associated with plant-level employment change while for the solvency ratio it is the opposite. Long-term debt instead does not seem to significantly affect plant level job creation and destruction. Leverage is clearly endogenous. the remaining three columns of table 4.1 display 2-stages least squares estimates in which leverage is instrumented by the age of the CEO. The underlying identification assumption is that the age of the CEO affects the level of leverage (e.g., because of age-related differences in the discount factor) while it does not affect employment variation during the Great Recession. The first-stage results point to a significant (and negative) effect of the age of the CEO on leverage. In the second stage we still find a negative and statistically significant effect of leverage on firm-level employment adjustment. The effects of leverage on employment adjustment are non-negligible: bringing, say, a typical Austrian firm to the average gearing ratio of a German firm involves employment losses of the order of 4 per cent during a financial recession; increasing by 10 basis points the solvency ratio (like moving an average Italian firm to France) involves a 2.3 increase of employment.

Table 4 and 5 display estimates of equation 9 when only firms downsizing or only firms upsizing are considered. this suggests that the effects of leverage on firm-level employment adjustment are driven by firms

Table 3: All Firms

First stage		IV Gearing		IV Solvency		IV LT DA
Age of CEO		-10.38095***		1.982744***		-0.0032705
		(1.816268)		(0.2163267)		(0.0027128)
	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	IV	OLS	IV	OLS	IV
VARIABLES	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$
$\Delta\bar{y}$	1.192*	1.332*	1.200*	1.032	1.188*	0.199
	(0.640)	(0.703)	(0.639)	(0.671)	(0.638)	(2.055)
Gearing	-0.00430***	-0.0398***				
	(0.000853)	(0.0151)				
Solvency			0.0399***	0.231***		
			(0.00637)	(0.0731)		
LT DA					-0.152	-148.5
					(0.602)	(130.9)
Constant	-6.158***	-3.382*	-8.556***	-13.99***	-7.776***	-6.019
	(1.417)	(1.973)	(1.395)	(2.509)	(1.371)	(4.314)
Country	YES	YES	YES	YES	YES	YES
Sector	YES	YES	YES	YES	YES	YES
Size	YES	YES	YES	YES	YES	YES
Observations	8,596	8,582	9,649	9,630	8,064	8,044
R-squared	0.069		0.066		0.052	

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

Table 4: Only Firms Downsizing

First stage		IV Gearing		IV Solvency		IV LT DA
Age of CEO		-10.80607***		2.166254***		-0.0026206
		(2.720889)		(0.3149594)		(0.002428)
	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	IV	OLS	IV	OLS	IV
VARIABLES	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$
$\Delta\bar{y}$	0.813	0.519	1.004	0.556	1.107	-0.395
	(0.936)	(1.106)	(0.915)	(0.984)	(0.936)	(3.117)
Gearing	-0.00305**	-0.0502**				
	(0.00119)	(0.0226)				
Solvency			0.0578***	0.264***		
			(0.00914)	(0.0959)		
LT DA					-2.495*	-256.3
					(1.456)	(249.2)
Constant	-19.72***	-14.68***	-23.10***	-27.83***	-21.80***	-21.52***
	(2.090)	(3.440)	(2.060)	(3.075)	(2.052)	(6.032)
Country	YES	YES	YES	YES	YES	YES
Sector	YES	YES	YES	YES	YES	YES
Size	YES	YES	YES	YES	YES	YES
Observations	4,151	4,145	4,677	4,668	3,783	3,774
R-squared	0.061		0.063		0.045	

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

that are downsizing. When we analysis is confined to firms upsizing, only the gearing ratio is significant and limited to the un-instrumented regressions.

The effects of leverage survive when we put on the left-hand-side a categorical variable (0 for downsizing, one for firms keeping the same employment level, two for those upsizing) in order to cope with the heaping problem mentioned above. There is still a statistically significant effect, which is in line with the model's predictions, both in the OLS and in the IV, 2SLS, estimates. We also run regressions (reported in the annex including as right-hand-side variable firm-level output growth (rather than the average growth rate at the sectoral level). Such a specification clearly creates a problem of endogeneity, but potentially captures idyosincratic shocks unrelated to the financial recession. Also in this case, there is still an effect of leverage on employment growth. Coefficients are remarkably stable across these different specifications.

Overall, the firm-level results suggest that leverage matters for employment adjustment during a financial recession and affects mainly job destruction. Ceteris paribus, more leveraged firms destroy more jobs than firms with a higher solvency ratio. If our identification assumption is correct, this relation can also be attributed to a causal effect of leverage on employment adjustment.

4.2 Macro estimates

Our firm-level data cover only the Great Recession. Hence, they cannot evaluate a substantive implication of the model, notably the fact that leverage is bad for employment only during financial recessions (or more broadly financial crises). The model predicts that finance is good for output and employment during normal times. In order to assess these asymmetric effects of finance, we need to use another dataset on *net*

Table 5: Only Firms Upsizing

First stage		IV		IV		IV
		Gearing		Solvency		LT DA
Age of CEO		-0.5751268		0.7021634		0.0033848
		(5.244327)		(0.6536459)		(0.0175636)
	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	IV	OLS	IV	OLS	IV
VARIABLES	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$
$\Delta\bar{y}$	3.846***	4.474	3.859***	4.566**	3.917***	3.667
	(1.292)	(12.78)	(1.309)	(1.933)	(1.319)	(4.571)
Gearing	-0.00386*	0.639				
	(0.00223)	(5.822)				
Solvency			-0.00891	-0.405		
			(0.0163)	(0.625)		
LT DA					0.0344	-6.928
					(0.695)	(118.1)
Constant	16.81***	-24.49	16.02***	26.33	15.85***	16.13**
	(2.793)	(373.0)	(2.743)	(16.84)	(2.740)	(8.034)
Country	YES	YES	YES	YES	YES	YES
Sector	YES	YES	YES	YES	YES	YES
Size	YES	YES	YES	YES	YES	YES
Observations	1,060	1,058	1,181	1,178	1,033	1,030
R-squared	0.061		0.052		0.054	

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

Table 6: All firms (Δe categorical)

First stage		IV Gearing		IV Solvency		IV LT DA
Age of CEO		-10.23189***		1.982963***		-.0031821
		(1.809991)		(0.216324)		(0.00268)
	(1)	(2)	(3)	(4)	(5)	(6)
METHOD	OLS	IV	OLS	IV	OLS	IV
VARIABLES	Δe	Δe	Δe	Δe	Δe	Δe
$\Delta \bar{y}$	0.00952	0.0138	0.00119	-0.00400	-0.00219	-0.0291
	(0.0298)	(0.0312)	(0.0294)	(0.0301)	(0.0301)	(0.0625)
Gearing	-0.000163***	-0.00128*				
	(3.95e-05)	(0.000679)				
Solvency			0.00103***	0.00689**		
			(0.000292)	(0.00327)		
LT DA					0.0223	-4.053
					(0.0284)	(4.058)
Constant	0.724***	0.810***	0.688***	0.520***	0.694***	0.741***
	(0.0653)	(0.0871)	(0.0636)	(0.112)	(0.0641)	(0.130)
Country	YES	YES	YES	YES	YES	YES
Sector	YES	YES	YES	YES	YES	YES
Size	YES	YES	YES	YES	YES	YES
Observations	8,693	8,679	9,757	9,738	8,161	8,142
R-squared	0.067		0.066		0.062	

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

Table 7: Descriptive Statistics

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Debt to Sales	3332	93.998	125.466	0.000	540.120
Debt to Assets	3332	23.431	10.169	0.000	62.160
Δ employment	5270	0.002	0.023	-0.178	0.197
Δ GDP	5270	0.005	0.028	-0.341	0.403
EPL index	4708	1.927	1.052	0.210	3.670
UB	4000	0.306	0.190	0.005	0.650

employment variation and leverage by sector. We draw below on a unique IMF dataset of quarterly data on employment, value added, debt-to-sales and debt-to-assets ratios by country and sector in OECD countries. As some figures on debt-to-sales and debt-to-assets ratios were implausibly large, we removed from the panel observations featuring leverage ratios above the 96th percentile.

Table 7 displays descriptive statistics of the key variables used in the empirical analysis. In particular, our key covariates are the debt-to-sales assets and debt-to-assets ratios (available at yearly frequencies for each sector) as well as the OECD index of strictness of employment protection (EPL) (available at the country-level at yearly frequencies), and the OECD summary measure of generosity of unemployment benefits.

As shown by table F.2 in the Annex, there is a substantial time-series variation in leverage and labor market statistics. This is encouraging in light of the estimation framework proposed below.

The model has implications related to shocks, involving an unexpected reduction in credit flows to firms. These shocks may or may not result in a recession on the aggregate. Table 8 provides information on the number and duration of *financial recessions*, that is NBER-type recessions featuring a financial crisis (according to the Reinhart and Rogoff (2008) classification). The overall count of *financial crises* (involving or not involving a recession) is also offered. Reinhart and Rogoff capture a relatively large set of recessions involving the financial sector, including housing booms-bust sequences. A financial crisis is, according to their definition, 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 financial institutions;

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

As shown by the table, there are 8 financial recessions and 14 financial crises in our sample, involving 16 countries.

The three sources of variation in our data (time-series, cross-country, cross-industry) allow us to cope with the different types of interactions pointed out by the model presented in the previous section. In particular, we can identify the effects of financial variables on employment adjustment by drawing on time-series variation within each country and sector, controlling for fixed country and industry characteristics influencing the responsiveness of employment to output.

Our estimates take, as dependent variable, the log variation in employment while, on the right-hand-side we control for fixed sector effects, moving the intercept (hence the minimum level of output growth inducing employment growth), output growth at the country level, leverage ratios, dummies capturing financial recessions (FR) or, alternatively, financial shocks (FC) as well as interaction of leverage and the former two variables. We also include time (but not within country) varying institutions potentially affecting the employment responsiveness to output changes, such as the OECD indexes of strictness of employment protection (EPL) and the summary generosity of unemployment benefit measure (UB). Formally, the model that we estimate is as follows:

Table 8: Number of financial recession in different countries

	Financial Recessions		Financial Crises	Other Recessions	
	av. Lenght	nr. Of	nr Of	av. Lenght	nr. Of
Country	(qrt)	Episodes	Episodes	(qrt)	Episodes
Australia	5	1	1		
Austria			1	2.5	2
Belgium	3	1	1	2.7	3
Canada				3	1
Denmark			1	3.6	3
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

$$\Delta e_{ijt} = \alpha_j + \beta \Delta y_{jt} + \gamma Lev_{ijt} + \delta_1 FR_{jt} + \delta_2 FR_{jt} Lev_{ijt} + \delta X_{jt} + \epsilon_{ijt}$$

where Δe_{ijt} is log employment variation in sector i, country j at time t, α_j denotes the coefficients of sectoral dummies, Δy is the variation of GDP, Lev is the leverage ratio (either debt-to-assets or debt-to-sales), FR denotes financial recessions,and X a set of time-varying institutional variables potentially affecting the responsiveness of employment to output change.

Our key parameter of interest is δ_2 capturing the effects of leverage on employment adjustment during financial recessions (or, more broadly, crises).

As in the case of firm-level estimates, a problem with this framework is that the presence of leverage on the righ-hand-side of the equation poses a potential problem of endogeneity. Firms' hiring policies are indeed likely to affect the degree of leverage of firms and this could bias our estimates. We tackle this issue in two ways. In our first empirical strategy we parametrize leverage by operating on the distribution of debt-to-assets and debt-to-sales ratios over the entire period. The alternative strategy is to use current values for the leverage ratios but impose an exclusion restriction, defining variables that are correlated with leverage but not with ϵ_{ijt}.

Our first empirical strategy involves developing a time-invariant measure of leverage based on the entire distribution of debt-to-sales and debt-to-assets ratios. In particular, the dummy $HighDA$ or $HighDS$ takes value 1 if the average of the debt-to-assets (DA) or debt-to-sales (DS) ratios for each country and sector in the years featuring no financial or banking crises is located in the top 40% of the distribution, and 0 otherwise. The list of highly-leveraged sectors and countries is provided in tabel F.3 in the Annex. As some sectors in all countries are structurally more leveraged, we also develop a second measure which draws on the DS distribution specific to each sector, notably taking the US, industry specific, average-period debt-to-assets and debt-to-sales ratios as reference. The implicit assumption is that in the US, where financial markets are more developed, firms do actually choose in normal times the optimal degree of leverage without being seriously credit constrained. In this second definition, sectors with DA or DS ratios larger than 3/2 of the

Table 9: Regression with time-invariant leverage

VARIABLES	(1) $\Delta e\%$	(2) $\Delta e\%$	(3) $\Delta e\%$
$\Delta\bar{y}$	0.380	0.357	0.387
	(0.266)	(0.266)	(0.269)
Recession	-0.00474***	-0.00471***	-0.00473***
	(0.00168)	(0.00168)	(0.00168)
FinancialRecession	-0.00904***	-0.0104***	-0.0116***
	(0.00247)	(0.00266)	(0.00266)
FinancialRecession*HighDS_US	-0.00610		
	(0.00463)		
HighDS_US	0.00308**		
	(0.00134)		
FinancialRecession*HighDS		0.00124	
		(0.00363)	
HighDS		-0.000372	
		(0.00120)	
FinancialRecession*HighDA			0.00454
			(0.00363)
HighDA			0.000537
			(0.00112)
UB, EPL, Country	YES	YES	YES
Constant	-0.00638***	-0.00645***	-0.00681***
	(0.00208)	(0.00208)	(0.00214)
Observations	3,738	3,738	3,738
R-squared	0.055	0.053	0.054

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

US level (High DS_US) for that sector are defined as highly leveraged. These two alternative specifications can be estimated via a simple OLS.

The results are displayed in Table 9.

We generally find an effect of financial recessions (or financial crises) on sector-level employment adjustment over and above the effect of of aggregate output decline. Leverage ratios positively affect employment adjustment or are insignificant when considered in isolation, while they are negative when interacted with financial crises or financial recessions.

Our second empirical strategy allows for time-series variation in leverage ratios. We simply carry out our regressions by using debt-to-sales ratios at yearly frequencies. In order to take into account of the endogeneity of leverage we used DA and DS ratios lagged one period. The underlying assumption is that lagged leverage in a sector is correlated with current leverage, but not with current employment adjustment.

5 Final Remarks

Empirical evidence suggests that financial shocks have important implications on labor market adjustment. This paper develops a simple model indicating that in highly leveraged equilibria there is not only a negative effect of recessions on job creation, but also an additional effect of financial shocks acting on the job destruc-

Table 10: Regressions with time-varying Leverage

First Stage			(3)/**(4)**	
			FinancialRecession*DA /	DA/
			FinancialRecession*DS	**DS**
DA (-1)			3.02E-06	0.96311***
			(-0.0000138)	(-0.0055427)
DS (-1)			**-0.000069**	**0.9160637*** **
			(-0.0003186)	**(-0.0079824)**
FinancialRecession*DA (-1)			1.004258***	0.2601286
			(-0.0024089)	(-0.9692058)
FinancialRecession*DS (-1)			**1.028851*** **	**-0.0167296**
			(-0.0028409)	**(-0.071175)**

	(1)	(2)	(3)	(4)
METHOD	OLS	OLS	IV	IV
VARIABLES	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$
$\Delta\bar{y}$	0.428	0.436	0.293	0.307
	(-0.315)	(-0.316)	(-0.318)	(-0.319)
Recession	-0.00500**	-0.00496**	-0.00472**	-0.00468**
	(-0.00196)	(-0.00196)	(-0.00199)	(-0.00198)
FinancialRecession	-0.0106***	-0.00114	-0.0110***	-0.00192
	(-0.00339)	-0.00576	(-0.00341)	(-0.00579)
DS	2.59E-06		4.19E-06	
	(-0.00000301)		(-0.00000333)	
DA		-3.99E-07		-4.19E-07
		(-0.00000117)		(-0.00000123)
FinancialRecession*DS	-7.56E-06		-4.18E-06	
	(-0.0000262)		(-0.0000264)	
FinRecession*DA		-0.000412**		-0.000392*
		(-0.000204)		(-0.000206)
UB	Yes	Yes	Yes	Yes
EPL	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
Constant	-0.00680***	-0.00707***	-0.00563**	-0.00588**
	(-0.00254)	(-0.00255)	(-0.00257)	(-0.00257)
Observations	2,912	2,912	2,846	2,846
R-squared	0.044	0.045		

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

tion margin. We use a variety of datasets to test the substantive assumptions and implications of the model. We find that highly leveraged firms and sectors are characterised by higher job destruction rates during financial recessions. If our emprical strategies to deal with the endogeneity of leverage and identification assumptions are considered plausible, the relationship between leverage and employment adjustment can be interpreted as a causal effect.

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6 Statistical Annex

Table F.1: All Firms (with firm-specific Δy)

First stage		IV Gearing		IV Solvency		IV LT DA
Age of CEO		-9.244168***		2.122875***		-0.002206
		(2.536106)		(0.2227416)		(0.0046271)
	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	IV	OLS	IV	OLS	IV
VARIABLES	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$	$\Delta e\%$
Δy	4.511***	4.441***	4.797***	4.813***	4.088***	3.903***
	(0.313)	(0.339)	(0.307)	(0.320)	(0.312)	(0.964)
Gearing	-0.00423***	-0.0361***				
	(0.000889)	(0.0140)				
Solvency			0.0417***	0.227***		
			(0.00689)	(0.0701)		
LT DA					0.361	-151.8
					(0.633)	(124.2)
Constant	-6.468***	-3.392	-9.278***	-14.14***	-8.491***	-6.809
	(1.675)	(2.272)	(1.634)	(2.489)	(1.605)	(5.117)
Country	YES	YES	YES	YES	YES	YES
Sector	YES	YES	YES	YES	YES	YES
Employees classes	YES	YES	YES	YES	YES	YES
Observations	7,571	7,561	8,375	8,363	6,882	6,869
R-squared	0.094		0.092		0.074	

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

Table F.2: Variance Decomposition

Variable	*Group*		*Mean*	*Std.Dev.*	*Min*	*Max*	*Observation*
Debt to Sales	overall		156.95	498.40	0.00	11199.52	N = 4704
	between	sector-country		289.27	0.00	2392.89	n = 92
	within	sector-country		427.83	-2229.06	8963.58	T = 51.13
	between	country		134.06	50.07	678.79	n = 18
	within	country		485.95	-515.19	10677.68	T = 261.33
Variable	*Group*		*Mean*	*Std.Dev.*	*Min*	*Max*	*Observation*
Debt to Assets	overall		55.03	356.50	0.00	6652.25	N = 4704
	between	sector-country		175.60	0.00	1703.13	n = 92
	within	sector-country		285.56	-1619.88	5004.15	T = 51.13
	between	country		89.93	17.56	406.17	n = 18
	within	country		340.93	-335.90	6301.11	T-bar = 261.33
Variable	*Group*		*Mean*	*Std.Dev.*	*Min*	*Max*	*Observation*
EPL Overall	overall		1.97	0.97	0.21	3.67	N = 6185
	between	sector-country		0.90	0.21	3.49	n = 101
	within	sector-country		0.30	0.97	2.79	T-bar = 61.24
	between	country		0.93	0.21	3.49	n = 18
	within	country		0.30	0.97	2.79	T-bar = 343.61

Table F.3: Sectors with leverage in top 40% of the distribution

country	sector	highly leveraged (more than 2/3 of US value)
Australia	construction	yes
	financial	
	industrial	
Canada	construction	yes
Finland	financial	yes
France	construction	yes
	financial	yes
Germany	financial	
Italy	financial	yes
Netherlands	financial	
Norway	construction	yes
	financial	yes
	industrial	yes
Portugal	financial	yes
Spain	construction	
	financial	yes
United Kingdom	financial	yes
United States	construction	
	financial	
	industrial	